



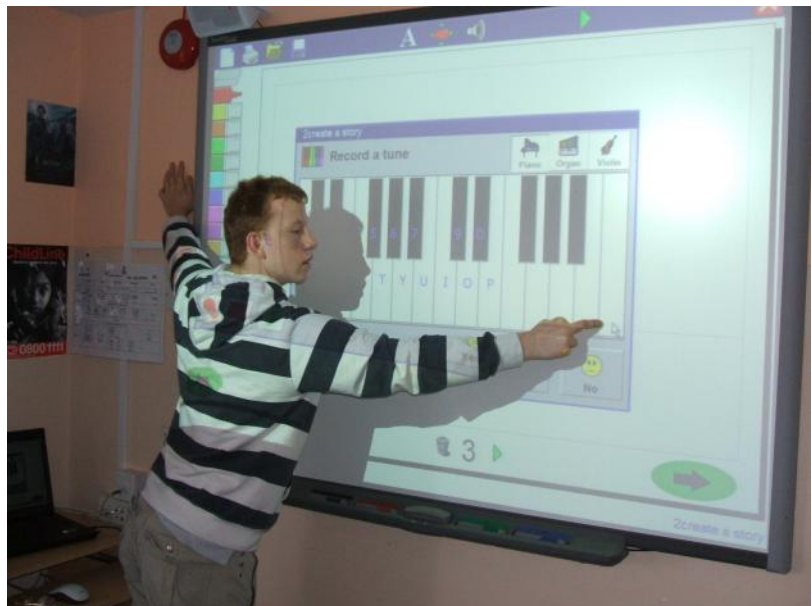
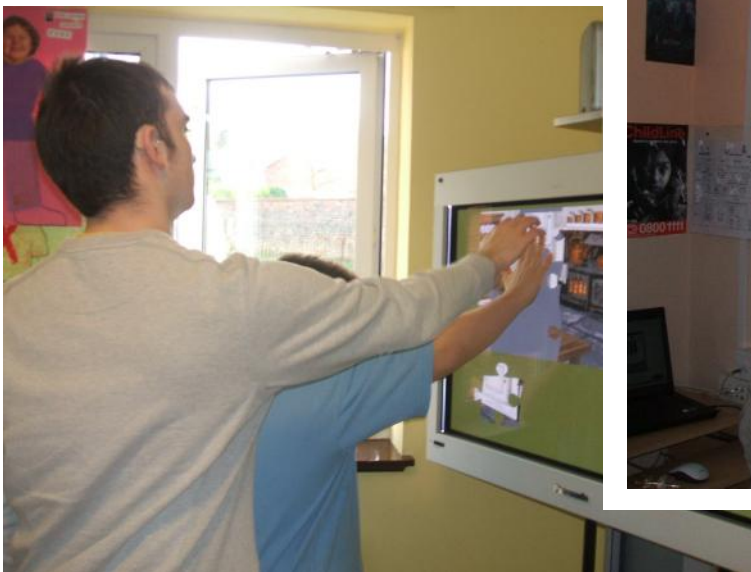
Training and Development Agency for Schools R&D Award (SEN) 2:

Developing a Model of Pedagogical Best Practice in the Use of Interactive Whiteboards for Children with Autism and Complex Learning Disabilities: Implications for Initial Teacher Training

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(Lessons and photos: Chris Harvey)

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KEY WORDS: interactive whiteboards, autism, autistic spectrum disorders, learning disabilities, initial teacher training

Aims and rationale

Interactive whiteboards are fast becoming established in schools as a valuable means of engaging pupils, and when used appropriately can have a positive and radical effect on teaching and learning (British Educational Communications and Technology Agency (Becta), 2003, 2007; Higgins, Beauchamp and Miller, 2007). However, while there is a steadily growing literature on the use of interactive whiteboards in mainstream education, there has been little work done around their use in engaging pupils with autistic spectrum disorders (ASD), taking into consideration their sensory disruption, atypical learning styles, environmental needs and communication/social difficulties in the teaching strategies used. The high prevalence figures of children with ASD – 1 in 100 children (National Autistic Society) – suggest that most teachers at some point in their careers will need the skills to include pupils with ASD meaningfully within their teaching and learning environments. It is important to find ways of engaging this group of pupils, as pupils with autism or Asperger syndrome are 20 times more likely to be excluded from school than their classmates (Barnard, Prior and Potter, 2000; BBC News, 2000). This is an issue which needs to be raised during Initial Teacher Training. This study therefore aims to address this by identifying teaching skills and strategies which will ensure the access of these students to the benefits of cutting edge ICT technology open to other pupils, and in doing so to reflect the aims of *Every Child Matters* by working to increase these pupils' enjoyment, their achievements and their ability to participate in their own learning.

This research project at Sunfield School – a residential school for students from 6–19 years with severe and complex learning disabilities – aims to:

- Identify strengths, weaknesses and best practice in the use of interactive whiteboards for pupils with ASD and learning disabilities, and make recommendations for optimised practice and adaptations within existing pedagogical approaches
- Involve Initial Teacher Training students in research and increase the facility and confidence of all teaching staff in using interactive whiteboards in the classroom with pupils with ASD
- Develop one-day professional development training relating to the above.

Key staff

<i>Project consultant:</i>	Peter Mayne, Senior Lecturer, University of Worcester (UW)
<i>Research Fellow/</i>	
<i>Project Lead:</i>	Jo Egerton
<i>Research Fellow (IWB):</i>	Cheryl Stambolis
<i>ICT Training Officer:</i>	Jan Cook
<i>Staff Development Co-ordinator:</i>	Iain Chatwin
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Methodology

This research took the form of a case study over 12 months. Following an in-depth review of literature around best practice in interactive whiteboard use for students with disabilities, an audit of current practice with interactive whiteboards in the school was carried out. An action research approach to subsequent practice development in response to the learning needs of students with ASD was taken.

Outcomes

It is intended that the outcomes of this research will enable all teaching staff including Initial Teacher Training students to extend their skills in the areas of ICT and inclusion by:

- increasing their knowledge and understanding of interactive whiteboard-associated teaching and learning strategies and how to adapt and personalise these for students with ASD
- providing strategies to include students with ASD by supporting access to interactive whiteboard-based learning resources to help them achieve their full educational potential

- providing opportunities to evaluate the impact of different interactive whiteboard-associated teaching and learning strategies on the progress of students with ASD and to modify their planning and classroom practice where necessary.

Benefit realisation: dissemination, outputs and evaluation of impact

These outcomes will be evidenced and evaluated by pre- and post- research surveys of practitioners involved in the project, by liaison with the University of Worcester Institute of Education as the initial teacher training provider, and on-going participant evaluation of the associated professional development training courses which will be developed as part of this project. Dissemination to stakeholders, teaching staff (ITT students, NQTs and qualified teachers) and higher education institutions will take place externally and internally throughout the project in a variety of ways via: the Teacher Training Resource Bank, the Sunfield website and other key websites and links; internal and external one-day training through Sunfield Professional Development Centre and other venues; conferences; professional and academic journals; information sheets distributed through national and international networks; Sunfield Publications; and Sunfield's internal research dissemination systems.

Timetable

Research task	Responsibility of:	Time frame:
Phase 1 – Preparation and baselining		
• Literature review	Research Fellow (PM)	Feb–Mar 2008
• Establishment of Research Steering Group (meeting at least termly – more often if required) to support and monitor the research process	Research Fellow (PM)	Feb 2008
• Brief teaching staff	Research Fellow (PM) / R&D Officer	Mar 2008
• Devising non-participant observation schedules and questionnaires	Research Fellow (PM)/ Staff Development Co-ordinator	Mar 2008
• Baseline data collection	Research Fellow (PM)/ ICT Training Officer	Mar 2008
• Dissemination of research outcomes	All involved	Throughout project
Phase 2 – Training and data collection		
• Present Literature Review outcomes to research and teaching staff (inc. ITTs, NQTs, teachers and HLTAs)	Research Fellow / Research and Development Officer	Apr 2008
• Training of teaching staff (ITTs/NQTs/teachers/HLTAs) in research methods and optimal methods of interactive whiteboard use and management	Consultant (UW) / R&D Officer / Research Fellows / ICT Training Officer	Apr–Jul 2008
• Monitoring of practice and ongoing support and advice	Research Fellows / ICT Teacher Advisor / ICT Training Officer	Apr–Jul 2008
• Data collection at identified intervals (includes non-participant observation, video evidence, administration of questionnaires, research diary) to determine outcomes, e.g. adapted teaching approaches, adapted practice, levels of pupil engagement	Research Fellow (IWB) / ICT Training Officer	Apr–Jul 2008
• Meeting of Research Steering Group at beginning and end of period to support/monitor the research process	Research Fellows	Apr 2008 Jun 2008
• Data review and initial analysis	Research Fellows / ICT Training Officer	Apr–Jul 2008
Phase 3 – Data analysis and dissemination		
• Analysis of data	Research Fellows / ICT Training Officer	Sep–Nov 2008
• Meeting of Research Steering Group at beginning and end of period to support and monitor the research process	Research Fellows	Oct 2008 Jan 2009
• Writing of TDA project report	Research Fellows	Nov–Jan 2009
• Inclusion of training course within PDC rolling programme and advertising materials from Spring 2009	Research and Development Officer / PDC Manager	Oct 2008
• Development of training course and materials	Research Fellows / Staff Development Co-ordinator / ICT Training Officer	Nov 2008 – Jan 2009

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Review of literature

Introduction

Although ICT is considered key to 21st century learning (Ofsted, 2004), it is the ways in which it is deployed which create impact (Harrison et al., 2002). Interactive whiteboards (IWBs) are just one element of the ICT toolkit (Glover et al., 2005) although, following a UK government initiative to promote and support the deployment of IWBs in schools (Department for Education and Skills (DfES), 2004a), they have moved quickly from being peripheral to classroom teaching (Becta, 2003) to being a central teaching and learning resource. The following definition of an IWB system combines those given by Beauchamp (2004), Hennessey and Deaney (2007) and Moss et al. (2007):

An IWB system comprises a computer linked to a data projector and a large touch-sensitive screen which displays the projected image; it allows teachers and students the option of operating the board from the screen using direct input via finger or stylus instead of using the computer mouse. In addition to standard computer software, the IWB is loaded with associated software which provides the facility to write or type on blank 'pages', tools for controlling features, and resources for classroom use, including readymade lesson materials. Annotations made to create or amend texts can be saved for reuse or printing; items can be hidden and later revealed by varying means. Within presentations, it is possible to exploit different kinds of computer software, active use of the internet, and the choices they offer. The IWB can also be used with remote input and peripheral devices.

There are two basic models of IWB currently on the market – the front and rear projection models, although the rear projection model is currently being phased out due to its bulkiness; these have been recently joined by the 'plasma screen'. The models currently used at Sunfield (and in many other special schools) are SMART front projection models. These IWBs were selected for their affordance for users who had poor motor skills to make marks on the board using their fingers instead of the pen.

The IWB provides a strong, visual focus for learning (Somekh et al., 2007) and, in contrast with the computer, its size offers simultaneous access to large groups of students (Bell, 2002; Walker, 2002). Research shows that most students and teachers are very positive about its use in the classroom, valuing the effect it has on lesson pace, motivation of both teachers and students, and student engagement, involvement, participation and collaboration (BECTA 2003; Tanner et al., 2005). Its appeal lies in its clarity, image size, dynamic rather than static display, and opportunities to create, move, save and recall resources (Beauchamp and Parkinson, 2005; Bell, 2002; Miller et al., 2004; Moss et al., 2007; Smith et al., 2005). Its versatility confers the ability to make immediate responses to individual student's needs (Coghill, 2002). The unique feature of the IWB is, as its name suggests, its potential to mediate interactivity – both technological (student interacting with the IWB) and cognitive (student–student and student–teacher).

While there is a steadily growing literature on the use of IWBs in mainstream education, there has been little research carried out around their use in engaging students with autistic spectrum disorder (ASD) and severe/complex learning disabilities, taking into consideration these students' sensory disruption, atypical learning styles, environmental needs and communication/social difficulties in the teaching strategies used.¹ For this group of students, there have been fewer curriculum developments, fewer imaginative teaching approaches and fewer opportunities for learning. This study therefore aims to address this by identifying teaching skills and strategies which will promote the access of students with ASD and severe/complex learning disabilities at Sunfield School to the benefits of cutting edge ICT technology open to other pupils. In doing so, it also aims to reflect the aspirations of *Every Child Matters* by working to increase these pupils' enjoyment, their achievements and their ability to participate in their own learning.

¹ Wendy Keay-Bright's work using whiteboards with children with ASD at the University of Wales Institute in Cardiff focuses on the use of a specific software programme, 'Reactive colours'. [Online at: <http://www.steljes.co.uk/Education/CustomStories/Reactive+Colours.htm>]

Sunfield School

Sunfield School is a national charity with a regional focus based around a residential special school for approximately 65 students, aged 6–19 years, with profound ASD and severe/complex learning disabilities. The school's capacity to be a responsive organisation, that offers high quality services underpinned by a sound evidence base and a dynamic research process, is crucial to both its future students, and its current students' futures. The school therefore supports staff in developing approaches that will be innovative, dynamic and, at times, ground-breaking to meet the students at their point of learning.

The aim of the present research is to develop a good practice model of IWB pedagogy for these students, with a particular focus on interactivity and the engagement of students. The results will be disseminated within and outside Sunfield so they can also benefit the wider professional community (e.g. ITT students, newly qualified teachers, qualified teachers, teaching assistants) and therefore students themselves. It will culminate in the development of a one-day course on IWB use with pupils with ASD and severe/complex learning disabilities to be run through the Sunfield Professional Development Centre as part of a rolling programme for internal and external course participants.

Definitions

Engagement

Unless a student is engaged, they cannot learn. Engagement is a complex concept which includes both what students are doing (a state), and how they are doing it (a trait) (Ruble and Robson, 2007). Associated with engagement, Ruble and Robson have identified various learning behaviours in relation to a goal-directed activity including:

- Willing involvement
- Time spent on activity
- Attention
- Persistence
- Participation
- Motivation to attain and master skills – this relates to: students' confidence in skills and learning; interest in and perceived relevance of tasks; personal enjoyment in activity (Banyard, Underwood and Twiner, 2006).

Engagement in learning involves an emotional investment in the outcome (Jordan and Powell, 1995). McWilliam and Bailey (1995, in Ruble and Robson, 2007) found that students' level of engagement was dependent on their temperament or diagnosis, level of skill and environmental factors. It has been noted that when students have a degree of control over their own learning, their levels of motivation and engagement increase (Coghill, 2002; Hennessey et al., 2007).

Interactivity

The interactive process is an essential component of all pedagogy (Somekh et al., 2007; DfES, 2004b). Teaching is described as interactive when 'students' contributions are encouraged, expected and extended' (DfEE, 1998, p. 8) in a way which deepens meaningful student participation and brings something of the student themselves to the exchange rather than their being passive recipients (Kennewell et al., 2008; Tanner et al., 2005).

Interactivity is particularly relevant in relation to the IWB, as it is the IWB's potential for 'enhanced interactivity' (Miller et al., 2004) which sets it apart from most other pedagogical tools. There are different levels of interactivity associated with IWB teaching and learning, and this research focuses on two in their various combinations. The first is described as technological interactivity, in which the student physically interacts with the IWB or peripheral gadgets; the second is conceptual interactivity, in which the student is involved with the teacher and/or their peers in co-construction of knowledge through the medium of the IWB and peripheral gadgets (Somekh et al., 2007; Tanner et al., 2005).

While technological interactivity alone has associated desirable outcomes (e.g. reinforcement of ICT skills; introduction of a tactile/kinaesthetic learning modality), it is the level of IWB-mediated conceptual activity which is taken by many researchers as the stronger indicator of best IWB practice (Tanner et al., 2005). This has largely involved advanced communication skills and social interaction both with teachers and peers (see Table 1 below). However, for students with severe/complex learning disabilities and ASD, who are often greatly impaired in the areas of communication and social interaction, these best practice indicators need to be adapted to accommodate their level of cognitive development, communication ability and social tolerance.

Table 1. Examples of conceptual interactivity associated with ‘active learning’ in mainstream pedagogy

Inquiry	Explication	Evaluation
<ul style="list-style-type: none"> • Strategic/open questioning • Exploring ideas • Interpretation • Hypothesis generation • Discussion/addressing cognitive conflict • Reconciliation of scientific and informal ideas • Collective knowledge building 	<ul style="list-style-type: none"> • Articulation of methodology, reasoning or understanding • Illustration and explanation • Public expression of ideas, not only verbally, but also graphically, etc. • Answering questions 	<ul style="list-style-type: none"> • Recall/review • Evaluation/evaluative comment • Offering/receiving/responding to critical feedback • Reformulation of ideas/material

Severe/complex learning disabilities

Learning disability is a life-long condition, and involves ‘a significant impairment of cognitive and adaptive functions, with onset before 18 years of age’ (Foundation for Genomics and Population Health, 2006). When individuals have a learning disability, by definition their IQ score is less than 70, and they also have dysfunction or impairment in two areas of the following: communication, self-care, home living, social/interpersonal skills, use of community resources, self-direction, functional academic skills, work, leisure, health and safety (American Psychiatric Association, 2000). The IQ scores of those with severe and profound learning disabilities fall between 20/25–35/40 and below 20/25 respectively (World Health Organisation, 1992, 2001). Individuals described as having complex learning disabilities usually have one or more co-morbid conditions in addition to their primary disability.

Autistic Spectrum Disorders

Autism is a pervasive, developmental disability probably caused by genetic conditions leading to neurological dysfunction (Baron-Cohen, 2004; Mesibov et al., 2006). It is defined in the *Diagnostic Statistical Manual* (American Psychiatric Association, 2000) as conferring characteristic developmental delays or impairments in the areas of social interaction, social communication and imaginative play (the ‘triad of impairments’; Wing and Gould, 1979), and giving rise to ‘restricted, repetitive, and stereotyped patterns of behaviour or interest’. These core criteria result in diagnoses of ASDs ranging from Asperger Syndrome (Frith, 1991) through to classic Kanner’s autism (Frith, 2003), according to symptomatic severity and effect. Autism does not invariably occur alongside learning disabilities, although it is estimated that 75% of all young people with ASD also have learning disabilities (Cumine et al., 2000). (This excludes young people with Asperger Syndrome.)

The prevalence figures for ASD vary depending upon the criteria used to define the condition (Wing and Potter, 1999). The Medical Research Council (www.mrc.ac.uk) estimate prevalence in the UK at 1 in 166 children, Baird et al. (2006) have proposed a prevalence of 1 in 86 children, and the National Autistic Society, 1 in 100 children (www.nas.org.uk). These figures suggest that most teachers at some point in their

careers will need the skills to include students with ASD meaningfully within their teaching and learning environments.

In comparison with typically developing people, individuals with ASD think and perceive the world around them in a very different way. They experience challenges as a result of their difficulties with:

- Imposing meaning on their experiences by drawing relationships between different ideas or events
- Their compelling need to focus on specific, individual detail (sensory (especially visual) or cognitive)
- Understanding the significance of details or events in a life context
- Distractibility due to hyper- or hyposensitivity to sensory stimuli and their compulsion to focus on detail
- The use of symbolism (e.g. use of words, gesture, expression, pictures, etc.) to convey meaning or abstract concepts, which impacts upon their communication and understanding
- Organising and sequencing, and consequently predicting, everyday tasks, occurrences or events (e.g. getting up, daily timetables, etc.)
- Generalising knowledge and skills
- Understanding time
- Strong impulses
- Excessive anxiety due to problems around understanding, timing, sequencing, etc.
- Sensory and perceptual differences

(Mesibov et al., 2006).

These impact on their learning style. Many people with ASD are predominantly visual and kinaesthetic learners (Jordan and Powell, 1995; Just et al., 2004, 2006), and are dependent on often concrete, visual prompts and cues to initiate tasks and complete established routines. They are likely to have difficulty with initiation, be attached to routines, be limited in their social skills, emotional empathy and play skills, and may exhibit aggressive behaviour as a result of anxiety and frustration (Mesibov et al., 2006). Various theories have been proposed to explain the difficulties that people with ASD face, including: mind-blindness – an inability to infer other people’s states of mind; weak central coherence – a weakness in global processing; executive dysfunction and empathetic difficulties (Baron-Cohen, 2004).

Interactive whiteboards in the classroom

There are a number of recently published articles which summarise comprehensively the existing literature on the use of IWBs in schools (e.g. BECTA, 2003; Glover et al., 2005; Higgins, 2007; Schroeder, 2007; Smith et al., 2005), so it is not proposed to do so here. For the purposes of the present research, the focus of this review will be on literature which describes best practice (e.g. Miller et al., 2004; Glover et al., 2005), and the potential for adopting or adapting this practice for work with students who have severe/complex learning disabilities and ASD.

The advice on IWB best practice can be categorised according to its focus:

- The environment (i.e. wider classroom environment, immediate student environment, IWB environment)
- The IWB display
- The software/activities used
- The pedagogy (teaching/learning interface).

Environment

Although school environments are rarely ideal for IWBs or students, it is important that they are optimised within their limitations to provide the best possible learning opportunities (Glover et al., 2005). The Department for Children, Schools and Families recognises the importance of learning environments which are conducive to participation by all students (DfES, 2002). The importance of the location of the IWB is highlighted by Miller et al. (2008) in respect of lighting, pupil access and health and safety.

In the wider classroom environment light interference – light from other sources, such as windows, skylights, direct sunlight or electric lights – can lead to a less distinct image on the IWB or surface glare. The IWB should be positioned out of line with a direct light source, and effective blinds should be installed where necessary. BECTA (2008) recommends that ambient light should not be completely excluded, as children have been shown to work better in environments which have a degree of natural light.

The interactive whiteboard environment

In relation to the IWB itself, there are a number of well-documented issues which have been problematic. These can be divided into physical and display issues. Physical issues include:

- Height of IWB (Higgins et al., 2007; Painter et al., 2005) – To ensure that students are able to interact with the board effectively the various buttons and icons for navigating through and between programmes and activities must be within their reach. Therefore, the positioning of the IWB should be lower than that of the traditional blackboard; if necessary, the teacher may need to operate the IWB while seated. Alternative solutions observed for IWBs that were mounted too high (Beauchamp, 2004; Wood, 2001) have included: teachers carrying out procedures on instruction from students, which resulted in reduced student agency; and students manipulating the IWB from a raised platform, which, while recommended as a solution by BECTA (2008), has health and safety implications for students with poor balance and motor coordination.
- Shadowing – to avoid their shadow obscuring the projected image, students need to stand to the side rather than in line with the image (Beeland, 2002; Higgins et al., 2007; Painter et al, 2005). Ways of addressing this include installing back projection screens or positioning the projector so a steep projection angle reduces the shadowing effect. The cost of the former solution is prohibitive for many schools; while the latter involves mounting the projector on a protruding arm standing proud of the IWB.
- Projector beam – For health and safety purposes, students should not be allowed to gaze at the projector beam (Health and Safety Executive, 2008) – looking directly into it for more than a few seconds could damage the retina. To reduce this possibility, projectors should either be ceiling mounted, or mounted on a projection arm attached to the IWB, and when facing the class, the teacher or student should stand out of the line of the projector beam.
- Mobile IWB units – There are various issues with health and safety (such as trailing wires and non-integrated speakers), access (resource demands from other classrooms) and calibration (see above)
- Equipment breakdown (Smith et al., 2005) – BECTA (2008) advises that having ‘spare’ equipment available to substitute for faulty equipment reduces frustration and loss of learning opportunity.

Possible display issues are:

- Pen calibration (i.e. the marks made by the pen on the IWB do not align with the pen tip) (Beauchamp, 2004; Wall et al., 2005) – In this case, the pen will need to be recalibrated with the IWB, although there is a programme available which will calibrate the pens automatically as the IWB software is loaded. In environments where the IWB is subject to tremor or vibration (Wall et al., 2005) (e.g. from movement in adjacent rooms or when the IWB is part of a mobile unit), the pens may require recalibration during the course of a lesson which may cause inconvenience, frustration and delay for teachers and students.
- Failure of pens/finger to make continuous marks on the IWB – This can be caused by moving the writing instrument too quickly or, in the case of the SMARTboard, writers resting their hand against the IWB for support.
- Delay in programmes loading – to avoid unnecessary delay, student frustration and loss of lesson pace, programmes should be opened and minimised before the lesson starts
- Visual clarity – This is important for all students, but especially so for those with ASD and severe/complex learning disabilities who have increased difficulty with sensory discrimination and selective processing of information. Sharp (2006) warns that for students with ASD, the IWB should not be too busy, and that the IWB ‘desk top’ should also be cleared as far as possible, with only those icons which are necessary for the lesson remaining in view.

- Eye strain – Sharp (2006) advises that, to minimise the possibility of IWB-associated eye strain, backgrounds to activities should be coloured rather than white.

Student environment

For students learning from the IWB, the arrangement of seating within the classroom is important, and IWB literature reflects the need for student comfort and health and safety (Sharp, 2006). Students should be able to face the board straight on without having to angle their heads, to avoid reduced levels of concentration and the risk of muscle strain (Miller et al., 2004 ; Sharp, 2006). They need clear access to the IWB – anything which limits students' access to it may affect their inclination to contribute (Higgins et al., 2007).

Although the majority of mainstream students are positive about the IWB, some find it confusing (Smith et al., 2005), while others find working at the front of the class daunting and embarrassing (Moss et al., 2007; Smith et al., 2005).

Interactive whiteboard software and electronic resources

In addition to the standard software packages associated with computers (e.g. Powerpoint, spreadsheets, etc.) and a generic range of software developed by the IWB manufacturers for education purposes, the IWB allows teachers to include a wide range of resources within their lessons, including CDs, DVDs, video, animation, interactive games, the internet, etc. While most of these can be accessed without an IWB, the IWB confers a seamlessness of presentation and interaction without the distraction of mobilising different items of equipment, loss of lesson pace (Latham, 2002; Higgins et al., 2005) and opportunity for student distraction. All these can increase student interest and attention in lessons; however, they have most impact when they are strategically used within curriculum lesson plans to increase understanding (Moss et al., 2007).

Realism in illustration, simulation and demonstration decreases ambiguity and increases student comprehension allowing them to cope with more complex concepts (Beauchamp and Parkinson, 2005; Hennessey et al, 2007; Moss et al., 2007), and this is particularly noticeable for less able students (Hennessey et al, 2007a,b). Hennessey et al. (2007a,b) also suggest that when simulations were used the teacher was able to spend less time explaining the task and struggling with equipment, and more time discussing learning points. Simulations can also reduce demands on students by enabling them to focus on a single aspect of learning (Beauchamp and Parkinson, 2005).

Moss et al. (2007) note that commercially produced IWB programmes and activities are variable in quality, with the more successful programmes being developed with reference to the National Curriculum, and after long periods of research. Researchers recommend the use of:

- Programs which give positive responses for the correct answers, and sound clips to correct or signify repeated errors (Smith et al., 2005)
- A variety of different programmes which allows curriculum coverage and prevents boredom (Wall et al., 2005)
- Programmes which stimulate reflection and analysis (e.g. the use of delayed animation effects, which allow students to discuss the next step in a progression)
- Curriculum-orientated, interactive learning games – these are motivating for students, allow teachers to spot students' conceptual errors, and encourage students to self-correct over time (Smith et al., 2005); learning outcomes are also more memorable (Gray et al., 2005) – although it is important that teachers do not allow the effects of the games' motivational aspects to conflict with the desired learning outcomes (Gray et al., 2005)
- Resources which are chosen to meet students' learning objectives rather than the reverse – the learning needs and capabilities of the children should be the first consideration so that they do not become overfaced by too complex a task (Gray et al., 2005).

Miller et al. (2008), referring to Mathematics resources, emphasise the need for a range of IWB resources to be developed which 'reflect the nature of interactivity'. This also needs consideration in the context of resources for students with ASD and severe/complex learning disabilities.

Sharing interactive whiteboard resources

97% of teachers interviewed during research carried out by Moss et al. (2007) stated that they would welcome a shared IWB network space which gave them access to resources collected and created by other teachers (Sharp, 2006), although only 45% of those interviewed said that they currently used pre-created materials from colleagues or commercial companies. However, Gray et al. (2005) suggest that often the resources that teachers develop for students on the IWB are very specialised in terms of their own teaching objectives and individual students' needs, and that their usefulness depends on their quality and their curriculum relevance. Therefore when creating shared resources, it is important that the design incorporates clear learning paths which enable the resources to be adapted to the needs of different teachers, students and teaching contexts and used independently of their creator (Moss et al., 2007).

Use of peripheral gadgets

The IWB interfaces well with peripheral gadgets such as: digital cameras/video recorders, tablets, visualisers, infra-red mice, voters, scanners, web cams, etc. (Bell, 2002). However, the extended possibilities when using the IWB to incorporate peripheral gadgets ('peripherals') in teaching and learning was rarely exploited by teachers described in the research literature – one of the reasons for this was the lack of teacher knowledge of how to use them. Moss et al. (2007) observed that the use of peripherals was often associated with an increase in student conceptual interactivity.

The interactive whiteboard and pedagogy

The question asked by researchers attempting to identify pedagogical best practice in the use of IWBs is: 'How can the IWB enhance learning compared with other whole-class pedagogical tools?' While some researchers report that the IWB encourages student collaboration, motivation and participation, others claim that it engenders superficial interactivity at the expense of executive skills (Hennessey and Deaney, 2007; Higgins et al., 2005; Gillen et al., 2007a,b; Smith et al., 2006; BECTA, 2003; Kennewell et al., 2008). Despite anecdotal evidence about the beneficial effect of IWBs on student learning (Gray et al., 2005), there have been concerns about how little firm evidence there is of heightened classroom interactivity and student attainment and achievement to support these claims (Higgins et al., 2007; Smith et al., 2005). However, recently Somekh et al. (2007) found that students of mid- to high ability who were taught using an IWB showed several months' gain in academic attainment over their peers who were not. Although students of 'low ability' (compared with students with 'high' and 'mid-ability') showed neither academic gain nor regression associated with IWB use, the IWB did have 'a marked impact' in engaging their attention and improving their behaviour in the classroom.

As stated earlier, the unique feature of the IWB is interactivity. The IWB can support an 'active' pedagogical style (Glover et al., 2005) which promotes innovation and lateral thinking (Walker, 2002) using a variety of teaching modes (Smith et al., 2005). It can lead to enhanced interactivity and conceptual sharing between teacher and students and greater focus (Beauchamp and Parkinson, 2005; Hennessey and Deaney, 2007; Hennessey et al., 2007; Miller et al., 2004; Moss et al., 2007; Smith et al., 2005), greater spontaneity (Beauchamp and Parkinson, 2005; Walker, 2002) and a quickened lesson pace (Beauchamp, 2004; Smith et al., 2005). However, although IWBs offer teachers greater flexibility and students greater possibilities for interactivity than non-interactive boards, it seems that rarely is this potential realised (Moss et al., 2007). Many teachers have merely transferred their pre-IWB pedagogical practice to the IWB, and therefore in many classrooms opportunities for IWB-mediated interactivity are low (Miller, 2004; Moss et al., 2007; Sime, 2005). Research has indicated that unless teachers truly understand, accept and exploit the potential of the IWB to afford pedagogical change, then it becomes merely another presentation platform with little more impact on students' learning than the non-interactive white- or blackboard it has replaced (Beauchamp, 2004; Miller et al., 2008). Researchers warn that poor IWB practice can lead to unimaginative, linear

pedagogy delivered in a transmission style to spectator-students (Moss et al., 2007) and to difficulties with lesson pace – either slowed by individual student contributions to the IWB (Moss et al., 2007; Smith et al., 2005) or quickened to a pace which allows insufficient thinking time (Hennessey and Deaney, 2007) and minimal interactivity (Greiffenhagen, 2000, in Miller et al. 2004).

Various features of good IWB practice have been identified. Greiffenhagen (2000, in Miller et al., 2004) emphasises the need to ensure that the IWB is an integral, as opposed to complementary, element of lesson delivery (Coghill, 2002). Miller et al. (2004) advise – as do Hennessey et al. (2007) – that effective interactivity relies upon ‘stepped conceptual learning, pace in activities and cognitive review’. Among others (e.g. Beauchamp and Parkinson, 2005; Glover et al., 2005; Greiffenhagen, 2000, in Miller et al., 2004), they suggest that for enhanced interactivity to occur, the teacher needs to set up and manage clearly structured episodes of interaction in which they act as mediator between the IWB and the students, stimulating engagement by judicious questioning and building connections between learning experiences. Hennessey et al. (2007) recommend the gradual increase of a student’s participation, responsibility, knowledge and skills, and that teachers need to be responsive to learners and to create space for their contributions. In short, as Hennessey and Deaney (2007) observe, much of the good pedagogical practice associated with teaching using an IWB replicates that associated with teaching in any context. Moss et al. (2007), reporting the outcomes of Department for Education and Science-funded research into the IWB efficacy, confirm this: ‘The main emphasis needs to rest with the appropriateness of the pedagogy, not the use of the technology per se’ – a view shared by Harrison et al. (2002), Kennewell and Beauchamp (2007) and Miller et al. (2004) among many others.

The current focus of the ‘IWB pedagogy’ debate rests on the quality of interactivity within lessons (see section on ‘interactivity’ above), and empowerment of the learner; as Hennessey et al. (2007) write: ‘The relationship between technology and interpersonal classroom interactions has emerged as critical’. There have been two distinctions drawn. The first is between low-level, technological interactivity (the physical manipulation of text and images using the technological features of the IWB) and higher level interactivity in which the IWB mediates pedagogic or conceptual exchange between the teacher and student or among students (Coghill, 2002; Glover et al., 2005; Higgins et al., 2007; Moss et al., 2007; Smith et al., 2005). The different levels of IWB exploitation represent points on a continuum along which teachers gradually progress with increasing expertise and confidence. Moss et al. (2007) noted that the lower level, technological interactivity was particularly prevalent in classrooms of students with lower abilities.

The second is between a range of teaching styles (with their associated interactivity levels) from the ‘lecture style’, which focuses on knowledge uptake and supports minimal teacher–student–IWB interactivity to deeper pedagogy which aims to facilitate students’ use of deep thinking skills and supports the highest level of interactivity. Although, researchers’ initial tendency was to promote heightened levels of interactivity in relation to IWB practice (Coghill, 2002; Glover et al., 2005; Higgins et al., 2007; Moss et al., 2007; Smith et al., 2005), Kennewell and Moss argue for a balanced selection of ‘surface’ and ‘deep’ forms which is appropriate to the curriculum topic, the type of knowledge being constructed and the desired learning outcomes (Kennewell et al., 2008; Moss et al., 2007).

Table 2. Interactive teaching categorised into ‘surface’ and ‘deep’ forms (after Hargreaves et al., 2003 in Kennewell et al., 2008))

Surface forms	Deep forms
<i>Associated with: lesson pace, motivation, involvement, participation and collaboration</i>	<i>Associated with: acquisition of thinking skills</i>
<ul style="list-style-type: none"> • Engaging students • Practical and active student involvement • Broad student participation • Collaborative activity • Conveying knowledge 	<ul style="list-style-type: none"> • Assessing and extending knowledge • Reciprocity and meaning making • Attention to thinking and learning skills • Attention to students’ social and emotional needs and skills

Whole class and small group teaching

The IWB has been described as the most effective tool for whole class teaching to emerge. Kitchen et al. (2007, in BECTA, 2008) report that, in most schools, the IWB is usually used for whole-class activities, and that only 43% of primary teachers and 21% of secondary teachers use it for small group activities. The opportunity to use the IWB for whole-class work is valued by some mainstream teachers for its contribution to greater incidental learning (Walker, 2002), and for offering teachers and students the opportunity to adopt a collegiate approach to knowledge building (Hennessey et al., 2007). Miller et al. (2004), however, associate a more balanced variety of teaching involving whole class, small group, pair and individual work with their ‘enhanced interactive stage’ of teacher IWB use, and Gray et al. (2005) emphasise that use of the IWB as a teaching tool should be appropriate, and balanced with other, more kinaesthetic, practical and interactive approaches such as drama and handling objects.

Kennewell et al. (2008) suggest that teachers find it difficult to balance the needs for collective and individual learning, and the different, associated teaching styles, with ‘individual student autonomy [being] constrained by the need to develop collective knowledge and understanding’, and Somekh et al. (2007) found that teachers need to have worked with an IWB for two years in their classroom before it became fully integrated in their teaching repertoire and resulted in decisive gains for students.

Review and assessment

One of the most valued features of the IWB is the ability for teachers to save annotated materials so that work done within a lesson can be reviewed later in the same lesson or at a later date (Beauchamp and Parkinson, 2005; Glover and Miller, 2001). Teachers can spontaneously and immediately access previously used resources (Smith et al., 2005), and saved work can also be used for assessment purposes (Beauchamp and Parkinson, 2005; Hennessey et al., 2007).

Learning and students with autistic spectrum disorders

It is important to find ways of engaging students with ASD. Those with autism or Asperger syndrome are 20 times more likely to be excluded from school than their classmates (Barnard et al., 2000; BBC News, 2000). Students with ASD are often drawn to technological devices (Goldsmith and LeBlanc, 2004), and appropriate use of IWBs can utilise this fascination, thus increasing their engagement in learning.

One valued feature of the IWB is its potential to accommodate different learning styles, thus supporting inclusion (BECTA, 2003; Higgins et al., 2007; Miller and Glover, 2002; Smith et al., 2005). It allows the teacher to combine, visual, tactile, kinaesthetic and auditory input. Some researchers see this as an advantage, while others question its value (Beauchamp and Parkinson, 2005; Beeland, 2002; Bell, 2002; BECTA, 2003; Clemens et al., 2001; Glover et al., 2005; Smith et al., 2005, 2007; Schroeder, 2007), and there is debate about whether simultaneous, multimodal presentations may confuse students (Higgins et al.,

2007; Sharp, 2006; Smith et al., 2005), particularly those with ASD for whom busy environments are overwhelming (Sharp, 2006). However, as Beauchamp and Parkinson (2005) comment, the IWB also affords the ability to focus instruction selectively on one element of a concept being taught, which allows teachers to prioritise information acquisition by students in a stepped approach to learning (Miller et al., 2004).

However, the IWB does afford students without strong verbal or literacy skills the ability to learn through non-verbal means through the presentation and manipulation of pictorial images, and similarly the opportunity to participate and to demonstrate their skills and knowledge (Somekh et al., 2007). This visual presentation of materials can scaffold students' use of higher order thinking skills (Smith and Blankinship, 2000, in Beeland, 2002). The IWB can also facilitate the inclusion of students with limited motor skills, as it is often easier for them to open programmes and make marks by tapping or writing with their fingers than by using a mouse or an IWB pen (Beauchamp and Parkinson, 2005; Bell, 2002).

IWB as a visual learning environment

A high proportion of individuals with ASD are visual learners (Just et al., 2004, 2006), and the majority find it difficult to decode and encode spoken language. When people speak face-to-face, the meaning carried by the spoken word is supported by such stimuli as variation in voices, facial expressions and gesture. Competing with this is extraneous environmental information in the form of movement, noises, smells and activity around the speaker and listener. Unlike people without ASD, individuals with ASD struggle to focus their attention in these situations and selectively to filter out stimuli which are unrelated to the speaker's communication. For them, all stimuli have equal priority so easily become meaningless. Alternatively, a single stimulus unrelated to the communication can assume supreme priority (e.g. the way a single hair trembles). They find it difficult to process and interpret not only the spoken word, but also the accompanying gesture. Even those people with ASD who appear highly verbal often have difficulty in processing spoken information for meaning. The IWB with its emphatic visual representation and interactive potential can support the learning of people with ASD and enable them to channel their attention in a way that more conventional verbal teaching approaches cannot. Jordan and Powell (1995) write:

The majority of pupils with autism learn more effectively without additional verbal explanation or direction. The ideal situation seems to be where there is enough visual and/or kinaesthetic and haptic (from the movements involved and the feel of the task materials) information in the presentation of the task for the child with autism to be able to understand immediately how to tackle the task and when it is complete. (p. 74)

Students with ASD, as a group, have an acknowledged affinity with ICT tools, and typically learn more easily from a computer than another human (Murray, 1997). Murray suggests that computers offer a simplified learning environment which:

- Has contained, very clear-cut boundaries and rules of engagement
- Offers a single focus for attention/single source of stimuli
- Is predictable and controllable
- Has a safe response to user error
- Offers a perfectible precision interface.

The IWB offers a very similar learning environment which, being simultaneously viewable by a whole class group, has an enhanced potential as a mediator of shared learning and supported adult/peer interactivity. The use of the IWB centres the learning on the board itself rather than the teacher. It provides a simplified focus with enduring, concrete, visual explanations, which make it easier for students with ASD to understand and assimilate information, reducing 'the confusion that comes from trying to interpret socially mediated and spoken instructions' (Jordan, 2001).

Developing thinking skills and shared learning approaches

As described above, best practice in IWB use should encourage and support extension of thinking skills, and the development of shared/negotiated knowledge. However, these areas of learning, aligned as they are with Autism's Triad of Impairments (Wing and Gould, 1979; see above) and conceptual thinking are very challenging for students with autism. With the extension of thinking skills is associated an ability to reflect on one's own experience, to predict outcomes and to generalise learning across different contexts; and shared/negotiated knowledge building presumes a high level of social sophistication. These areas are severely impaired in students with ASD.

At a basic organisational level, students with ASD often require visual structure and organisational prompts (e.g. timetables or schedules, work systems and task instructions, physical delineation of space, etc.) (Mesibov et al., 2006). Without these strategies, they usually find it difficult to adhere to even common routines and sequences of actions. Most students with ASD and severe learning disabilities find it difficult to shift their focus of attention, and benefit from the use of a visual timer to enable them to predict when they will have to move on to another activity and prepare themselves to do this.

Higher thinking skills

A lack of a sense of self and other, and of a sense of themselves experiencing events, means that students with ASD often lack a sense of agency, and have little incentive to communicate with other people by conventional means other than to fulfil felt needs. Skills associated with self-knowledge, such as recall, reflection, personal interaction, prediction, etc., do not develop typically (Jordan and Powell, 1995):

Individuals with autism are aware of what is happening, but not aware that it is happening to them...they experience the coldness of the shower, but it is as if they do not know that they are having that experience. (Jordan and Powell, 1995)

Jordan and Powell (Jordan, 2001; Jordan and Powell, 1995) suggest that students with ASD can be taught basic thinking skills through teaching them how to demonstrate skills to peers or an adult – this encourages them to reflect on learning – and that the skill of commenting can be taught by building on student's special interests. However, these situations need careful structuring, and the student is likely to continue to need specific adult or peer support to succeed. It is important to build in tailored expectations, approaches and targets so that the achievements of students with ASD in these areas can be acknowledged and recorded.

Shared/negotiated learning

Shared learning involves social interaction with either adults or peers within a small group, and demands high level communicative and thinking skills. Students with ASD usually find both the action and the premise of shared/negotiated learning difficult to grasp, and their anxieties around social proximity, understanding and interaction, mean that such a situation is extremely stressful – even for more able students.

The premise of any shared discourse is 'joint attention'. With the difficulties of students with ASD in perceiving 'self', 'other' and personal experience, it does not develop automatically for them, as it does for most non-autistic individuals (Jordan, 2001). Students with ASD also have an impaired 'Theory of mind' (Baron-Cohen, 2001). This means they find it difficult to appreciate that people have different thoughts from themselves, or to infer other people's states of mind from social cues, body language, etc. Thus, they have little incentive to share information spontaneously. 'Shared attention' and gestures signifying the desire to share attention (e.g. pointing, commenting) have to be taught specifically, and the situation structured to allow them to do this.

The language of children with ASD shows significant impairment in speaker/listener relations (Tager-Flusberg, 1994). They are often not aware of what language is for and do not realise the communicative effect of their own speech (Jordan 2001; Jordan and Powell, 1995). In her study of non-verbal children with autism, Tager-Flusberg (1994) found that protodeclarative and informative functions were 'strikingly absent', and that even linguistically able people with autism (apart from those who monologued obsessively on their

special interest), rarely added new information to a conversation. She suggested that that the failure to develop shared attention (associated with Bruner's prelinguistic and early language development stages) and the later failure to develop declarative/informative language were linked. Therefore, while students with ASD may be able to use language to refer to concrete objects, they are unlikely to be able to use it spontaneously to express abstract concepts and ideas or engage other people in conversation.

Familiarity vs. maintaining interest

Students with ASD, with their difficulties in prediction, contextualisation and generalisation, find change, extremely stressful unless it is carefully managed, and their preference is for sameness within a familiar situation (Jordan, 2001). Their confidence and competence grows with knowing what is expected, and experiencing increasing success within a given situation. Therefore they are easily disturbed when this is disrupted. As Jordan (2001) writes:

It is [important] to resist the temptation always to be pushing ahead to the next phase of learning. But there is a complementary need in autism to continually look for ways of incorporating more advanced strategies into the child's repertoire...learning style does not always develop without intervention from outside.

Motivation to engage in learning

Students with ASD are very differently motivated to engage in learning. Whereas for mainstream students, motivation is predominantly provided by intellectual coherence or social rewards such as approval or opportunities for social interaction, students with ASD and severe/complex learning disabilities rarely are – due to weak central coherence and social difficulties. For many students, use of the IWB interface can provide sufficient motivation. However, for those it does not, other motivators need to be identified (e.g. alignment of learning with a student's 'special interest' area; the association of favoured activities with learning; the inclusion of favoured sounds/images within the lesson

Teaching students with autistic spectrum disorders

Jordan and Powell (1995) observe that students with ASD usually need one to one teaching to develop new skills and incremental extension of those skills. They caution:

The prime fact to remember is...that a child should not be expected to learn more than one new thing at a time and that levels of difficulty in a problem should not be increased within more than one dimension at a time.

In stressful situations, student's level of cognitive understanding may decrease with rising anxiety, and teachers need to respond to this; for example, pitching communication at a lower level to allow students to cope with both communication and the stressful situation. Jordan and Powell emphasise the necessity for teaching staff to be clear on the learning priority for each particular student and to focus upon it. For example, if social communication is the priority learning goal, then the associated activity should be one in which the student is confident of success. For students with severe/complex learning disabilities and ASD, pedagogy in association with the IWB needs to take account of the students' communicative, cognitive and social abilities and difficulties, and deploy the appropriate strategies to extend them within the remit of acknowledged IWB best practice.

Teacher training in interactive whiteboard usage

The IWB literature indicates that teacher competence and confidence in using IWBs varies widely (Moss et al., 2007), ranging from 'black/whiteboard substitute' (Beachamp et al., 2004) or 'supported didactic' (Miller et al., 2004), where the IWB is used as a visual support for the lesson through to, respectively 'advanced user' or 'enhanced interactive' where the IWB is used as an integral part of the lesson and is used to

promote students' conceptual and cognitive skills. The necessity for ongoing IWB support and training for teachers has been highlighted by many researchers (e.g. Hennessey and Deaney, 2007; Miller et al., 2008). Miller et al. (2008), in their most recent report, state:

It is our view that the level of support needed to enable mathematics teachers to develop an appropriate mathematics IWB pedagogy has been greatly under-estimated.

(This, too, can be argued for teachers of students with ASD and severe/complex learning disabilities.) Miller et al. note that particular support is needed for teachers to develop a truly interactive approach to IWB teaching. To this end, they have developed SPORE (Skills, Pedagogy, Opportunity, Reflection and Evolution), a framework for continuing professional development in IWB use.

The history of interactive whiteboard technology at Sunfield

Five SMARTboards were introduced into classrooms at Sunfield in September 2007. Interviews carried out for the Learning Environments Project at Sunfield (Brooks, 2009) in June 2008 found that staff who had IWBs in their classroom were very positive. They commented:

It really engages all of them, I mean for all their different needs and different abilities, and the wide range, it really grabs all of them, so I'd like to be able to use it more productively, to be able to use it to its potential.

I've got students who have never shown any interest in writing at all, or colouring even, you know, apart from a quick scribble, and who will get up and spend quite a long time interacting with the whiteboard, and through that have shown more interest in doing it on paper as well.

It's just like a key to another world, really.

However, teachers also commented on the need to become more familiar with it and build up knowledge of it, and the time involved in building up resources

Prior to the beginning of this project in March 2008, teaching staff had comparatively little experience of using IWBs with students. They had received a one-day introductory training session prior to installation of the IWBs delivered by SMART, and since then had been reliant upon their developing experience in using the IWB with students with ASD and severe/complex learning disabilities. In the light of this, the research project, therefore, set out to develop a best practice model of IWB use with these students in terms of teacher and initial teacher training and utilisation of the IWB.

The aims of the project were to:

- Identify possible strengths, weaknesses and best practice in the use of IWBs for students with ASD and severe/complex learning disabilities, and make recommendations for optimised practice and adaptations within existing pedagogical approaches
- Involve Initial Teacher Training students in research and increase the facility and confidence of all teaching staff – initial teacher training students, qualified teachers, teaching assistants – in using IWBs in the classroom with students with ASD
- Develop a one-day professional development training relating to the above.

2. METHODOLOGY

Introduction

The aim of the research was to develop a model of pedagogical best practice in the use of IWBs for children with autism and complex learning disabilities for use by teaching staff (including ITT students and teaching assistants). As a single-site case study, the research was founded upon a review of best practice articulated in existing interactive whiteboard literature to ensure reliability (Yin, 2003), and it adopted qualitative exploratory approaches within a residential special school setting and among relevant external professionals. Classroom and training interventions used an action research approach (McKernan, 1996), based upon establishing evidence-based solutions to identified problems following the 'plan–act and observe–reflect' research spiral (Kemmis and Wilkinson, 1998). The findings and outcomes of the research, while not generalisable due to the small-scale, purposive nature of the exploration, will provide a basis upon which other teaching staff can develop IWB pedagogical best practice models relevant to their own situation and will indicate areas for possible future research.

Research structure

The research was divided into three phases:

Phase 1 (4 February – 19 March 2008):

- Literature around IWBs, ICT, special needs and autism was reviewed, and an interim chart of findings produced.
- Baseline evidence of class team perspectives and practice, and student responses to IWB learning, was collected via a group interview, class team survey, video evidence and non-participant observation.

Phase 2 (4 April 2008 – 18 July 2008 + 8 October – 13 February 2009)

- Methodology was devised.
- Issues and interventions around IWB pedagogy and the learning of students with special educational needs and autism were identified, trialled and assessed.
- A centralised, IWB programme/activity resource on the school intranet was created.
- A training programme was devised.

Phase 3 (13 February – 14 July 2009, and beyond)

- Research was written up.
- The training programme was finalised.
- Results were disseminated.

The research team

The core research team comprised: a Research Fellow (IWB) who was an ICT-specialist Education Officer for the NSW Education Department in Australia, with wide experience of training and providing school-based support in IWB practice for education staff; a Project Leader, who was a Research Fellow at Sunfield; and Sunfield's ICT Training Officer. They were supported by a Project Steering Group, comprising Sunfield's then Chief Executive, the Head of Education, the Research and Development Officer, the school's ICT Subject Leader, the ICT Department Manager and Technician, the Staff Development Co-ordinator and a Senior Lecturer from the University of Worcester, who also acted as consultant to the core research team. The research team also received support from the Research and Development (SEN) Awards team at the Training and Development Agency for Schools.

Research sample

Across the period of the research, a total of seven Sunfield class teams (each comprising a class teacher (total n=7), two or three teaching assistants (total n=24) and their students (total n=41)) were involved in the research to varying degrees and for varying periods of time (see Appendix 2). All but one class, which had access to a plasma screen in a designated room, had full-time access to an IWB. It was anticipated that across the class groups, replication of outcomes, in addition to the replication through literature, would increase the reliability of the research (Yin, 2003).

Of the 41 students involved, 28 had a diagnosis of autistic spectrum disorder, and a further 7 had autistic features (see Appendix 2).

Three Initial Teacher Training (ITT) students were involved in the research: one, who was based at Sunfield, was part of the main participant group, and two further ITT students took part in the research while on a 4-week special needs education school placement from the University of Worcester (April 2008). (They were placed at the school as part of an on-going relationship between the school and the University.) The Sunfield-based ITT student was engaged in part-time PGCE training, and led a class team under the supervision of a senior teacher.

Baseline phase data collection

Baseline information for the research was collected during March 2008 through:

- A group interview involving five class teams with IWBs – to give an overview of how IWBs were being used, and teaching staff needs (see Appendix 3)
- Individual class team questionnaires – to gain a perspective on IWB use and needs identified by individual class groups (see Appendix 3)
- Video/non-participant observation of IWB activity and student response – to gain a perspective on baseline levels of student engagement and IWB-mediated interaction.

When collecting the baseline data, a video camera was used to record the responses of the students watching activity at the IWB, and complementary non-participant observation data were collected as a record of activity at the IWB. However, the researchers felt that too much data was lost due to the frequent and often fleeting responses of the student at the IWB and student–teacher interactions (Anderson, 2006). Therefore, in the main research phase, it was decided to use two video cameras to record data – one recording the activity of students not at the IWB; and the other, the activity taking place at the IWB.

The information gained from baseline data collection was summarised and, with evidence obtained from the literature review, was used to inform the interventions during the main research phase.

Main phase data collection

A holistic approach to teacher pedagogy and student learning was adopted, which focused upon the environment and conditions in which the teaching and learning occurred, as well as on the interaction, pedagogy and learning centred upon the IWB. Environment and structuring are important considerations for students with ASD, and greatly affect their ability to engage with learning (Mesibov et al., 2006), so while student engagement was the primary focus of the research, it was also important to optimise the environment. The areas identified for consideration in relation to children's ability to learn and teachers' ability to teach were:

1. The within-classroom environment
2. The student's immediate environment (e.g. proximity of peers, presence of distractors)
3. The environment directly around the IWB
4. The IWB environment itself (e.g. background colour, cleanliness, pen alignment, etc.)
5. Activities/programmes used on the whiteboard (including exploration of use of peripherals, e.g. digital video cameras, visualiser, voters, etc.)
6. Teaching strategies used.

All these areas were investigated so that students' opportunities to engage with learning could be maximised, and interventions relating to pedagogy and programmes/activities could have the maximum possible impact. They were assessed according to the structured approach to teaching advocated by TEACCH (Treatment and Education of Autistic and related Communication-handicapped Children) (Mesibov et al., 2006) to identify and document possible issues and solutions which would minimise potential distractions and encourage focus upon learning (see Appendix 4). They were also analysed in terms of best

practice around IWB learning identified in the related literature. Again, issues and possible solutions were identified and documented.

In response to issues identified for intervention, a proposed solution based upon evidence from literature and research evidence was identified, which was then modified to take account of the real environment in which the intervention was taking place. This gave a proposed solution aimed at 'optimising' the pedagogical/learning environment. The optimised solution was trialled, reviewed, then either accepted as the best possible solution within that environment or modified and retrialled.

Evidence was collected through multiple means which allowed for triangulation of evidence:

- **Research journal** – An on-going, informal record of ideas, reading, records of conversations and discussions with classroom staff and others, reasons for action, and any other informal material relating to the research
- **Classroom response form** – A short feedback form on which classroom teams could record any comments related to the intervention (e.g. questions, ideas for modifications, etc.)
- **Video/photographic evidence** –Used to record evidence of students' initial and post-intervention responses
- **Documentary evidence** – Student information (e.g. term targets, behaviour support plans, personal profiles, etc.), together with evidence from class teams, allowing individualised intervention strategies to be identified for students
- **Survey questionnaire** – once during Phase 1.
- **Interviews** – Class teams group interview (Phase 1); mid- and end-of project interviews (Phase 2). (In the latter phases, interviews were carried out as opposed to surveys to minimise variation in interpretation of the questions.)

Data collection by University of Worcester ITT students

As part of their placement, the University of Worcester ITT students were given a literacy task involving whole-class story telling by the University. Each student presented a story to the class using the IWB, while the other observed and video recorded the session. Following this, the students evaluated the session jointly with one of the research team, and made recommendations for modification of the lesson, commenting on the seven different assessment areas identified above.

Facilitation of the voice of students with severe and complex learning disabilities

Students were facilitated to indicate choice and comment during the research in areas such as:

- Comparable high tech (IWB) versus low tech activities (e.g. story-telling session using IWB versus story-telling session using a standard big book)
- Training: students who were able were supported to demonstrate to and train other students.

Research tools

The research tools used to assess student responses in relation to IWB pedagogy were devised with specific reference to the present research and in relation to IWB, research and curriculum literature. These assessment criteria were applied to Phase 2 observation and video evidence, and used to gain a perspective on overall student progression (taking into consideration day-to-day variation dependent upon mood and circumstances). They are:

- **Levels of student engagement** (*relating to both active student participation at the whiteboard; and to passive student participation watching others*)
This is based upon the concept of a student engagement scale devised by Konaka (2007), and subsequent adaptations (Hills, 2007; Brooks, 2009). See Appendix 5.

- **Levels of student IWB-based interaction**

This is based upon levels of interaction (cf. Miller et al., 2004; Moss et al., 2007) from mainstream classroom practice:

1. *Technological interactivity* – where the focus is on the young person going up to the IWB and manipulating elements on the board
2. *Conceptual interactivity* – where the focus is on interacting with, exploring and constructing curriculum concepts and ideas.

Miller and Glover (2007) used the degree of interactivity as an indicator of pedagogical quality. For students with special educational needs and ASD, involvement may need to be scaffolded.

Following identification of the key areas for IWB and practice intervention, action was determined (see Table 1 below). Initial data about students and curriculum requirements, targets, etc., were obtained from teaching staff via questionnaires. Further data to gain an overview of teacher perceptions of the project, were collected initially via an initial group interview and a class survey, followed by semi-structured interviews with class teams at key stages in the project. Informal conversations and observations were recorded in the research journal by the researchers. The interventions involving teaching staff and students in classroom and training situations comprised:

- Working with teaching staff to optimise programmes/activities on which they wanted to focus – via feedback sheets and informal conversations
- Collecting video data from classrooms – to ascertain levels of student engagement and interaction associated with different activities/approaches
- Working with students to attain specific conceptual goals (e.g. presenting, demonstrating, etc.)
- Gaining student feedback on interventions – via observation, informal interviews/conversations
- Trialling different training approaches based upon feedback from teaching staff.

Analysis of data

Interviews and questionnaires

Data obtained from interviews and questionnaires was collated and summarised. This was used formatively to direct future interventions, and summatively to gain a perspective on the perceptions of teaching staff about the effectiveness of past interventions.

Video analysis

A total of 36 lessons/interventions were videoed and, of these, 11 were analysed in depth, the remaining videos contributing general data. Assessment scales for student engagement (both IWB participant and non-IWB participant) and for IWB-mediated interaction were drawn up (see Appendix 5), and a minute by minute assessment of the level of student engagement/interaction was recorded for each student involved in the lesson against the IWB-associated activity. From this, it was possible to ascertain the types of IWB activity which generated the highest levels of student engagement/interaction.

Ethical considerations

Details of the project were submitted to the Sunfield Research and Ethics Committee, and the British Educational Research Association (BERA) guidelines were observed in relation to the project. Parents, class teams and residential care key workers received information about the project, and were invited to approach the Research Fellow/Publications Manager for further information if required. Permission to collect video/photographic evidence has been gained from class teams and parents of students. The research will be disseminated through Sunfield's transition focus groups, the parent newsletter, the project report and summary, and possible future publication or talks.

Table 1: Areas identified for intervention

Area	Aims	Action
Policy on IWB use in school and permitted activities	<ul style="list-style-type: none"> To agree the level of priority for ICT support of school staff with IWBs (e.g. loading/updating software, introduction of associated hardware, etc.) To agree the degree of ICT system freedom for the teaching staff and research team to facilitate the sharing of IWB activities/programmes 	<ul style="list-style-type: none"> Literature review Comprehensive discussion of these issues and relating to teaching staff need, data protection issues, ICT system integrity, etc. at management level (ICT, Business and Education Departments)
Identifying the most effective interactive board equipment for students with ASD and severe/complex learning disabilities	<ul style="list-style-type: none"> To explore the advantages and disadvantages of front (ceiling), short-throw and rear projection IWBs (SMART and Promethean) and plasma screens (RM and SMART) 	<ul style="list-style-type: none"> Organisation of company demonstrations Visits to special schools to see equipment in situ
Identifying effective peripheral equipment for use with IWB and students with ASD and severe/complex learning disabilities	<ul style="list-style-type: none"> To maximise the potential of the IWB as a teaching tool To extend the experiences open to students through the medium of the IWB To increase student agency in learning in relation to the IWB 	<ul style="list-style-type: none"> Literature review Organisation of company demonstrations Discussion with special schools about their experience of equipment Teaching resource centre loan of equipment where possible Acquisition of equipment where appropriate
Identification of a core package of key software programmes for IWB teaching staff	<ul style="list-style-type: none"> To increase the range and variety of IWB activities which can be created by teaching staff to meet the needs of their students 	<ul style="list-style-type: none"> An audit of existing software at Sunfield available to teaching staff for creating resources Based upon professional experience of Research Fellow (IWB), an expansion of the existing core package of programmes
Optimising the classroom environments for IWB use within the constraints of classroom design and day-to-day use	<ul style="list-style-type: none"> To identify classroom features which interfered with best practice in IWB use To identify ways in which IWB learning could be environmentally enhanced for students with ASD and related communication disorders To affect change within the classroom environments 	<ul style="list-style-type: none"> Literature review In liaison with the TEACCH co-ordinator, carry out a survey of classrooms with IWBs Offer advice to staff teams on ways in which their classroom environments could be enhanced for IWB use
Best practice use of IWB with students who have ASD and severe/complex learning disabilities	<ul style="list-style-type: none"> To identify types of programmes/activities/approaches using the IWB which maximise student engagement and technological/conceptual interaction (for both students who are manipulating the IWB and those who are not) To explore means of student conceptual interaction using the medium of the IWB 	<ul style="list-style-type: none"> Literature review Observing/videoing classroom sessions Obtaining feedback from teaching staff
Training of teaching staff	<ul style="list-style-type: none"> Increasing knowledge and confidence of teaching staff in using software on the IWB Increasing ability of teaching staff to create resources to meet the needs of their students Optimisation of IWB management within the classroom 	<ul style="list-style-type: none"> Literature review Implementing various approaches to IWB training including: external trainers; regular after school training sessions; individual training support on request
Sustainable support for teaching staff (both at and outside Sunfield) using the IWB	<ul style="list-style-type: none"> To develop an IWB resource bank To design a model of sustainable IWB support for teaching staff To designate a person responsible for triggering updates of existing software / researching new IWB software. To develop a one-day course on best IWB practice with students with ASD and severe/complex learning disabilities 	<ul style="list-style-type: none"> Literature review Building up an IWB resource bank using resources developed by teaching staff and researched on the Web Discussion of sustainability at management level Liaison with key people with training expertise

Results and Discussion

The results of the research are divided into four main sections:

- Optimising the IWB learning environment
- Optimising IWB learning resources
- IWB teaching approaches
- Equipping teachers to teach using the IWB.

These outcomes have been derived from three main sources of data – IWB literature; analysis of video evidence; and teaching staff (teachers, ITT students, HTLAs and TAs) responses to interviews and questionnaires. As purposive sampling was used, the outcomes of data analysis relate to this sample only. While these outcomes cannot be generalised, it is hoped that they will provide useful indications for schools supporting similar groups of students. However, reliability was increased by corroboration in literature and the degree to which outcomes were replicated across the participating classes (Yin, 2003).

The strategies described in the results relate to the situation at the end of Phase 2 of the research. Over the course of Phase 2, as a result of the training and consultancy provided by the specialist IWB researcher and the ICT Training Officer, teaching staff modified their teaching approaches to take account of their advice on best IWB practice.

Findings from each of the sections were summarised and prepared as handouts to support Continuing Professional Development for teaching staff (see Appendix 9).

Difficulties encountered

Over the course of the project, as is to be expected, various setbacks to the research were encountered, particularly due to the extension of Phase 2 beyond the original end date of mid-July 2008. From mid-June 2008 (originally scheduled for questionnaires and write-up), there was major disruption caused by reorganisation of classrooms (their location and, in some cases, students and staff) due to a new school build, and, following that, a necessary settling period the following term. The Education Department requested that we did not resume data collection on the project until after the Autumn half-term. Due to ill health, one of the researchers (the ICT Training Officer) was then not available to the project between mid-November 2008 and early January 2009, which impacted upon training and resource development. Heavy snow in early February further disrupted data collection, and there was significant disruption in one class due to students experiencing behavioural difficulties.

A further difficulty related to in-house research. The fact that the research was carried out largely by an in-house team meant that while staff appreciated the importance of developing a best practice model, some felt awkward offering criticism, however constructive, of approaches and resources provided, despite being specifically invited to do so by the research team. Therefore there may be other hidden issues which did not emerge from the research.

Optimising the IWB learning environment for students with ASD and severe and complex learning disabilities

The physical context in which teaching and learning occurs is important for all students, but particularly so for students with ASD and severe and complex learning disabilities. Environmental issues which compound the effect of these students' difficulties need to be addressed. The difficulties may include:

- Sensory hyper- or hyposensitivity – e.g. to bright light, certain colours, particular noises, smells, etc.
- Impaired sensory processing – e.g. difficulties in prioritising attention to focus on a particular image or voice, and to attribute meaning to it
- Impaired spatial perception – e.g. disorientation when moving across spaces (e.g. between their chair and the IWB).

Their effects will reduce the student's ability to learn, and, in extreme situations, can prevent learning taking place altogether and may trigger challenging behaviours. It is therefore important to consider and minimise these effects and to adapt the learning environment to take account of students' needs.

The learning environment for students with ASD can be optimised by:

1. Resolving environmental issues that distract from learning
2. Providing visual reinforcement of learning-relevant environmental cues – this gives students information about where they are supposed to be and the when, what and how of the learning experience, increasing the predictability of their environment and reducing ambiguity. The structured teaching approach for students with ASD advocated by TEACCH (see Appendix 1) addresses these needs. It is widely used at Sunfield, has been adapted by class teams where appropriate to take account of students' learning needs in relation to the IWB.

Both these strategies will reduce students' levels of stress and anxiety, and thus increase their capacity to engage in learning.

Resolving environmental issues

The most common environmental barriers to learning mentioned by teaching staff in relation to the IWB were (numbers in brackets relate to the number of class teams (n=7) citing it as an issue):

- Effects of IWB shadowing due to projector angle (5)
- Height of the IWB (3).

Other issues mentioned included: lack of physical space to accommodate ideal seating arrangements and allow unrelated furniture to be moved away from the IWB (3); light interference from other light sources (2); student interference with/distraction from the laptop (1).

The student's shadow cast on the IWB by the projector in front of them obscured the projected IWB teaching materials, seriously affecting student learning. This shadowing effect was increased if students required hand-over-hand support from teaching staff. One class reported that an activity had had to be abandoned due to this. Careful consideration needs to be given to the type of interactive board and projector chosen. Short-throw projectors can reduce the shadowing effect; while plasma screens and rear-projection IWBs eliminate

it; however, all interactive boards have associated advantages and disadvantages, and these are summarised in Appendix 6.

Using information supplied by class teams, a classroom environment checklist for IWB use was developed (see Appendix 7) to help teaching staff optimise their learning environment. Elements were drawn from IWB literature, from a classroom assessment carried out by one of Sunfield's TEACCH-trained, structured teaching trainers (see Appendix 4) in association with the IWB specialist researcher, and from class teams' responses to questionnaires and interviews (see Appendix 8 for questionnaire and interview summaries).

Student seating

IWB literature emphasised the importance for students of being able to sit comfortably when learning from the IWB in a position where they do not have to angle their heads, and the need for all students to have free access to the IWB (Higgins, 2006; Sharp, 2006). In four of the seven classes involved in the research, students were seated around a group table when working with the IWB. In two classes, students were seated around three sides of a rectangular space around the IWB. In the remaining classroom, the seating arrangements alternated between the group table and a semi-circular arrangement of chairs adjacent to the IWB for whole class and small group work respectively.

Most classrooms who had an IWB within the classroom (3 out of 4) used the IWB several times within a lesson as part of a sequence of short activities appropriate to the attention span of the students in that class. Its use was supported by and interspersed with practical activities for which a group table was used. In most classes (3 out of 4), it was felt that, as well as providing a necessary work surface, the table also contributed to the physical structure needed by students. This was corroborated by a visiting IWB and ICT specialist in an email to the research team:

I think it is important to add that the level of disability caused by their autism impacts on [my] students' ability to cope: students whose autism is severe worked better sitting behind tables whereas those whose autism is less severe (they are able to communicate more effectively and have lower levels of anxiety/challenging behaviours) cope sitting in a semi-circle without tables. (Paveley, 26.11.08)

On one occasion, one class replaced their work table with a semi-circle of chairs around the IWB. However, this meant the resources associated with the activity had to be placed on the floor. Three students gravitated to the floor, one student moved his chair back against a partition, and two remained seated in their chairs. On this occasion, it was felt the student group would have benefited from the presence of a table, in terms of supporting structure for students and manageability of resources.

In the classrooms which used a group table in conjunction with an IWB, space was limited, and the group table was arranged so that the short sides of the oblong tables ran parallel to the IWB. This meant that only one student faced the IWB directly – other students had to angle their heads to look at the IWB.

Optimising IWB learning resources

To maximise effectiveness, it is important that IWB resources are identified and created within a school-wide, strategic, planned approach to IWB resource development which will support students across a range of ability to access the school curriculum.

While there are increasing numbers of commercial IWB software resources available to meet the curriculum needs of students with learning disabilities, the experience of the research team was that in comparison with those available for mainstream students and students with mild or moderate learning disabilities, for students with severe and complex learning disabilities there is little choice. Many available resources – even those designed for students with learning disabilities – were too complex. Much of the software pitched at the right developmental level for students with severe and complex learning disabilities was age inappropriate, having been designed for infants.

Throughout the course of the project, the project team researched educational software and activities for the student group, both those commercially produced and those available free on the internet. Available resources were evaluated using structured teaching principles advocated by TEACCH.

Conceptual clarity

Many commercial resources lacked flexibility and specificity. They tended to be illustrated rather than photographic, making them less realistic and therefore less accessible to students with ASD and severe and complex learning disabilities. With the difficulties that these students have in knowledge transference, it is important that learning materials are as realistically representational as possible. For example, these students are less likely to be able to equate an illustration of an apple with the real object than they would be if a photo was used.

Visual clarity

Students with ASD and severe and complex learning disabilities also need visual clarity within tasks to aid understanding. Many of the available IWB resources were visually busy, making it difficult for these students to discriminate key elements within their pages. Against a plain background, key visual elements are emphasised, and are easier for students to focus upon.

Alternative and augmentative communication

Another disadvantage with commercial resources was that most used text, and did not support rebus or supported it with difficulty. While the majority of Sunfield students are unable to access text, Widgit Software's rebus programmes (e.g. Symwriter) allow many students access to writing that they would not otherwise have. Where possible, it was important to create learning resources which incorporated rebus. Where appropriate, electronic speech was used to augment words/rebus/photos. One teacher reported an increase in student interest when electronic speech was used to augment symbols.

Resources developed during the research project

During the present research project, resources to support the learning of students with ASD and severe and complex learning disabilities were created by the researchers together with teaching staff to supplement other commercial curriculum resources. The resource design took into consideration:

- Recommendations from IWB literature
- Structured teaching principles

- Class team advice and feedback
- Video evidence.

Sunfield also drew upon the advice of the IWB-specialist researcher to expand their core package of programmes which were used by teaching staff to create resources. The core package now includes:

- SMART Notebook (SMART)
- Symwriter (Widgit Software)
- Communicate in Print (Widgit Software)
- Clicker 5 (Crick Software)
- Jigworks (Crick Software)
- Powerpoint (Microsoft)
- Paint (Microsoft)
- Photostory3.

When creating resources, for students with ASD and severe and complex learning disabilities, the principles below, derived from the review of literature and teacher feedback, were followed:

- Inclusion of symbolled text where appropriate to support student learning – only a few students at Sunfield could read and understand text although many understand key words when these are symbolled. One teacher advised that:
 - Where text was used in activities, this should be used in conjunction with symbols for key words
 - Non-key words should not be symbolled as too many symbols confused students
 - Use of abstract words should be minimal; only simple, common abstract words should be symbolled
 - Symbols need to be large enough for students to read them from their seats.
- Where possible, structured teaching principles should be followed:
 - Working from left to right and top to bottom
 - Visual clarity, e.g.:
 - Making different elements and areas of the task visually distinctive – for example, in a sorting activity, the areas into which the virtual objects were to be sorted were of a different colour to the general task background colour (use of colour needs to take into account student sensory responses to colour)
 - Cutting out any non-essential information or illustration which may confuse students, and where possible using a plain background
 - Structural differentiation to support achievement (e.g. the use of templates or ‘jigs’ to support a student in spelling out their name using drag and drop) which is gradually faded as the student becomes more proficient
 - Individualisation of tasks to support specific targets, learning styles, structuring needs, inclusion of motivational elements/rewards (e.g. individual interests), etc.
- Use of realistic representation (e.g. photographs rather than illustration; dynamic simulations rather than static photographs). One teacher emphasised that photos, etc., needed to be large enough for students could identify them from their seats. Objects should be photographed against a plain background to reduce visual confusion.
- To reduce any potential eye strain, muted colours were used instead of white for task/activity backgrounds (cf. Sharp, 2006).

- When appropriate, errorless learning was built into activities.
- Resources were designed to be appropriate to students' ages and individual needs as well as their abilities.
- To increase motivation, activities needed to incorporate animated and auditory rewards at different levels. For example, in some programmes (e.g. Bugz) the placing of a picture in a correct category was accompanied by a brief auditory 'reward'; the successful completion of a whole task or sequence of tasks culminated in an extended auditory reward and/or a piece of animation.

Class teams were asked to feed back about the resources created and to make suggestions about how they could be improved. The improvements suggested fell into three categories: making the task more appropriate to the students developmental level/understanding (e.g. changing some symbols to those students would recognise); individualising elements within the task to suit the circumstances, experience or taste of specific students or a group of students (e.g. changing rewards; options within a letter-writing activity); and increasing the quality of reward.

Within-activity motivational elements/rewards

For both typical students (Moss et al., 2007) and students with ASD, within-activity audio and visual rewards have been found to be motivating – both in terms of intermittent rewards and as an end product. However, for students with ASD, sensory rewards are often the sole motivating factor, as often they do not experience social elements of a task (e.g. teacher approval, peer interaction) as motivational (Mesibov et al., 2006).

Different audio or visual effects can be linked to either correct or incorrect answers. However, as video evidence showed, linking these effects to incorrect responses was not wholly successful with Sunfield students. In one case, it caused a student distress because it signified an error, seeming to undermine his confidence and self-esteem, and his willingness to try again; in another, the student enjoyed the audio or visual effect associated with the wrong answer, and therefore at times seemed to deliberately make a wrong choice for the associated 'reward'. On this basis, it was decided that when creating resources in-house, the most effective electronic response to a wrong answer was no response at all, providing the student with the incentive to search for the correct response.

Video evidence recorded the success of audio or visual rewards which were linked to individual students' special interests. These generated the most enthusiastic response from students. One student who had previously been reluctant to engage for more than 30 seconds with an IWB 'reveal' activity, remained engaged for 12 minutes, demonstrating his enjoyment with a broad smile and dancing. He persisted with erasing a colour overlay from the image, made intentional movements to trigger the auditory reward, and initiated interaction with staff. This heightened response was also shown by a student who was already highly motivated by the IWB during a tessellation activity. Again he showed heightened expressive response, and initiated interactions with staff.

The most successful reward in terms of non-participant engagement in an IWB activity was one in which minor rewards were associated with each of 10 elements in a counting activity, and a major reward was triggered at the end of the activity if all the elements had been answered correctly. Unusually, as recorded in video evidence, all students' attention remained focused on the IWB throughout the activity in anticipation of the final outcome, even when they were not directly involved in manipulating the IWB.

Sharing IWB resources

In the baseline questionnaire, three out of six class teams said that they would like a list of useful websites or an IWB resource bank on the intranet. IWB literature comments on the potential usefulness of shared resource banks for teaching staff. Sharp (2006) states that the variety of available resources results in a more interesting learning experience for students, and Kennewell (2004) writes that a Resource Bank has the potential for reducing teacher workload. However, Moss et al. (2007) reported that while 97% of teachers agreed that building up a bank of resources to share with colleagues would save time, there was little evidence of resource banks being created.

Over the course of the project, an IWB resource bank was installed on Sunfield's intranet which contained both resources and links to websites categorised by curriculum subject. In Interview 2, IWB leads from five classes were asked what they thought about the IWB Resource Bank. One had found the IWB Resource Bank really useful, and another commented that although they were using all the resources created specifically for their classroom, they had not used the extended Resource Bank. Another, who not been able to attend either of the two training sessions scheduled, commented that an introductory training session would be useful.

Three people who attended Resource Bank training evaluated the usefulness of the internet links in the IWB Resource Bank for their class group using a five-star rating system (one: low; five: high). The session highlighted some difficulty with access for some resources. As expected, usefulness ratings were distributed fairly evenly across the range depending upon the appropriateness of the resource for the student groups. When asked during Interview 2 whether they would be prepared to contribute resources which they had developed to the IWB Resource Bank, four of the five IWB leads agreed. Although two (one of whom did not agree) had concerns that not all class teams would contribute, and would exploit others' hard work.

Discussion within the steering group raised IWB Resource Bank management issues such as the time taken to research, create and categorise resources, the need to monitor the quality of submissions, and to limit direct access to the Bank in case resources were mistakenly changed or deleted. It was decided that the Resource Bank therefore needed someone, working closely with the ICT subject co-ordinator, to oversee it, update it, and to routinely approach class teams to ask for resource donations. The contents of the Bank would also need to be reviewed and publicised. The time-consuming nature of this project may be the reason for Moss and colleagues' (2007) observation that Resource Banks are less common than one would expect.

Optimising teaching approaches for students with ASD and severe and complex learning disabilities using the IWB

Over the course of this research project, class teams completed one survey questionnaire at the beginning of the project and were interviewed twice – at the mid-stage and end of the project – using semi-structured interview schedules. Their responses to these questionnaires – and also in another Sunfield-based research project on learning environments (Brooks, 2009) – indicated that many students show higher levels of engagement in IWB activity than in other activities:

M. doesn't look directly at many work-based activities, but does so with the interactive whiteboard because it holds his interest. (Class Team F)

T. really pays attention to the interactive whiteboard. It is the longest he has ever sat concentrating on anything. (Class Team D)

The introduction of IWBs into classroom reportedly increased students' ability to learn in a group situation (Class Team B). Two class teams described how students who showed little interest in the computer were enthusiastic about interacting with the IWB. One teacher observed:

I used to struggle to write about my students' progress in ICT in end of term reports. The interactive whiteboard has meant that there is now something to report. (IWB lead 6)

Another IWB lead added:

A. and J. find [the IWB] much more rewarding than the computer. (IWB lead 3)

Some students who did not engage with traditionally presented curriculum subject activities did so when they were presented on the IWB:

We have students who won't engage in reading books, but who will engage when the book is presented as a DVD or Clicker 5 on the interactive whiteboard. (IWB lead 5)

I've got students who have never shown any interest in writing at all, or colouring...apart from a quick scribble, and who will get up and spend quite a long time interacting with the whiteboard, and through that have shown more interest in doing it on paper as well. So I think it's really important. (Brooks, 2009; the learning environment Ph.D. research at Sunfield)

Some students who have spent years trying to learn some skills are now able to learn using the IWB.

The interactive whiteboard is a good motivator – all students love using it. All students have learned to spell their names through drag and dropping [JigWorks programme] with different levels of structuring [in the last few months], although they have spent years trying to do it [previously] (IWB lead 3).

Range of IWB activities

The IWB literature describes a variety of different educational situations in which the IWB can be the focus, incorporating both teaching and shared learning experiences:

- Independent
- One-to-one staff/student
- Small group learning (students only or staff/students)
- Small group teaching
- Large or whole-group learning/teaching.

At Sunfield, with between 4 and 7 students per class, the most common uses of the IWB were whole group learning and individual learning. Although the latter could be seen as an under-utilisation of the IWB, it allowed students who would not use the computer to develop their ICT skills. Most students seemed to gain greater satisfaction and enjoyment from using the IWB than they did using the computer, and, for some, it was a means of pre-teaching shared IWB activities in preparation for a more pressured, group situation. When appropriate, students were also able to access activities of their choice independently (with supervision) giving them the incentive to practice ICT skills such as navigating, selecting and opening programmes, etc.

In addition to being used as the focus of teaching, the IWB was also used to provide a context for activities (e.g. to present book illustrations as a mnemonic back drop to related drama activities such as costume and set creation, sensory experiences, etc.; a reminder of steps in a recipe during a cookery lesson; etc.).

Students involved in the activity

Among the 31 students taking part in the research for whom there was regular video and/or verbal evidence, 25 showed high levels of motivation in interacting with the IWB, evidenced by such behaviour as needing only a single prompt to go to the IWB, approaching the IWB rapidly, selecting the IWB as a choice activity, anticipating and, in some cases, pre-empting their turn at the IWB, initiating activity at the IWB, and indicating they would like to extend the IWB activity. There were two students who could use the IWB for only short periods of time before becoming disorientated and distressed. There were 4 students who showed low motivation levels in interacting with the IWB, needed repeated prompting to approach it and regular hand-over-hand support to take part in activities. In some cases, they turned their head away from the IWB when engaged in an activity, indicated after a short period working at the IWB that they had had enough, and showed low tolerance levels for IWB tasks.

Although these elements may combine, the students' predominant interaction with the IWB can be categorised into:

- Technological engagement – manipulation of the IWB
- Triggering IWB activity rewards – cause-and-effect
- Conceptual engagement with IWB learning materials
- Social interaction through the medium of the IWB.

All students achieved IWB manipulation and accessed cause-and-effect activities, each associated with varying levels of conceptual engagement. Only the most able group were supported to engage with the IWB as a social tool, and, of these, only one appreciated the potential for sharing knowledge with other people although maybe not the impact.

Although with mainstream students it is debated whether technological interaction enhances learning, with students with ASD, and their difficulties with focusing their attention, it is almost certainly beneficial as it gives them the visual medium through which they can familiarise themselves with an IWB activity and come

to engage conceptually with it. When observing from a distance (e.g. the group table), there is greater likelihood of students' learning being disrupted through distraction.

Supporting students

Staff interview responses and video evidence suggested that for all students at Sunfield, effective learning using the IWB was possible only with one-to-one staff support – both in whole class groups to and in individual IWB-based tuition. The IWB, even as an individual in a one-to-one activity, may not be suitable for all students. The IWB-specialist researcher advised:

Effective use of IWBs will require that the student is able to attend to the IWB, and more specifically to a picture or detail rather than just to the board as a whole. If students are unable to do this independently, then the use of IWB activities for that individual would not be appropriate.

Swinton (2009) also emphasises the need for developmentally appropriate learning. Video evidence suggests that by providing sufficiently motivating materials, and working initially on a one-to-one basis supported by physical prompts (hand-over-hand) the less able students progressed from fully supported to independent contributions in daily IWB activities (e.g. registration and circle time) during the course of the research project.

Responding to Interview 2, one IWB lead advised that:

- 'It is important not to set sights too high – aim towards little goals'
- 'In group situations, turns should be kept short to maintain the interest of the whole group'.

In three classes where students had shorter attention spans, IWB-mediated activities were delivered in short sessions alternated with short, related practical activities while the students were seated at the group table. The more able groups were able to focus for longer periods of time, and the proportion of IWB work was extended.

Some students who found it difficult to remain as part of a group initially did so if there was an additional incentive to remain at the group table (e.g. a Koosh ball, a puzzle, a book). These objects could be phased out gradually, but allowed staff to support students to take part in specific elements of the group activity without causing them too much anxiety by demanding continuous engagement and triggering challenging behaviour incidents.

Mayer (2003 in Smith et al., 2005) questioned whether it was useful to present verbal and visual information simultaneously when using the IWB, and this is a pertinent concern for students with ASD. They have difficulties in processing verbal information, and in prioritising their focus, so the predominant teaching approach needs to be visual/kinaesthetic. They should not be expected to process spoken language and visual information simultaneously (Mesibov and Howley, 2003), and it is therefore important that when presenting unfamiliar visual material, for example, other communication (e.g. language) and expectations are minimised.

Students with ASD often find it difficult to respond to direct questions. It is therefore more productive to use sentence cuing – allowing students to supply the answers in a verbal equivalent of cloze (observed in 2/6 classes).

Incentive to interact with the IWB

The IWB-specialist researcher advised that first step in encouraging a student's engagement with the IWB should be through making use of their known special interests, rather than using pure curriculum activities. Students need to perceive interaction with the IWB as enjoyable and rewarding. However, IWB literature (Gray et al., 2005) warns of the learning disadvantages of students completing an activity for an incentive alone. Supervision by teaching staff is important in order to ensure that learning outcomes, as well as reward outcomes, are met and understood. A student's pursuit of the incentive should not eclipse the learning objectives.

Management of the IWB

Practical issues for students using the IWB which were identified by teaching staff in questionnaires and interviews related to the classroom management of the IWB included:

- Students attempting to write on the IWB while resting their non-writing hand against it for balance (2/6 classes). *This was resolved through prompting students to take the balancing hand away from the IWB.*
- The differences in clicks (i.e. single click/double click) needed to launch different programmes (group interview). *This can be resolved by changing the programme settings. In the short term, it was resolved by prompting students.*
- Time spent waiting while programme loads (group interview). *Where possible, teaching staff opened programmes and minimised them prior to the lesson beginning so that when the time came, they could be quickly accessed by clicking on the task bar, or used the waiting time constructively (e.g. counting forwards/backwards, etc.).*
- Student obsession with the IWB/IWB activities (3/6 classes). *At the end of IWB activities, students were directed to the next activity using a schedule when necessary (see Appendix 1 on the structured teaching approach). To ensure the students concentrated on other tasks, in some classes the IWB needed to be switched off when not in use.*

Additionally, for students with ASD and severe and complex learning disabilities, it is important that as many factors in the environment be kept as predictable as possible. Changes cause many of these students to become anxious, reducing their ability to learn. To maximise their ability to focus on learning, factors such as seating, staffing, interaction cues, etc., should as far as possible remain consistent (Mesibov et al., 2006).

Applying the structured teaching approach to the IWB

Howley and Mesibov (2003) describe the structured teaching approach as 'a system of organising the classroom and making teaching processes and styles autism-friendly'. Through questionnaires and interviews, class teams were asked about the structured teaching support in place for students. Where an individual student's needs required structured teaching support in relation to the IWB, the following approaches were adopted:

Schedule

If an IWB activity was being used as a stand-alone task, a visual cue (i.e. a representative object, symbol, photo, etc.) would be positioned on a student's schedule/timetable as one of a sequence of two or more cues relating to different activities. The student would then take the cue from the schedule and match it to a similar cue at their destination, which could be the group table, a chair or the IWB itself. The cue itself would indicate to the student that the IWB was about to be used. A work system at the destination would then

indicate the order of activities or programmes taking place at the IWB. (This was recommended by TEACCH trainers, but was not used in the classrooms.)

Schedules were also used to redirect students who had become obsessed with IWB activities to the next task (2/6 classes). Students were more likely to respond positively to the permanent visual reminder of the next scheduled activity than verbal, gestural or physical prompts.

Work system

However, when IWB activities are being used within an extended sequence of IWB and non-IWB activities, it is not appropriate for an IWB cue alone to appear on the schedule. In this case, the student's schedule would direct them to the group table or seating area, and the IWB activity cue would appear on the student's work system within the activity sequence (1/6 classes).

Shared work systems, displaying photographs of each of the students, were also used by some class teams to indicate the order in which turn-taking would occur (1/6 classes).

Transitioning to the IWB

In order to focus students' attention on where they were transitioning to (e.g. from their seat to the IWB and back), some students required a physical object which acted as a present reminder of their destination. The IWB pens were useful in this respect, particularly as their designated space in the pen tray below the IWB positioned the student near the centre of the IWB ready to take part in the activity once they had placed the pen in the required tray. After the student had completed the activity, they were given another visual cue to support their return to their seat (3/6 classes).

Physical boundaries

Some students had difficulty with the physical management of a task. For example, in one class, students, who were instructed to turn the pages of a Powerpoint book, were uncertain where to stand when turning the 'pages' of the book so their shadows did not obscure the 'page forward' button. To overcome this, the teacher taped an 'x' to the floor to indicate to students where they should stand. With this visual guide, students stood in the right place, and were able to succeed at the task independently.

Task instructions

Task instructions visually indicated to a student involved in a task how they should complete it. For example, during a 'date and weather', circle time activity, a member of staff worked with a student using physical resources to compile a physical record of the date and weather by placing the appropriate symbols on a template (1/6 classes). The student then took the physical record with him to the IWB, where he used it as a prompt to complete the on-screen activity correctly.

Choice (using PECS)

After a sequence of 'work' activities, the 'choice' cue directed the student to a choice board where they were able to choose a favoured activity from a selection (the size of which depended upon the student's ability). In the case of two students, one of these choices was an IWB activity represented by a visual cue (a written word, symbol, photo or object of reference, depending upon the level of the students' symbolic understanding). Taking the chosen symbol, the student could then request the activity from a member of staff (1/6 classes).

Timing

While whole-class and small group IWB activities under teacher direction usually had an obvious end point, individual teaching or choice activities were less demarcated. Teacher-directed activities could be ended with

the presentation of a cue to the students which prompted them to go to their next activity. When the IWB activity was an art-based choice activity, some students often became obsessively involved and could not identify an end point. A visual on-IWB timer is one option which would indicate to the student the amount of time they have left during an activity. Towards the end of the project, a suitable timer was identified at www.timetimer.com/product_cd.php. Unfortunately there was not time to trial this during the course of the project.

Introducing new IWB activities to students

In Interview 2, the five IWB leads were asked to describe the steps they used to introduce their students to a new IWB activity. The following steps were mentioned (the number of leads mentioning the step appears in brackets):

- Prior to teaching the activity, preview the activity from the student's perspective and plan the support needed according to that student's needs and interests (1)
- Demonstrate the activity to the student (cf. Konaka, 2007) – one staff member described how she played the part of the exploring learner, modelling this behaviour for the student (2)
- Support the student to carry out the activity with a gradual fading of prompts from physical prompt (i.e. hand-over-hand), through gestural to verbal depending on their need (3)

If the activity includes computer-generated speech (e.g. task instructions), prompt the student to listen, by repeating key words supported by gesture if necessary. Prompt student to repeat the key word. (NB the student will not be able to process speech at the same time as performing actions or taking in other information; prompt their full attention, before returning to activity.) Continue this support while necessary. (1)

- Allow students to explore/experiment with the activity for themselves (with supervision) to gain knowledge, experience and enjoyment from it; having explored it, students are more focused in working towards learning outcomes (1)
- Initially, make the activity part of a daily routine so that the student can gain in proficiency (1).

Widening learning horizons

In the IWB literature, researchers commented on the restricted teaching approaches and unimaginative pedagogy that were often associated with IWBs use. Moss et al. (2007) noted that the most common technological interactions expected of students were to come and write on the IWB, to draw linking lines between objects, and to drag and drop objects, and they observed that this was especially true in lower ability classrooms.

Students with ASD and severe and complex learning disabilities often do not have the expressive communicative skills or executive skills to demonstrate or present their knowledge and understanding verbally. Physical manipulation of the IWB allows them to demonstrate this visually. Students with ASD need to learn by doing – they rarely learn by watching others, lacking the inborn ability to imitate (Ramachandran et al., 2006; Rizzolatti et al., 2006), the innate social understanding and the intrinsic motivation to attend to or learn from other people (Mesibov and Howley, 2003). However, evidence suggests that with appropriate support students with ASD can experience and develop the protoskills associated with higher conceptual learning.

In addition to subject-specific linear outcomes, in Interview 2, IWB leads described how the IWB could be used to facilitate:

Revising Recalling Building on prior knowledge

All five IWB leads used the IWB to review what students had experienced and learnt – variously through immediate review of an activity for a student group (when possible assisted by the student actively involved); by repeating activities; through use of digital photographs and Digiblu camera video (taken by both students and staff) of previous activities either to aid straightforward recall or as a preface to the next lesson in a sequence.

Class teams created shared IWB activities which built upon basic skills (e.g. constructing the day's date during circle time, building upon number and time concepts; or constructing a class letter home using Widgit Software's Symwriter programme, building on time and symbol recognition).

To increase interactivity:

- Students could identify and select photographs of a previous activity from a range of photos depending on their level of activity
- From a selection of photos, students could indicate what resources had been needed for an activity, or what the outcome of an activity had been
- Students could move learning from the IWB into the classroom.

Making choices Exploration Prediction

Students with ASD and severe and complex learning disabilities can easily become overwhelmed by too much choice, or choices which they do not understand. In these situations, it is important to provide limited, understood choice, which may be as basic choosing one simple option of two offered. Once students gain confidence, and are motivated enough, guided exploration is the next step. One IWB lead modelled exploration for her students, accompanied by appropriate language (e.g. "What will happen if I press that?").

IWB leads identified these strategies:

- Allowing students to interact with a programme on their own terms but within a supported situation, so that they gained enjoyment from the ability to find out what would happen, but ended with a tangible outcome.
- Similarly, three IWB leads encouraged student exploration on internet sites with close supervision. The animation and music available provided a high incentive for students to explore.

IWB leads also recalled examples of students predicting outcomes:

- Learning to select the correct IWB tool, button or icon to carry out an activity or launch a programme
- Predicting outcomes of games or activities
- Using the internet to preface and contextualise activities (e.g. Chinese New Year celebrations; exploring the website of a destination prior to an outing)
- Predicting the next events in familiar stories (e.g. Who is swallowed next in 'The old lady who swallowed a fly').

Sequencing Planning

All but one IWB lead recalled carrying out planning activities with students using the IWB. The planning activities recalled included:

- Displaying symbolled recipe instructions on the IWB, previewing them, then following and ticking them off as the steps were completed (supported by individual recipe sheets)
- Making a flyer for a charity event – planning the sequence of activities needed to create it within the time and executing this.

To increase interactivity:

- Students could order photographs of selected steps of an activity to contribute to the set of instructions
- With staff support, students could decide the next step in an activity using photographs to indicate their choice; the IWB answer could then be revealed and compared with their choices.
- Students could use the IWB as a prompt to collect resources together for an outing or activity with individual students locating one or more items

Social interaction with peers

All students with ASD find it difficult to engage socially with others, and lack sophisticated social understanding. For students with additional severe and complex learning disabilities, this is especially so. Most students at Sunfield are operating at a pro-social skills level achievable with staff support (e.g. sitting in proximity with another student; turn-taking with another student). When asked to identify learning instances when students interacted with peers, all five IWB leads cited staff-supported turn-taking with peers in registration and curriculum activities and games.

No students were a stage where they were consistently able to share attention with a peer independently. However, the IWB provided an incentive for increased social interaction between students which allowed staff to scaffold interactions (the number of IWB leads identifying this is in brackets):

- Two students who were normally intolerant of one another would independently sit down in adjacent seats during a small group IWB session (1/5)
- Motivated by an IWB choice activity, staff support enabled two students to negotiate an agreed order for their chosen activities (1/5)
- On one occasion, a member of staff observed a student spontaneously show another how to access an activity (1/5).

Working at the IWB Demonstrating Presenting

One IWB lead suggested that the first step in demonstrating an activity was for students learning to come out and manipulate the IWB in front of the class group. Another lead encouraged students to show video and photos they had created in front of the class.

Four students within the most able group were able, with intensive one-to-one staff support over several sessions, to create IWB presentations using Clicker 5 and PhotoStory 3 based upon accreditation targets and individual interests. With support, they presented their outcomes a number of times to audiences of varying sizes from their own class group to a staff meeting. Video evidence shows that two students spontaneously pointed out occasional elements of their work to a small audience of 2 or 3 people. Another more able student appeared to understand that the purpose of the presentation was to impart information to the audience. He was able to present his work at a fund-raising event and a government forum.

Students and the IWB – engagement and interactivity

During this project, the researchers wanted to investigate what the kinds of activity which resulted in increased levels of engagement for students – both for those actively involved in manipulating the IWB, and for those observing as part of a whole-group activity. To this end, teaching staff were asked to feed back about the resources developed, and a selection of lessons involving the IWB were video recorded and the video analysed using scales of interaction and engagement (see Appendix 5).

Although IWB work was often used as a group activity, while the student interacting with the IWB showed high levels of engagement with the IWB, the students observing demonstrated apparent low levels of engagement with the IWB activity. (This was unsurprising as students with ASD rarely learn from observing their peers as they do not possess innate interest in other people are doing.) This effectively meant that serial IWB activities were taking place with individuals. There were two possible approaches to this situation: (a) to investigate activities which captured the attention of the whole group; (b) to provide supplementary activities which related to the IWB and engaged the students with it.

Activities which captured the attention of the whole group

Class team feedback suggested that IWB activities which had high levels of animation and rewarding sound and visual effects were successful in holding the attention of students.

- One class team reported how during a lesson on ‘Jonah and the Big Fish’, students had paid only fleeting attention to static IWB activities. However, when a short, animated film, sourced from YouTube, was shown, all the students’ focused their attention on the IWB.
- During animated maths activities, which had stepped rewards – minor rewards for each correct answer within a series, followed by an extended reward for a series of correct answers – video evidence shows that all students’ attention remained focused upon the IWB. When one student made an error which meant that the extended reward would not be forthcoming, two of the watching students indicated their disappointment which suggested their anticipation of the extended animation.
- In letter-writing activities, the class team stated that the students particularly liked the computer voice reading the rebuses they had generated to the whole class. Researcher observation found that the students watching gave substantial attention to the activity at the IWB.
- Comparisons of student engagement between whole group reading using physical, symbol-supported materials, and the same book presented in an animation on the IWB were carried out in two classes. In one class, while the students’ remained focused on their individual, symbolled materials, there was no spontaneous response to the story. However, when the same story was presented as an animation, staff reported that a student who had absented themselves from the group, returned to watch, and the other students spontaneously commented on what was happening in the story.

In another class, shifts in attention focus of a small group of three students, who were predominantly non-verbal, were logged using video evidence over initial 5-minute periods of an activity – the first during a group reading and the second during an animated DVD presentation of the same story. Two students’ participation in signing in the second was more enthusiastic, and they remained largely engaged in watching the story. Their shifts in attention were fewer and off-task behaviour was fleeting. The third student needed frequent prompting in the first activity, but was unable to give attention to the DVD, becoming over-stimulated by it and rocking wildly. Although, these outcomes suggest that it is beneficial for animated elements to be included where possible within a sequence of learning activities, it is important that they are part of a range of activities related to the main topic, so that students are

encouraged to communicate their responses, demonstrate their understanding and make conceptual links. This is particularly important for students with ASD whose focus may be on peripheral elements of the animation rather than the story.

Engagement of students observing the IWB activity

In Interview 2, IWB leads (n=5) were asked for their advice on engaging students who were not directly involved in manipulating the IWB. They suggested (no. of responses in brackets):

- Staff prompting (2)
- Enough staffing to give students 1:1 support (2)
- Sensory incentives (e.g. music, animation, etc.) (2)
- Familiar participatory activities in which students anticipated their turn (2)
- Physical activities in support of the main activity (1)
- Turn taking should be short (1)
- Maximising accessibility (e.g. use of symbols) (1).

During classroom observations, the students not working at the IWB were engaged in:

- Working with physical components which involved relating to the IWB and using them to respond to a teacher prompt (e.g. using expression masks to duplicate the expression illustrated on the IWB and using them to respond to a simple teacher question; overwriting the name of the student whose photo appeared on the IWB)
- Completing physical activities which duplicated activity on IWB but did not involve relating to the IWB or the teacher (e.g. students physically creating date/weather report; marking off steps in a cookery activity; practice writing the names of students as the named student created their name on the IWB)
- Manipulating sensory supporting activities which related to the IWB but which did not involve relating to the IWB or the teacher (e.g. working with representational objects; experiencing materials associated with the activity)
- Signing (with prompting/help from staff) in support of the IWB activity
- Watching the student working at the IWB
- Waiting their turn.

In terms of best practice IWB pedagogy, literature suggests that any IWB supporting activity should require a response from the student to the material on the IWB and the teacher.

While sensory activities would appear to meet suggested best practice in terms of multimodal learning, these supporting activities distracted pupils most from the main teaching activities. For example, in a teaching activity which used soft toys to represent characters in a story, the students became absorbed in manipulating the toys, barely glancing at the IWB. In another lesson, sensory resources such as water mud, grass and artificial snow were used to support a story. In this case, not only did students become completely absorbed in the resources rather than the story, but once their hands were dirty, they then became unable to interact with the IWB. Mayer (2003, in Smith et al., 2005) suggests that different modes of presentation should be used sequentially rather than simultaneously. Staff reported that in a drama session, illustrations from a story were used to contextualise related activities. This worked well as a mnemonic, allowing students to experience consecutive, sensory 'layers' to build up a multimodal learning experience while being able to relate back visually to a previous learning experience.

Use of peripheral devices

Over the course of the IWB project, the possible use of peripheral gadgets were considered in conjunction with the IWB. These devices included:

- Voters – devices held by individual students which allow individual responses to questions or scenarios to be registered by the laptop in association with the IWB
- A visualiser – a device which allows solid objects to be projected onto the IWB screen
- Digital and video cameras
- A tablet – allows students to contribute to data presented on the IWB
- Wireless mouse – allows the student in control of a mouse to manipulate the IWB at a distance as with an ordinary computer mouse
- Webcams / remote video links.

Voters

These were found by Sunfield and another school to be too complex for use with students with severe and complex learning disabilities. The configuration of buttons was too complex for students to comprehend.

Visualiser

This had limited use within the typical class size at Sunfield – from 4 to 6 students – where much group teaching occurs with one-to-one support around a table that all can see easily. However, it would be useful within a large mainstream class group where it would allow all students to watch a demonstration or review a single piece of physical work in detail.

However, the visualiser was useful in comparing physical features (e.g. students' hands and feet), allowing them to be uniformly photographed and projected upon the IWB to allow a comparison of different features (e.g. hand width, finger length, etc.). It is also useful for enlarging very small objects (e.g. found objects) instantaneously so that students can see them in detail.

Digital and video cameras

These were in regular use at Sunfield, enabling students to be involved in recording their own work, and activity. During one project, students from one class were linked with another class in a local mainstream school. Communication difficulties were overcome though swapping photographs and videos showing daily experiences.

Wireless mice, webcams and video links

These were not explored as part of this project.

Equipping teachers to teach using the IWB

Staff need to be confident and competent in using the IWB, and in their ability to troubleshoot common problems with the IWB. In an initial survey questionnaire, when teaching staff were asked what they thought they needed to improve their use of the IWB, four out of six teachers identified training as central to this. The concern of teaching staff for effective training continued throughout the 12-month period of the project, with one member of staff contributing a concluding statement in the final questionnaire: 'Training is key – training, training, training'.

In Questionnaire 2, all 17 teaching staff who used the IWB said they had increased in both knowledge and confidence in IWB use. They were asked to use a 10-point rating scale to estimate their knowledge and confidence at the beginning of the project, and again at the end of term.

All staff who took part in the interview said that their knowledge of the IWB had increased. Using a rating scale of 1 (poor) –10 (excellent), staff estimated their knowledge and confidence at the beginning of the project, and again at the mid-point of the project. Their self-rated increase in knowledge was as follows:

- 1 point – one member of staff
- 2 points – three members of staff
- 3 points – seven members of staff
- 4/5 points – four members of staff
- 5 points – no members of staff
- 6 points – two members of staff.

Similarly, all staff taking part in the interview said that their confidence in delivering lessons using the interactive whiteboard had increased. Again, rating their increase in confidence as above:

- 1 point – one member of staff
- 2/3 points – five members of staff
- 3/4 points – three members of staff
- 4 points – four members of staff
- 5 points – no members of staff
- 6 points – three members of staff
- 7 points – one member of staff.

It was noted by several of the basic level teaching assistants that they were not given training whereas all the teachers and senior level teaching assistants had been offered training. Two teaching assistants said that they would have welcomed the opportunity to take part in training, and felt this was necessary because should the senior teaching assistant and teacher be directed elsewhere, they would need to be able to use the IWB. One described a situation in which this had happened. Basic level teaching assistants described themselves as picking up IWB information and expertise on an as-needed basis from more senior staff.

A range of training approaches were trialled during the course of the research, and the lead IWB person/people in each of the five staff teams were asked during the Interview 2 which approaches they had found to be effective for them. The approaches were:

1. Day courses run by external IWB specialists
2. Individual consultancy sessions with an external IWB specialist

3. Overview of all activities possible using a specific programme by an internal ICT trainer
4. Overview of two or three activities possible using a specific programme by an internal ICT trainer
5. In depth overview of a single activity within a specific programme.

Three of the four leads who had attended a day course run by an external IWB specialist found it 'very useful', and the fourth found it of 'some use'. In each case, they had been able to transfer what they learnt into their classroom practice.

Two of the four leads found that individual sessions during the day with a visiting consultant had been 'very useful' or 'a lot of use'. Of the remaining two, one had found it of 'some use' while the other described their session as 'too whizzy' and had not been able to transfer the learning into their classroom.

Of the twilight training sessions delivered by the in-house ICT trainer (types 3–5 – see above), three of the five leads found the programme overview (type 3) 'very useful' and one found it of some use. All but one had transferred their learning into classroom practice. Two had found type 4 training 'very useful', two found it of 'some use', and one found it 'a little bit' useful. Again, all but one had transferred the training into their classroom. In type 5 training, where a single activity was overviewed in depth, four leads had found this 'very useful', and the remaining lead had found it of 'some use' – one commenting that the handout which had accompanied this session was of especial use. Four of the five leads had transferred the training into their classroom.

All but one of the leads commented that the pace of internal training (types 3–5) had been too fast – although they felt the speed of delivery had improved in the second half of Phase 2 of the Research. They particularly noted the need for the trainer to wait in between pointing out an icon or button to click clicking before moving on, and to check that all teaching staff had understood the instruction before moving on. They also asked that at each stage they were given time to review and practice. One lead commented on the importance of understanding all the stages:

In-house training needs to be slower – otherwise when you get back to the classroom, you find you're missing a step and can't continue.

All leads were enthusiastic about straightforward visual instructions developed by the ICT Training Officer which accompanied single activity training (type 5). One higher level teaching assistant commented: *It's the only [ICT] training session I've ever come out of knowing what I was doing.*

When offered a choice between having a copy of the Software Manufacturer's full manual on different programmes and straightforward visual instructions specific to an activity, only one lead chose the full manual; the other four all selected the visual instructions. Two said that they would prefer paper copies of instructions, two asked for both paper and intranet copies to be available, and one asked for intranet only.

When asked about what they felt the next training step was for them, two felt that creating their own resources based on the programmes already provided and getting to know the programmes in depth. Two staff wanted to build up access to and to create more curriculum-based activities. One member of staff wanted to find out how to progress a student from 'reveal' activities.

Future IWB support at Sunfield

During Interview 2, the five IWB leads were asked to reflect on possible future IWB support (including training) based upon a list of given options and indicate which they would like to have access to. They were then asked to select from the list a priority three. The outcomes are given in Table 2 below.

Visiting external specialists were endorsed by all the IWB leads, although some questioned whether termly sessions were too frequent. The most endorsed internal options (by four of five leads) were (a) termly group discussion between the ICT training officer and teaching staff to review what resources could be developed to support targets and (b) support from a IWB-trained team of STAs/TAs. However, the practicalities of releasing specialist staff from their own teams were questioned. One suggested solution was for 2 or 3 classes to be grouped together, with an IWB-specialist STA/TA trained to an advanced standard) within each group. The least popular support option was twilight training. Three of the five project leads opposed it, with two staff commenting that it was difficult to concentrate on learning new material after a full day in a challenging classroom situation.

Those options which had the highest number of priority ratings (from three of five leads) were (a) individual consultancy from an external IWB specialist, and (b) individual consultation sessions with the ICT training officer to review the term's resource needs.

Table 2: Teaching staff endorsement of different support options

Support option	No. of staff endorsing (n=5)	Of these staff, no. selecting as priority	Comments
External IWB specialist: Termly one-day training course	5	(2)	Two IWB leads tentatively endorsed this, one suggesting that perhaps twice per year was enough; one made it a priority choice
External IWB specialist: Termly individual consultancy	5	(3)	Two IWB leads tentatively endorsed this, although making this a priority choice
Internal ICT training officer: Regular twilight training sessions in house (two per term)	2	(2)	One suggested training needed to be geared to specific activities Three of five staff were opposed to twilight sessions, two because they found it hard to concentrate on challenging ICT work after a day's work.
Termly meeting with other IWB users at Sunfield to swap information	3		One stated that it would not be useful as everyone would be at different levels of expertise. They suggested that individuals could swap information on an individual basis
Internal ICT training officer: Group discussion with teaching staff to review what resources could be developed to support targets	4	(1)	
Internal ICT training officer: Individual discussion with teaching staff as above	3	(3)	
Advice from in-house IWB trained team / becoming part of team	4	(1)	Three questioned whether this would happen due to staffing One suggested this support should be available to all teaching assistants
Teaching staff contributing resources to a central resource bank	3	(2)	Two people expressed concerns that some staff would do all the work, and others would reap the benefits
Additional suggestions: Individuals could be supported in class by others in their team who had received training			
Internal ICT training officer: arrange a session once per term with individual class teams for focused training			Two other IWB leads asked about this said they thought it could work.
Classes should be grouped in twos or threes with a trained STA/TA who can trouble shoot and train informally within group.			People could plan and share resources within the group.

Training basic level Teaching Assistants

Initially, the IWB training was open to teachers and higher level teaching assistants only, but, after comments from the class teams, in the second half of Phase 2, the training sessions were opened to all teaching staff. Two staff teams in Interview 1 and an IWB lead in Interview 2 suggested that IWB training should be open to all staff, the latter saying that it should be made compulsory. The IWB lead felt that this would enable TAs to support the teacher, and that many TAs were afraid of the IWB. Two basic level teaching assistants also said they would have welcomed the opportunity to take part in formal training, although they had picked up information from senior colleagues who had attended training. They pointed out that any member of a class team needed to be able to pick up the teaching responsibility, as demands on class teams can change minute by minute. One higher level teaching assistant observed during Interview 2 that one colleague felt intimidated by training sessions and benefited from learning how to operate the IWB one step at a time in real classroom situations with support from someone they knew well.

Conclusion and Recommendations

Optimising the IWB learning environment

Although no environment is ideal, it is important to optimise the learning environment to provide students with the best opportunity to learn within the limitations of the environment itself and the school's budget. It is particularly important for students with ASD that teaching staff are aware of their need for structure, their known and potential hyper- and hypo-sensitivities, and likely distractors within the environment, and adapt their learning environment to accommodate these.

Optimising IWB learning resources

For students with ASD and severe and complex learning disabilities, it is important that activities have a strong, visual, internal logic and continuity which allow them to stand as independently as possible from auditory input from teaching staff. Students with ASD find transferring the focus of attention between modes of communication difficult and disruptive (Mesibov and Howley, 2003; Mesibov et al., 2006), and increased demands in this area will reduce their ability to assimilate information and may increase their anxiety levels.

To support the transfer of IWB learning into practical knowledge and understanding, it is important to create links, where possible, to real life experiences in a variety of contexts.

Practically, the research and creation of appropriate IWB resources for students with ASD and severe and complex learning disabilities which are age appropriate, at the right developmental level, motivating for students and which do not break copyright law are painstaking and time-consuming. It required a high level of ICT competence across a range of software often beyond what was possible for non-ICT specialist teaching staff. A continually developing shared resource bank, including internet links to specialist sites (e.g. www.thewhiteboardroom.com), to which all teachers contributed, would be a partial solution. However, its maintenance would be the oversight of an IWB specialist.

IWB resource management ideally requires dedicated support from an individual who would be able to work with the school ICT subject leader to train staff, acquire and develop curriculum resources in liaison with curriculum subject leaders and classroom teams, keep up-to-date with IWB developments, manage the resource bank, manage internal IWB support teams, oversee copyright issues, etc.

IWB teaching approaches

In the IWB literature, researchers commented on the restricted teaching approaches and unimaginative pedagogy that were often used with IWBs. Moss et al. (2007) noted that the most common technological interactions expected of students were to come and write on the IWB, to draw linking lines between objects, and to drag and drop objects, and they observed that this was especially true in lower ability classrooms. However, students with ASD and severe and complex learning disabilities often do not have the expressive communicative skills or executive skills to demonstrate or present understanding by ways other than physical manipulation of the IWB or the physical resources they are working with. Additionally, these students' need to focus on one aspect of learning at a time can dictate a linear and prescriptive teaching style. However, by employing a cumulative 'layering' approach whereby learning experiences in different modes are consecutively built up and, where possible, eventually combined, teaching staff can enrich students' learning experience.

While animation plays an important role in increasing the engagement of students with ASD, and can provide a powerful learning context, this should take its place as part of a range of complementary elements relating to the main learning focus. With the often idiosyncratic engagement of students with ASD with peripheral aspects of an activity, it is necessary to ensure that the main learning targets have been met. It is also important to scaffold students' communication skills, extended learning experiences, and promote the generalisation of student learning within the teaching programme across a variety of contexts.

IWB training approaches

The wide range of training approaches favoured across the class teams suggests that to support increasing IWB competence for all teaching staff, different training approaches need to be offered. Among staff, there was a widespread belief that it ought to be available, if not compulsory, for all staff. Those with a high level of competence in IWB use need high level training which will allow them to extend their skills, and to be given maximum information (e.g. complete software manuals) so they can use the software to its potential. Others need prescriptive training and pictorial guides relating to single resource outcomes. Yet others felt comfortable only in the security of their own classroom, being trained by someone they worked with in bite-size, practical situations. With the centrality of the IWB to the classroom, while all classroom staff should be able to demonstrate progress in learning, it should be possible to accommodate different routes to competency for those with differing ICT abilities within the school. One Education Manager suggested that some form of Continuing Professional Development accreditation associated with IWB training would also provide an incentive for all staff to invest time in IWB learning. However, four out of five staff in the final interview raised practical issues of staffing and time as critical for the development of an effective IWB pedagogy.

One solution to the dissemination of training throughout the school would be to identify a core IWB specialist team of teaching staff who could support colleagues across a group of two or three class teams. During the project, steps were taken to develop this group.

Engagement and interactivity

Most students demonstrated enhanced levels of engagement and interactivity when working directly with the IWB supported by teaching staff. Teaching staff commented on students' increased motivation to learn, to remain in a group situation, and to engage with ICT. However, students observing others at the IWB in the course of the lesson needed highly motivating rewards (e.g. animation, sounds, music) or intensive one-to-one support to engage with the lesson. With regular practice and/or the incentive of a special interest focus, students who were initially reluctant to engage with the IWB, were able to focus on IWB work, even if only for a short time.

All students demonstrated success with technological interactivity. However, conceptual activity needed careful scaffolding, and clear mapping in terms of moving slowly towards higher levels of conceptual thinking.

Every Child Matters outcomes

For most students involved in the project, the IWB enhanced their levels of enjoyment and achievement when tailored to their needs, and it enabled them to make positive contributions towards learning. However, there are basic IWB safety procedures which must be observed in order to ensure students' safety.

Future research

While this research project adopted a broad sweep approach and addressed a wide range of IWB-associated issues, future school-based research would benefit by taking a more focused approach and exploring different issues in greater depth. Some raised in the course of the project include:

- Characteristic differences between students with high and low motivation to engage with the IWB, particularly relating to their developmental level
- Further exploration of the use of peripheral devices in classrooms
- Focused investigation of the classroom conditions which foster high levels of student engagement when using the IWB; for example physical orientation in relation to the IWB (e.g. proximity, angle, etc.).
- The comparative engagement levels of students seated directly facing the IWB compared with those who had to angle their heads. The results could indicate the most effective orientation of the table (table length – so more students faced the IWB directly – vs. table width parallel to the IWB).

Outcomes of the project

This research project has resulted in four main outcomes relating to IWB pedagogy for students with ASD and severe and complex learning disabilities at Sunfield School:

- Identification of best practice approaches based on a review of literature, IWB specialist advice, classroom observation and teaching staff feedback
- The promotion of optimised IWB pedagogy at Sunfield School
- Involvement of Sunfield School and Worcester ITT students in increasing awareness and knowledge of using interactive whiteboards in the classroom through involvement in the research
- The development of a course on IWB pedagogy for students with ASD and severe and complex learning disabilities suitable for a range of teaching staff (e.g. ITT, NQTs and qualified teachers and allied educational staff (e.g. TAs, learning mentors)) which will be included within the rolling schedule of Sunfield's Continuing Professional Development Centre.

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APPENDIX 1

The structured teaching approach

The TEACCH (Treatment and Education of Autistic and related Communication Handicapped Children) approach was developed by Eric Schopler and Gary B. Mesibov at the University of North Carolina. The primary aim of TEACCH is to convey to teach individuals with ASD and related communication disorders the concept of cause and effect, and that the environment does have meaning, and to address their failures to understand, make connections and generalise. Mesibov and Shea (1998) state:

Our most important goal is for our students to find that there are patterns in the universe, and that they can identify and follow these patterns regardless of the presence of a teacher or familiar adult.

TEACCH goals are ultimately planned to enable these individuals to develop meaningful skills for adult life, including self-care and leisure interests.

The structured teaching approach developed by TEACCH was founded on the principle that visual information is more easily processed by people with ASD than verbal information (Schopler, 1966). This has been corroborated by scientists, professionals (Hodgdon, 1996; Howlin, 1997; Jordan, 1999; Jordan and Powell, 1997; Schuler, 1996) and able people with ASD (Grandin, 1996a,b; Williams, 1992). Mesibov (1997) writes:

According to Division TEACCH, structured teaching helps people with autism of all ages and levels of functioning by organizing their environments and providing clear, concrete and meaningful visual information.

The structured teaching approach is grounded in the behaviourist tradition (Lovaas, 1966, 1977; Lovaas et al., 1973) and is constantly reviewed by TEACCH according to recent research. It focuses on generalisation, functionality, incidental teaching, alternative communication techniques and psycholinguistic approaches. The work of O'Neill and Lord (1982) with its emphasis on communication also informs the TEACCH curriculum.

The structured teaching approach addresses ASD-related difficulties:

- *Context dependency.* The learning of individuals with ASD is known to be very context dependent and not readily generalised. In response to this, TEACCH uses a system of tangible, visual cues (e.g. objects of reference, photographs, symbols, words) arranged on a schedules and work systems which can be adapted to different environments while retaining the familiar principles of access (left to right and/or top to bottom). This supports flexibility.
- *Disorganisation.* By 'mapping' the environment – designating different areas of the environment for specific activities – the approach helps to generate expectations associated with that environment and reduce confusion.
- *Distractibility.* By providing a tangible visual cue which can act as a constant reminder of the task in hand, the person with ASD is more likely to remain 'on task'. For example, one child, when verbally requested to take an item from the fridge usually took a roundabout route via a fan and washing machine. When presented with a visual cue for the first time, he walked straight to the fridge, keeping his eyes on the picture (Quill, 1996).
- *Prediction anxiety.* Schedules provide constant visual reassurance about what is coming next and the inclusion of favoured activities.

- *Understanding of communication.* By reducing the complexity associated with verbal communication – facial expressions, gesture, tone, accent, rhythm, ambiguous wording, etc. – the concrete, visual communication reduces the likelihood of confusion, misunderstanding and frustration.

An outcome study sponsored by the Department of Social Services in Northern Ireland (1995–1996) found that over 86% of parents and professionals interviewed described TEACCH as effective, and described associated improvements in self-help and social skills and a reduction in inappropriate behaviours for individuals with ASD. Increases in communication, concentration and independence were also highlighted. Over 90% of those interviewed claimed that the TEACCH approach was associated with an increase in these individuals' quality of life.

Jordan and Powell (1995), while suggesting that structured teaching resulted in a better quality of life for people with ASD, suggested that a limitation is that it did not teach people with ASD to understand the nature of communication and how to apply it independently. However, they described the structured teaching approach developed by TEACCH as a 'compensatory approach in one of its most successful forms'.

APPENDIX 2

Research participants

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team A SMARTboard (Mar–Jul 08) – Class-based Plasma screen (Oct 08–Feb 09) – ICT room based	A1	Mar 08 – Feb 09	SLD, Epilepsy, Complex chromosome abnormality, Severe comprehension deficit, Autistic features (undiagnosed)	Exp. Single words/short sentences; repetitive phrases + sentences, writing Rec. short phrases/sentences + gesture/symbol Level NC2b
	A2	Mar 08 – Feb 09	ADHD; SLD; global developmental delay	Exp. Verbal Rec. short key word phrases Level n/a (FE)
	A3	Sep – Feb 09	ASD; Down syndrome; LD	Exp. Pointing, objects, photos, symbols Rec. Short key word phrases; in context, short sentences; visual back up Level n/a (FE)
	A4	Mar 08 – Feb 09	ADHD, SLD, suggested Aspergers, suggested emotional/ attachment difficulties	Exp. Verbal Rec. Longer phrases + sentences Level NC3
	A5	Mar 08 – Feb 09	Complex LD; obsessive features associated with ASD	Exp. Single words, short phrases/ sentences (repetitive); PECS (photo/symbols) Rec. longer phrases/ short sentences Level n/a (FE)
	A6	Mar 08 – Feb 09	ASD; LD; epilepsy	Exp. Single words; short phrases; PECS (symbols) Rec. short phrases/sentences + sign/symbol Level n/a (FE)
	A7	Mar – Jul 08	ASD	Exp. Single words/ signing; PECS (symbol) Rec. longer phrases/ short sentences Level n/a (FE)

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team B SMART board – class based	B1	Mar – Jul 08	Partial Chromosome 10 deletion; epilepsy; SLD; hypertonic	Exp. Single spoken words; gesture; mime Rec. Short key word phrases with visual back up (photo, symbol, word) Level P7
	B2	Mar – Jul 08	ASD; SLD	Exp. Sign; PECS; small verbal vocabulary Rec. Short phrases or sentences + visual back up (sign/symbol) Level P5
	B3	Mar – Jul 08	ASD; ADHD	Exp. Signing, repetitive phrases/sentences; PECS (TOBI/photos/ symbols); physical movement Rec. Short key word phrases/sentences Level P5
	B4	Mar – Jul 08	General developmental delay	Exp. Spoken, though indistinct Rec. Short sentences + visual backup Level NC2(b)
	B5	Mar 08 – Feb 09 (see below)	ASD; SLD; severe global developmental delay	Exp. PECS, Makaton + speech Rec. short phrases + sentences + visual back up Level P7

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team C SMART board – class based	C1	intermittent Mar 08 – Feb 09	Severe cognitive delay; epilepsy	Exp. Pointing; vocal; words Rec. Simple short phrases or sentences (4-5 words) + visual Level Level P8
	C2	Intermittent Sep 08 – Jul 09	ASD; SLD; Global developmental delay	Exp. Single words, PECS symbols Rec. Short keyword phrases + visual back up Level P2(ii)
	C3	intermittent Mar – Jul 08	SLD	Exp. Single words; signing; photos; vocalisation Rec. short keyword phrases + visual Level unknown
	C4	intermittent Mar 08 – Feb 09	ASD	Exp. PECS (symbols); single words; gesture Rec. keywords/phrases + visual Level P6
	C5	intermittent Mar 08 – Feb 09	ASD; SLD	Exp. Gestures, signing, photos (uses symbols under protest) Rec. Key word phrases with sign/symbol support Level P7
	C6	intermittent Mar – Jul 08	ASD; global developmental delay	Exp. Wide variety of sounds; gesture to indicate needs Rec. Objects of reference : short spoken phrases Level P4
	C7	Intermittent Sep 08 – Jul 09	ASD; tic disorder	Exp. Signing, vocalisations, single words; PECS (objects/photos/ symbols) Rec. short phrases or sentences + symbol/signing/gesture Level P7

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team D SMART board – class based	D1	Mar – Jul 08	ASD, SLD, pica	Exp. Body language; PECS (Tobi/object) Rec. Short key word phrases with visual back-up Level P4
	D2	Mar – Jul 08	ASD; global developmental delay	Exp. Single words; repetitive phrases/sentences; PECS (TOBIs/photos/ symbols) Rec. Short keyword phrases; needs visual back up Level P4
	D3	Mar – Jul 08	ASD; SLD	Exp. Single words; simple sentences; gesture; PECS (b/w symbols) Rec. simple sentences, key phrases supported by symbols/pictures Level P4
	D4	Mar – Jul 08	ASD; epilepsy	Exp. Body movement, eye contact, gestures; learning PECS exchange (TOBIs) Rec. Short keyword phrases backed up by objects or TOBIs Level.
	D5	Mar – Jul 08	SLD, Epilepsy, Microcephaly, ADHD, suggested mild ASD	Exp. Single words/ repetitive phrases/sentences; PECS (TOBIs/photos); physical movement Rec. Short keyword phrases supported with sign/symbols/gesture Level P7

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team E SMART board – class based	E1	Mar 08 – Feb 09	ASD	Exp. Body movement, pointing, gesture, single words + short phrases Rec. Short key word phrases + visual pack up Level P6
	E2	Mar 08 – Feb 09	Angelman Syndrome; assoc. SLD	Exp. Vocalising, pointing, eye contact; PECS (photo or symbol) Rec. short phrases or sentences supported by gesture or symbols Level P8
	E3	Mar 08 – Feb 09 (see below)	SLD, Epilepsy, Complex chromosome abnormality, Severe comprehension deficit, Autistic features (undiagnosed)	See A1 above
	E4	Mar 08 – Feb 09	ASD; ADHD	Exp. Spoken word Rec. Short phrases + sentences Level. NC2(b)
	E5	Mar 08 – Feb 09 (see above)	ASD; SLD; severe global developmental delay	See B5 above
	E6	Mar 08 – Feb 09	SLD; Weavers syndrome; global developmental delay	Exp. Single words, signs and symbols; PECS (photos + symbols) Rec. Verbal – short phrases + sentences Level P8

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team F SMART interactive whiteboard – class-based	F1	Oct 08 – Feb 09	Severe difficulties in social communication and restricted range of interests associated with Autism; SLD	Exp. Vocalising; taking adult by the hand Rec. Single words/short phrases + visual back up Level tbc
	F2	Mar – Jul 08	ASD; global developmental delay; arachnoid cysts; hydrocephalus	Exp. Vocalising; signing; simple words; repetitive phrases; beginning PECS (object/photos) Rec. situational cues (does not generalise language); short phrases/sentences/single words + sign/symbol Level P4
	F3	Mar 08 – Feb 09	ASD; childhood disintegration disorder; epilepsy; diabetes	Exp. Physically takes person; expression. Rec. minimal language supported by object Level P3 (i)
	F4	Mar 08 – Feb 09	ASD	Exp. Single words; repetitive phrases; gesture; expression Rec. Short phrases or sentences Level P5
	F5	Jan – Feb 09	Isodicentric 15 – General developmental delay with autistic features	Exp. Vocalise; takes adult by the hand Rec. Level tbc

Class teacher / staff supporting / Interactive board type	Student	Period of time in project	Diagnosis	Communication style
Class team G SMART interactive whiteboard – class-based	G1	Jan – Feb 09	ASD	Exp. Gesture, vocalising, signing, symbols; communication board Rec. 1-2 key words always supported by visual back-up Level P5
	G2	Jan – Feb 09	ASD; SLD	Exp. Sign + vocal; PECS (symbol) Rec. short phrases/ sentences + visual Level NC2(c)
	G3	Jan – Feb 09	Worcs. Drought Syndrome - a form of CP within ASD	Exp. Sign + some PECS; constructs simple PECS sentences Rec. short phrases/ sentences + visual Level P7
	G4	Jan – Feb 09	ASD; SLD	Exp. PECS (symbol); sign Rec. Verbal + signing/ symbol Level P6
	G5	Jan – Feb 09	ASD	Exp. Pointing, signing; PECS (photo/symbol/ written word); Voca Rec. Visual input (single symbols/symbol sentences) + v. limited verbal Level P7
	G6	Jan – Feb 09	ASD; SLD	Exp. Uses simple sentences; single words; PECS (symbols) Rec. Simple sentences/short phrases + symbols Level P8

APPENDIX 3

Summary of responses from Group Interview (11.3.08)

Interview questions:

1. How do you feel about IWBs in your classroom? What difference have they made to you and your students? How have students responded to the IWB?
2. What have been the issues/limitations when working with students and IWBs in your classroom environments and how have they been tackled? What difficulties do students experience?
3. What kinds of activities/programmes do students respond to positively/negatively? What features of programmes get the most response from students?
4. What kinds of activities do students carry out at the IWB? How do you use the IWB with students (e.g. whole group, one-to-one, leisure, etc.)
5. What do you think you need to help you use the IWB as effectively as you would like?

Classroom staff responses to these questions were analysed using categorical content analysis:

Student response to IWB	<ul style="list-style-type: none"> • Many students had a 'very positive' response and took to the IWB straight away • Some students who would not use computers responded positively to the IWB • One student with autism will watch from a distance • One student motivated to participate in circle time – pressed 'button' for music. It was the first time they had given full eye contact. •
Different ways the IWB is used in classes	<ul style="list-style-type: none"> • Circle time activities (e.g. date, weather, counting) • Writing practice • Choice activity (e.g. Disney/music clips) • Links to activities on other websites (e.g. Priory Wood; Poisson Rouge; TeacherTube; Promethean Planet) • To present a calming/ undemanding activity for students if they needed time to chill out (e.g. music CD/film DVD) <p><i>Activities/programmes used</i></p> <ul style="list-style-type: none"> • Art programmes (e.g. 2Simple) • 'Switch on' programmes • Web downloads (e.g. maths, songs)
Technological interactions carried out by students	<ul style="list-style-type: none"> • Activating cause and effect by pressing buttons/touching screen (e.g. activating music clips; turning 'pages' of a story) • Drag and dropping images (e.g. in context of song; weather activity, etc.) • Making choices
IWB benefits	<ul style="list-style-type: none"> • Students have a high level of focus on the IWB, even if there is disturbance in class • Develop students' turn-taking skills in a motivating way • Student with tunnel vision can see the IWB (TV too small) – he was amazed to see Madagascar.
IWB Issues	<ul style="list-style-type: none"> • Height of the IWB • Shadow on the IWB • Using a step up to reach the IWB – difficulties with balance and with the projector beam in their eyes (? Possible rear projection) • Students resting their hands on the IWB and trying to write at the same time (an impossibility) • Students removing electronic pens from the pen trays which means fingers cannot write • Double clicking on activities which need only a single click (possible to adjust laptop to take account of this) • Vibration from the room above throws out calibration • Students wanting to use the IWB simultaneously • One student finds it difficult – gets angry • Another does not like the board and will bang it to get away. • Some students obsessive about music – need to block controls • One student finds it embarrassing to stand out in front of the group

	<ul style="list-style-type: none"> • Some activities take a long time to download • Takes too much time to find resources – IWB and web • Takes too much time to create resources (e.g. put a book onto Powerpoint; incorporate symbols into activities) • The IWB laptops used to load quickly , but after being updated, now programmes take ages to load
IWB needs of staff	<ul style="list-style-type: none"> • More programmes • A central database with programmes/activities listed in files under subject headings (e.g. big books) • Simplified instructions for programmes would be good • Further training on specific programmes (e.g. Powerpoint) • Further training on carrying out specific activities (e.g. adapted books) • INSET day where programmes/activities could be shared • Problems with printing work off • We need additional equipment (e.g. microphone to record student's voices; something similar to a concept keyboard; A3 scanner) • We need someone who is designated to support IWB use in school

Analysis of baseline questionnaires administered to individual class teams – March 2008

Questions 1–4 requested factual information about class identities (e.g. names of staff/students, class name, etc.), so are not included here. In responses presented in the format 'N1/N2', the first number denotes the number of students for whom the statement applies, and the second number denotes the number of students in the class.

Question	Classes						
	A	B	C	D	E	F	G
5. Most useful kind of IWB programme/activity							
• Powerpoint (Circle Time/Registration)							
• Powerpoint (Stories)							
• Widget Software							
• Activities on internet							
• Simple Art / other art activities							
• Sim City							
• Lively singing action songs							
• Simple shape matching							
• Photographs of selves							
• Video clips							
• Etc							
6. Support needed to use the IWB as effectively as you would like							
• Tuition/Training (for all staff – not just for teachers)							
• Written instructions							
• List of useful websites / resource bank filed under topics or subjects							
• Support for making resources							
• Time to explore resources							
7. a. Students' favourite programmes/activities:							
<i>IWB EQUIPMENT</i>							
• <i>Using the electronic pens</i>	7/7						
• <i>Using the IWB to display laptop work</i>	1/7						
•							
<i>GENERIC SOFTWARE</i>							
• <i>Powerpoint – circle time</i>	7/7	3/5	1/5				
• <i>Powerpoint – stories</i>			1/5				
• <i>Media player</i>		3/5					
• <i>Building</i>			1/5				
• <i>Sound recognition</i>			1/5				
• <i>Photos</i>					1/5		
• <i>Symbols</i>							
•					1/5		
<i>SPECIFIC SOFTWARE</i>							
• <i>2Paint a picture / art programmes</i>	1/7	1/5			3/5		
• <i>2Tell a story</i>	1/7						
• <i>Bugz</i>		3/5					
• <i>Google Earth</i>		1/5					
• <i>Music Toolkit</i>	1/7						
• <i>Old lady who swallowed a fly</i>		3/5	1/5				
• <i>Sim City</i>		1/5					
• <i>Switch On Zoo</i>			1/5				
• <i>YouTube (video/music clips)</i>	7/7	4/5			1/5	1/3	

• Shape matching						1/3	
• No/little interest			1/5			1/3	
WEBSITES							
• Poisson Rouge		1/5					
• Priory Woods		3/5	2/5	3/5	Singing/music		
• Primary Resources				1/5			
OTHER							
• Class photos slide show		3/5					
•							
7. b. What do they like about them?							
• Drag and drop			1/5				
• Rhythm / repetition			1/5				
• Drama of story			1/5				
• 'Reward' sounds/noises	1/7	2/5	1/5				
• Music		1/5 (very loud)					
• Specific programme feature (Turntable)	1/7						
• Updating their preferred music and film clips	7/7						
• Making their own marks	7/7						
• Watching their own faces on the IWB	7/7						
• Using their own imagination	1/7						
• Looking at self large on screen		1/5					
• Size of the screen		2/5					
• Screen appearance		1/5					
• Ease of activating IWB		1/5					
• Responsibility			1/5				
9. What difficulties to students experience when using the IWB (only IWB/all activities)							
• Obsession with IWB or particular activities		1/5 Redirect with schedule	2/5		1/5		
• Moving on from IWB activities – does not know when to stop	1/7 (IWB) supervision		1/5	1/5	Schedule		
• Concentrating on IWB activities			2/5				
• Understanding what to pay attention to (e.g. touching wrong area of board)	7/7 - varies by programme (all) Staff direction		2/5			1/3 1:1 support	
• Understanding image on IWB			1/5				
• Knowing what is expected of them	7/7 – varies by programme (all) Staff direction	1/5 Verbal prompt or modelling	3/5	1/5	Prompt/demo		
• Distracted by other activities	7/7 – varies with activities (all) Staff direction		1/5				
• Distracted by self-stimulation (e.g. hand-flapping)			1/5	1/5			

• Difficulties interacting with the IWB			1/5		2/5 Placing other hand on screen		
• Difficulties taking turns			1/5	1/5	3/5 Verbal prompt		
• Difficulties coming to board to make a contribution			1/5				
• Sound – likes/dislikes sounds associated with IWB			2/5				
• Makes own repetitive sounds to drown out other noises				1/5			
• Perseverates on task	1/7 (IWB) Staff direction		3/5				
• Smells/licks/touches/taps IWB			1/5		1/5		
• Uses behaviour to get away from IWB			1/5				
• Obsession with particular activities		1/5 (More with stereo)					
• Dislike of particular activities		1/5					
10. Changes in student learning since IWB installed							
• Will use IWB although not interested in computer		2/5					
• Waits turn with four others for up to 30 minutes		3/5					
• Follows staff verbal or visual prompts to interact with a variety of programmes		1/5					
• Spontaneously thinks of own uses for IWB (e.g. Google Earth, YouTube)		1/5					
• Explores websites independently		1/5					
• Takes turns during interactive activities		1/5					
• Responds to video or photos of self		1/5					
• Improved sharing		1/5					
• Enjoys watching effect of typing/pictures on large screen	1/7						
• Enables him to see better - scans the larger photos, pictures, etc	1/7						
• Shows more interest in ICT; wants to learn more about different programmes	1/7					2/3	
• Shows more interest in group activities / Student who does not usually join group will do so for IWB	1/7					1/3	
• Greater concentration	1/7						
• No change	1/7						1/3

Other IWB difficulties							
• Shadowing	7/7		2/5		5/5	3/3	
• Touching IWB on non-work area causing program to change	7/7						
• Touching screen with other hand					5/5	2/3	
• IWB sometimes goes blank	7/7						

• Sometimes goes out of focus	7/7						
• Size of buttons/arrows			3/5				
• Exterior light diffuses image			5/5				
• Sensitivity of action buttons variable			5/5				
• Variations in number of touches needed to activate different programmes			5/5				
• Student impatience – moving screen on too quickly			5/5				
• Shorter students cannot reach the top of the screen to manipulate buttons			2/5				
• Students tamper with laptop			3/5				
• Programmes/activities need to be lockable			3/5				

All the programmes/activities used by classes

KEY: N = never; R = rarely; S = sometimes; O = often; D = daily

Classes	A	B	C	D	E	F	G
Programmes/activities							
Resource creation							
Powerpoint - registration	D	D	D	D	O	D	
Powerpoint – stories			D				
SMART Notebook		N		O			
Widget symbols					Re		
Specific software							
2Animate	D						
2Create		S					
2Paint a Picture	O	Re	O	O	Re		
2Tell a Story	S						
Musical Leaps and Bounds			Re				
Music Toolkit	O						
Simple city (maths program)	O	S					
Switch On Zoo			O				
Touch Funfair			Re				
Video Toolkit	O						
Internet activities (e.g. Priory Woods maths songs; Primary Resources; games; video clips)		D	Re/O	O		S/R/O	
Other activities							

Shape matching						O	
Media							
Media player ~ music		D			Re		
Media player DVD		O			Re		
YouTube	S				Re		
Internet (exploratory)	S						
Google images					Re		
Peripheral devices							
Digiblue video software (starting to develop our knowledge of this)		S					

APPENDIX 4. **Observation of Classroom Organisation**

Iain Chatwin and Cheryl Stambolis

30.5.09

General Classroom Layout

The arrangement of the furniture within the classroom, and the positioning of the interactive whiteboard (IWB) will need consideration within all settings, but assumes an added dimension when considering the needs of students who have an autistic spectrum disorder (ASD). The physical structure needs to support effective use of the IWB during lessons, and reinforce the purpose and relevance of activities within the lesson.

Clear physical boundaries to the lesson area should reinforce the expectations on student involvement, and support the routines of the lesson. This should support a maximum degree of independence for the student.

The physical layout of the room should assist the student to identify the purpose of each space; and additional strategies such as schedules, work systems and task instructions will clarify when to access these areas and for what period of time.

In order to incorporate IWB-based activities successfully within a lesson, there needs to be an appropriate means of indicating to the student that it is time to use the IWB, and how/where the IWB features in the lesson. Timetables (schedules) will identify the activity, and whether it is group or individual work. The physical structure will identify where to be, and whether sitting or standing. Lesson plans (work systems) need to identify what will take place, how long it will last, when it will be finished, and what will come next. Individualised task instructions will inform the student when it is their turn, and what they need to do. The presentation of this information will be in the format that is most suitable for the needs of the individual student (spoken, written, represented by pictures or objects), including appropriate representational identification of the IWB.

Positioning of IWB

The IWB needs to be accessible for students to stand in a comfortable position when using it. This means that there should be no furniture directly under the IWB nor impeding the standing area around the board (as there are currently examples of both in some classrooms). This also includes ensuring a clear route to the IWB for all students wherever they may be sitting during the lesson. Class E had chairs immediately under the IWB and students sitting on these chairs with their backs to the board, turning to face it when requested. The IWB in Class C is approximately 80 cm from the front student desk which creates more difficulty with shadowing as it is harder to move around.

The IWB needs to be mounted at a suitable height to avoid the need for steps to access any area of the board. In all classrooms, the IWB is currently mounted too high. Teacher's assistants are supporting the students whilst they stand on the step. Some students with an ASD may have difficulties with gross and fine motor control, and need to be able to reach the entire surface area of the IWB with ease while standing on the floor. Being above floor level may be an uncomfortable experience for students with vestibular sensory differences.

It is important to ensure that from the operating distance there is no reflection from artificial lighting or windows, and that shadowing by the operator is minimised. Many students who have an ASD may not instinctively make appropriate compensatory body movements to eliminate glare or avoid casting a shadow.

It is also important to consider the arrangement of seating for students' viewing the board when it is not their turn as operator. They should all be able to face the board without having to lean around obstructions or

face in a different direction to the orientation of their chair. The 'personal space' between students will need to accommodate their individual needs.

Positioning of Projector

The projector should ideally be mounted as close to the IWB as possible to reduce shadowing of the image. The ceiling mounted projector in one of the classrooms tends to 'bounce' when activities are taking place in the games room above throwing the calibration out. Similar applications may need a boom mounting from the wall. An unsteady image may be highly distracting for a student with ASD and inhibit their ability to attend to the task.

Further Autism-Specific Issues

The visual sensory distraction (e.g. flicker of the image, misalignment of board and projector), audible distraction (e.g. white noise from the sound system, projector hum), odours (e.g. from electrical equipment) and tactile issues (e.g. from the board texture, accessories and the cleanliness of these) will all need additional consideration when working with students with an ASD.

In addition to considerations relating directly to the IWB, it is also necessary to consider the potential distraction that may be caused by displays surrounding IWB and items in the immediate area of student.

Effective use of IWBs will require that the student is able to attend to the IWB, and more specifically to a picture or detail rather than just to the board as a whole. If students are unable to do this independently, then the use of IWB activities for that individual would not be appropriate.

To engage pupils with ASD it may be necessary to provide individualised materials that incorporate interests known to motivate them, and also to allow for students to be able to access calming objects/comforters while undertaking activities.

All students will need an individualised approach that considers the characteristics of autism which most impact upon their participation, engagement and learning. This will encompass addressing communication issues, visual learning strategies, sequencing of activities, social interaction, sensory and perception difficulties.

APPENDIX 5
Engagement and Interaction Scales

TECHNOLOGICAL ENGAGEMENT	
LEVEL	DESCRIPTION
0	Refuses to interact with/approach the IWB Becomes distressed when asked to do so Directs attention towards other stimulation in the room
0.5	Extreme reluctance to engage with IWB, needs sustained physical prompting Faces away from IWB Very fleeting attention to task No spontaneous interest in IWB Lack of enjoyment in interacting with IWB
1	Carries out activity but needs frequent prompting (e.g. physical hand-over-hand) Little spontaneous interest in IWB Pays attention to IWB in short bursts when prompted No obvious evidence of considered thinking/problem-solving in relation to the IWB No indication of enjoyment
1.5	Carries out activity but needs prompting (e.g. physical hand-over-hand) Shows some interest in manipulating the IWB. Looks at what they are doing.
2	Willingness to participate Demonstrates sustained interest in manipulating the IWB Some evidence of considered thinking/problem-solving in relation to the IWB
2.5	Willingness to participate – goes immediately to the IWB with a single prompt Demonstrates a high level of interest in manipulating the IWB Some evidence of considered thinking/problem-solving in relation to the IWB Initiates technological engagement at the IWB Indication of enjoyment
3	Willingness to participate – goes immediately to the IWB with a single prompt. Enthusiastically participates. Shows enjoyment by physical demeanour and facial expression. Anticipates/pre-empted turn. Exhibits tenacity and patience in facing vagaries of software/surmounts difficulties Positive response to completion of activity Displays programme management – purposefully opens/closes/swaps between programmes Evidence of sustained/considered thinking/problem-solving in relation to the IWB

CONCEPTUAL ENGAGEMENT	
LEVEL	DESCRIPTION
0	Refuses to engage with material/approach the IWB Becomes distressed when asked to do so Directs attention towards other stimulation in the room
0.5	Extreme reluctance to engage with materials, needs sustained physical prompting Very fleeting attention to task No spontaneous interest in materials Wavering concentration / distracted by other stimulation in the room Lack of enjoyment in interacting with materials
1	Carries out activity but needs frequent prompting (e.g. physical hand-over-hand) Little spontaneous interest in materials Pays attention to materials in short bursts when prompted No spontaneous interest in material No obvious evidence of considered thinking/problem-solving in relation to the materials
1.5	Shows willingness/some interest in engaging with materials Needs significant prompting (e.g. hand over hand) Haphazard engagement with materials Level of interest in materials reduced through familiarity No obvious evidence of considered thinking/problem-solving in relation to the materials
2	Shows sustained interest in engaging with materials Some evidence of considered thinking/problem-solving in relation to the materials Demonstrates periods of concentration in engaging with the materials
2.5	Willingness to participate – needs only a single prompt to go to the IWB Demonstrates a high level of interest in manipulating the materials Some evidence of considered thinking/problem-solving in relation to the materials Indication of enjoyment
3	Remains attentive and engaged throughout IWB activity Applies self in a methodical, logical way to task / learning task Positive response to completion of activity Positive response to teacher/class review of achievement Evidence of sustained/considered thinking/problem-solving in relation to the materials Demonstrates strong concentration when engaging with the materials Initiates learning focused activity at the IWB

PASSIVE ENGAGEMENT (if not engaged in parallel activity)	
LEVEL	DESCRIPTION
0	No attention paid to IWB Distracted by non-lesson related stimuli Taking part in parallel lesson-related activity, but no attention given to the IWB
0.5	Infrequent fleeting attention paid to IWB/activity. Mainly distracted by non-lesson-related stimuli
1	Some attention paid to IWB, but distractible by non-lesson related stimuli Taking part in parallel lesson-related activity, but fleeting attention given to IWB Apathetic.
1.5	Pays latent attention to the activity / waiting etc.
2	Gives main attention to IWB. Moderate level of interest.
2.5	Interested in IWB activity and gives substantial attention, but occasionally distracted.
3	Gives full, rapt attention to activity at the IWB Not distracted by any other activity.

INTERACTIVITY – STAFF (learning focused)	
LEVEL	DESCRIPTION
0	Does not initiate interaction with staff Does not respond or responds negatively to staff intervention throughout period Interaction with staff distracts from learning situation Does not engage in listening behaviour
0.5	Minimal response to staff interaction throughout period Requires a high level of staff prompting to respond Rarely initiates interaction with staff/fleeting interaction Interaction with staff mainly distracts from learning situation Rare listening/attending behaviour
1	Some positive response to staff interaction throughout period Requires repeat prompting from staff Rarely initiates interaction with staff/fleeting interaction Some distraction from learning situation Some listening behaviour/apparent listening behaviour
1.5	Responds positively to most staff interaction throughout period Usually requires prompting from staff Rarely initiates interaction with staff Some distraction from learning situation Some listening behaviour/apparent listening behaviour
2	Responds positively to most staff interaction throughout period Requires some prompting from staff Occasionally initiates interaction with staff Occasional distraction from learning situation Often demonstrates listening behaviour/apparent listening behaviour
2.5	Responds positively and actively to all staff interaction throughout period Some initiation of interaction with staff Mostly attentive to staff prompting Interaction focused mostly on learning situation
3	Responds positively and actively to all staff interaction throughout period Initiates/prompts interaction with staff frequently Interaction completely focused on learning situation Sensitive to staff prompting / gives full attention

INTERACTIVITY – STUDENT

No interactivity between students relating to the IWB was observed

APPENDIX 6

Interactive boards – advantages and disadvantages

Positives and negatives derived from conversations with other schools

General advice

1. If starting from scratch, get a mix of plasma screens and interactive whiteboards as both have advantages in different physical spaces and for different pupils.
2. Care should be taken with the placing of plasma screens/interactive whiteboards – class teachers need to be consulted about the best position. There need to be enough power points close to the interactive board to support both the boards and the projectors/laptops. The boards/screens need to be sited near to where the teaching will take place – i.e. near group seating/table.
3. When purchasing projectors, make sure they are of good quality and protected as far as possible from dust – some projectors develop problems with dust-burn on the lens. This dulls the projected image and maintenance becomes costly.
4. Laptops associated with some of the whiteboards/screens could be put on small trolleys with roller lids so that if there was an incident which threatened the laptop, it could be shut away immediately.

Wall-fixed plasma screens	Interactive whiteboards
<ul style="list-style-type: none"> • No shadow. 	<ul style="list-style-type: none"> • Reduced shadow with short throw projectors – varying success depending upon the quality of the projector.
<ul style="list-style-type: none"> • The plasma screen is much smaller than the interactive whiteboard and therefore is not as effective with a whole class group (5–6 students). • For small-group, close work (2–3 students) the plasma screen is better due to clarity of image. If you get too close to the interactive whiteboard, the images lose their distinctiveness. • In smaller rooms, plasma screens are effective and often preferred. 	<ul style="list-style-type: none"> • The large interactive whiteboards have greater whole class impact. • For close work (e.g. with individuals or small groups (2 or 3 students) it is less effective than the plasma screen because the images seem blurred. • In larger rooms, interactive whiteboards are more effective and often preferred.
<ul style="list-style-type: none"> • Some plasma screens are much better than others. It is better when: <ul style="list-style-type: none"> ○ the screen is matt so there is not as much glare ○ the surface is not glass, which is difficult to drag fingers across ○ resources can be transferred from interactive whiteboard to plasma screen. 	<ul style="list-style-type: none"> • Minimal reflection/glare
<ul style="list-style-type: none"> • The fixed plasma screens take up a lot of space away from the wall, and leaves space behind where students may interfere with wires, speakers, laptop, etc. Some students pushed things into the USB ports which made the speakers stopped working. 	<ul style="list-style-type: none"> • Interactive whiteboards are fixed flush to the wall with fewer trailing cables and other distractions.
<ul style="list-style-type: none"> • Plasma screens can be height adjusted. 	<ul style="list-style-type: none"> • Interactive whiteboards attached to a short throw

	projector can be height adjusted.
<ul style="list-style-type: none"> With the plasma screens you don't get the whirring of the projector (which increases with length of use) that you get with the interactive whiteboard, so this is better for students with sensitive hearing. 	<ul style="list-style-type: none"> Whirring sound from the projector can affect students
<ul style="list-style-type: none"> The plasma screens are very sensitive – sometimes the software is activated without touching the screen. <ul style="list-style-type: none"> The advantage is that it is easy to move on-screen objects. The disadvantage is that less able students can be confused the speed and number of actions that one touch can generate 	<ul style="list-style-type: none"> Needs a good, positive touch to drag and drop, etc. This makes it easier for students with poorer motor skills to manipulate the interactive whiteboard – the plasma screen is too sensitive for them
<ul style="list-style-type: none"> The touch screen works only if the tip of the finger is used to manipulate the board. Students cannot use the whole hand to drag and drop. This may be a problem for students with fine motor skill difficulties. 	<ul style="list-style-type: none"> On some models, students can use the whole of the hand to manipulate the board – this is much easier for students with fine motor skill difficulties.
<ul style="list-style-type: none"> Although the drag and drop facility was good on the plasma screen, the finer actions (e.g. closing down folders) was harder than on the interactive whiteboard – it was often easier to resort to using the lap top to close programmes. 	<ul style="list-style-type: none"> Finer actions (e.g. closing files) easier than on the plasma screen.
<ul style="list-style-type: none"> Even after the screen has been calibrated, there is a noticeable gap between the finger or pen writing on the board and the mark made. 	<ul style="list-style-type: none"> After the screen has been calibrated, there is a minimal gap between the finger or pen and the mark made.
<ul style="list-style-type: none"> It is easier to write on the plasma screen than the interactive whiteboard – you can move the pen or finger more quickly and the writing keeps pace and does not break up. 	<ul style="list-style-type: none"> Need to write on the interactive whiteboard with the finger or pen slowly, otherwise the mark fragments and does not 'keep up'.
<ul style="list-style-type: none"> On some models 	<ul style="list-style-type: none"> On some models, it is not possible for students to lean their non-writing hand against the board while writing
<ul style="list-style-type: none"> Once you've written something on the plasma screen, you can't go back and amend it 	<ul style="list-style-type: none"> You can amend something written on the interactive whiteboard.
<ul style="list-style-type: none"> The plasma screen is robust – one student hit the screen hard quite often with no effect. 	<ul style="list-style-type: none"> The interactive whiteboards are very robust.

The level of satisfaction expressed for some interactive whiteboards was greater than for others.

- On interactive whiteboards where it was only possible to write with the electronic 'pens', the screen was disabled if a pen was mislaid. On other interactive whiteboards, a pen could be replaced with a similar shaped object if necessary, and the interactive whiteboard would still work. Alternatively, one could write with fingers.

- Some makes of interactive whiteboard pens broke easily and were expensive to replace.
- Some makes of interactive whiteboard were too sensitive, and drew a line when you moved the pen near to the board without touching it.
- Some projectors were less durable than others, and had no protection from dust, which led to problems with dust burn on the projector lens.

APPENDIX 7

Environmental checklist relating to the use of interactive whiteboards with students diagnosed with ASD and severe and complex learning disabilities

KEY: Particularly relevant to students with ASD; Health and safety issue;

Lighting

To consider:

- Fluorescent lights are an acknowledged source of physical discomfort for students with ASD; alternatives should be explored
- If the projector light beam source is in the sightline of the person using the IWB, it can cause damage to eyesight.
- Students learn better if blinds do not completely block out daylight.
- Many students who have ASD may not instinctively make appropriate compensatory body movements to eliminate glare or avoid casting a shadow (Structured teaching advisor's report)

Potential issue	Impact on students			Possible solutions	Action / Comment
	insignificant	students	students		
Fluorescent lights in classroom				<ul style="list-style-type: none"> • Switch off lights • Change lighting 	
Light glare obscuring image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Re-site IWB 	
Reflection obscuring image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Re-site IWB 	
Faded image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Check/clean projector lens 	
Blurred image on IWB				<ul style="list-style-type: none"> • Adjust projector 	
Light beam from projector in IWB user sight line				<ul style="list-style-type: none"> • Re-position projector (e.g. ceiling mount) • Replace projector (e.g. short throw projector, rear-projection screen) 	
Shadowing interferes with the student's interaction with the IWB				<ul style="list-style-type: none"> • Teach the student strategies to manage the shadow • Change the projector to an effective short throw model to reduce shadowing • Select a rear projection interactive board 	

Physical arrangement of classroom (furniture)

To consider:

- For IWBs to transform classroom learning, teaching staff need IWBs in their classrooms (Levy, 2002 and Greiffenhagen, 2000, in Smith et al., 2005)
- Pupils should be sitting comfortably so they do not have to angle their heads (Sharp, 2006)
- All students should have free access to the IWB (Higgins, 2006)

Potential issue	Impact on students			Possible solutions	Action / comment
	insignificant	students	students		
IWB in a room other than main classroom				<ul style="list-style-type: none"> • Introduce IWB into main classroom to allow integrated use 	
IWB does not allow whole-class access				<ul style="list-style-type: none"> • Reposition IWB and plug sockets 	
Students need to turn their heads to view the IWB				<ul style="list-style-type: none"> • Re-orientate or extend seating to allow all students to face forward to view the IWB • Optimise seating so maximum number of students can face forward 	
Student access to IWB impeded (e.g. by furniture below/adjacent to IWB)				<ul style="list-style-type: none"> • Re-site obstructing furniture 	

IWB access for students

To consider:

- The IWB height needs to be adjusted for students using it (Painter et al., 2005; Higgins et al., 2007)
- Some students with an ASD may have difficulties with gross and fine motor control, and need to be able to reach the entire surface area of the IWB with ease while standing on the floor. Being above floor level may be an uncomfortable experience for students with vestibular sensory differences (Structured teaching advisor's report)

Potential issue	Impact on students			Possible solution	Action / comment
	insignificant	students	students		
Student cannot reach icons/buttons to access programmes				<ul style="list-style-type: none"> • Adjust positioning of icons on IWB or within programme • Re-position IWB to suit • Introduce step to allow access to IWB (not recommended) 	
IWB screen confusing for students				<ul style="list-style-type: none"> • Reduce number of icons / choices / information displayed 	
Sensitivity of IWB interface				<ul style="list-style-type: none"> • Support student hand-over hand • Match type of interactive board to student need (see Appendix 6) 	
Level of fine motor skills make access to IWB programmes/ activities difficult				<ul style="list-style-type: none"> • Support student hand-over hand • Match type of interactive board to student need (see Appendix 6) 	
Pen/finger out of alignment with mark made				<ul style="list-style-type: none"> • Recalibrate IWB 	
IWB repeatedly goes out of alignment				<ul style="list-style-type: none"> • If from interference/tremor from adjacent activity, consider repositioning the IWB if possible • If no mechanical cause, seek specialist ICT advice 	

Distractors

To consider:

'Sensory distraction (e.g. flicker of the image, misalignment of board and projector), audible distraction (e.g. white noise from the sound system, projector hum), odours (e.g. from electrical equipment) and tactile issues (e.g. from the board texture, accessories and the cleanliness of these) will all need additional consideration when working with students with ASD... it is also necessary to consider the potential distraction that may be caused by displays surrounding the IWB and items in the immediate area of the student.' (*Structured teaching advisor's report*)

Potential issue	Impact on students			Possible solutions	Action / comment
	insignificant	students	students		
Student distracted by laptop display				<ul style="list-style-type: none"> Set the laptop settings so it remains on when the lid is closed, and keep it closed Screen the laptop from student view using a screen or roller top trolley 	
Student interferes with IWB accessories (e.g. laptop, speakers, USB ports, etc.)				<ul style="list-style-type: none"> Put laptop in a lockable cabinet Ensure speakers are stabilised and out of reach Block access to USB ports 	
Student responds negatively to projector sound / smell				<ul style="list-style-type: none"> Reduce amount of time student is exposed to IWB projector Match type of interactive board to student need (see Appendix 6) 	
Cleanliness of IWB				<ul style="list-style-type: none"> Keep appropriate wipes available 	
Student targets IWB				<ul style="list-style-type: none"> As above 	
Wall displays in close proximity to IWB area				<ul style="list-style-type: none"> Re-position displays away from the IWB area to allow students to focus on learning without distraction 	
Clutter in close proximity to the IWB area				<ul style="list-style-type: none"> Put unnecessary materials away to allow students to focus on learning without distraction 	
Proximity of other staff / students				<ul style="list-style-type: none"> Address student needs on an individual basis bearing in mind other constraints (the need for students to face the IWB) Ensure they are seated in a place where they feel safe 	
IWB malfunction				<ul style="list-style-type: none"> Address issue with IWB specialists Train teaching staff to cope with malfunction 	
Computer system interference (e.g. pop-ups)				<ul style="list-style-type: none"> Address issue with IWB specialists 	

Health and safety issues

To consider:

Potential issue	Impact on students			Health and safety alert / solution	Action / comment
	insignificant	students	students		
Students need to climb on step to reach IWB				<ul style="list-style-type: none"> Re-position IWB to make step unnecessary. The step increases: <ul style="list-style-type: none"> Possibility of student or staff falling or tripping especially those who have vestibular or sensory difficulties Likelihood of projector beam shining in student's eyes 	
Eye strain				<ul style="list-style-type: none"> Reduce length of time student is exposed to IWB Use muted colour backgrounds in created activities instead of white 	
Projector light beam in sight line of IWB user				<ul style="list-style-type: none"> Reposition projector so the light beam is out of user's sight line (e.g. ceiling mounted or short throw) 	
Child protection				<ul style="list-style-type: none"> Monitor/restrict internet access 	

APPENDIX 8

Mid- and end-project questionnaires

MID-PROJECT QUESTIONNAIRE OUTCOMES (Summary) – June 2008

1. Staff increase in knowledge and confidence in delivery

All staff who took part in the interview said that their knowledge of the IWB had increased. Using a rating scale of 1 (poor) –10 (excellent), self-rated increase between the beginning and mid-point of the project were as follows:

- 1 point – one member of staff
- 2 points – three members of staff
- 3 points – seven members of staff
- 4/5 points – four members of staff
- 5 points – no members of staff
- 6 points – two members of staff.

Similarly, all staff taking part in the interview said that their confidence in delivering lessons using the interactive whiteboard had increased. Again, rating their increase in confidence as above:

- 1 point – one member of staff
- 2/3 points – five members of staff
- 3/4 points – three members of staff
- 4 points – four members of staff
- 5 points – no members of staff
- 6 points – three members of staff
- 7 points – one member of staff.

It was noted by several of the basic level teaching assistants that they were not given training whereas all the teachers and senior level teaching assistants had been offered training. Two teaching assistants said that they would have welcomed the opportunity to take part in training, and felt this was necessary because should the senior teaching assistant and teacher be directed elsewhere, they would need to be able to use the IWB. One described a situation in which this had happened. Basic level teaching assistants described themselves as picking up IWB information and expertise on an as-needed basis from more senior staff.

2. New IWB activities introduced as a part of the project

Classes were asked what new IWB activities had been introduced from the beginning of the project to the present. The number introduced ranged from one to seven new activities. The number of new activities introduced depended on the experience and capability base from which the staff team began the project, and their growing capability and confidence.

Activities introduced by class teams included:

- Powerpoint (e.g. books) – 3 class teams
- Clicker 5 – 2 class teams
- Photo Story 3 – 2 class teams
- Paint programme – 1 class team
- IWB Notebook – 2 class teams

Registration – 2 class teams
Weather – 1 class team
Matching – 1 class team
Over-writing – 1 class team
Building – 1 class team
Hide and reveal – 2 class teams
Specific curriculum activities – 1 class team
More websites – 1 class team
Activities from Peter Mayne's list – 1 class team
Students sharing own activities with class – 1 class team
Nothing not used prior to project – 1 class team.

3. Most useful new activity to support student learning

Clicker 5 – 2 classes
Websites – 1 class
Use of Widgit symbols within Powerpoint – 1 class
Primary resources on IWB – 1 class
Matching activities – 1 class.

Three classes rated the activity very useful, and two quite useful. Those that rated their activity very useful, cited:

- High level of student interest, participation and anticipation (Clicker 5 / Primary Resources)
- The ability of students to practice understanding, recognition and turn-taking at varying learning levels (Websites)
- Motivation of hearing own voice, seeing own image, opportunity for creativity in literacy without need to write (Clicker 5)

Those that rated their activity 'quite useful', suggested that the level of the activity was too high for the children in their class, and suggested the addition of noises on completion of the activity to provide incentive to complete.

4. Most useful new activity to support student engagement

Each class responding identified a different activity:

Activity related to student's special interest
Primary resources on IWB
Powerpoint presentations which include Widgit symbols
Photo Story 3
Painting / Music toolkits

Three classes rated their activity 'Very useful', with one rating their activity as 'Quite useful' and another as 'Neither useful nor not useful'. Those stating that their activity was very useful cited the reasons as:

Could be used as a reward
Motivation (2 classes)
High level of student concentration
Independence of student in activating and using software
Ability to share choices with others

High level of interest from other students now involved
Age appropriateness.

One class gave six reasons, the others one.

Those who rated the usefulness of the activities lower suggested that a musical reward at the end of the activity would increase its usefulness, and that the activity needed to be more interactive.

5. Training given

Class teams were asked about whole IWB group, class and individual training. All class teams had attended whole IWB-group training sessions. A total of three sessions were mentioned (Peter Mayne's session, a Clicker 5 session and a Photo Story 3 session), with one class recalling 3, three recalling 2 training sessions, and two more classes affirming that they had attended whole-group training.

Regarding class training, 4 classes recalled one session, one class did not recall any at the time of interview, and one class affirmed that they had had class training.

Regarding individual training, individual members of three classes were receiving regular weekly training, for one class individual training was being arranged, one class had had one individual training session, and one class none.

Four classes rated the training as 'very useful' and two as 'quite useful'.

When asked what improvements could be made to training given, the following suggestions were made:

- More training on Smartboard software
- Training needs to start at a more basic level
- The pace of training needs to be slower so staff can keep up (although they appreciated that the training was time-limited)
- A whole-day INSET on IWB training would be useful
- Training when the children were in the classroom didn't really work because of distraction
- A written exercise which could be revisited at a later date
- Written instructions for the different programmes (2 classes)
- Follow-up training sessions following initial training
- Sessions for staff to demonstrate IWB learning to one another (2 classes)
- Half-termly training sessions on IWB
- Trained staff need to have time to share training with untrained staff
- All staff should be trained – not only seniors (2 classes)
- Time needed to explore the resources (2 classes)
- The training has been a bit crammed

Other comments

- Would be lost without the IWB
- Project has been very useful and very motivating / fantastic (2 classes)
- It would have been useful to have had the project running from when we first got the whiteboards so that student and staff progress could be measured from 'Ground zero'
- Time to explore the programmes and make resources is a big issue. It would be useful to have someone responsible for doing this (similar to TEACCH)
- What are we going to do when Cheryl goes?

- Students' handwriting has improved since the IWB introduced
- All students get involved
- Improves turn-taking
- Students really pay attention

- Touch screen really helps students to make connection between their actions and what happens on IWB
- Need to have time to spend on IWB with individual students

- IWB needs to be lower (3 classes)
- Need to remove platform for Health and Safety. Also students try to balance using hand on board and then board does not respond.
- Shadow is a great problem for students

- Powerpoint books are brilliant
- Next year will incorporate IWB more within the curriculum
- Although you can be confident in using the IWB with one programme, it doesn't mean you are with others

- Interactive whiteboard very slow – needs more memory
- Some of the activities need to be more basic for students
- Need resource space with activities categorised by Sunfield levels (2 classes)

END-PROJECT QUESTIONNAIRE (Summary) – February 2009

Five IWB leaders responded to the End-Project Questionnaire.

Questions + answers	Summary of responses
No. of programmes increased since training started	All class teams for whom this question applied had increased the number of programmes they used since training started – one class team by 5 programmes, one class team by 6 programmes, and two class teams by 2 programmes.
1. Satisfaction with the IWB as a learning tool	On a 5-point Lickert scale, three IWB leaders rated their satisfaction as 'Very high' and two as 'High', with one of these commenting that the shadowing on the IWB had caused them to rate it as 'High' rather than 'Very high'.
2. (a) Changes suggested to the classroom environment	<p>Four IWB leaders suggested they needed more classroom space: one wanted to move the laptop completely away from the IWB; another wanted to move furniture from under the IWB, although it did not interfere with student access to the IWB; and another so that students could be seated in a semi-circle around the IWB in a separate area of the classroom.</p> <p>Two IWB leaders commented on the light interference: one suggesting that their IWB should be repositioned, and the other that the blinds should be more effective.</p> <p>The IWB leader whose IWB was in a separate room wanted the IWB brought back within the classroom so that it could remain on throughout the day, and students could access it readily.</p>
2. (b) Changes suggested to student seating	<p>Three IWB leaders said that they would not make changes to student seating in their classroom. One commented on behaviour constraints with students which meant that seating had been less than ideal, and another that she would like all her students to be facing the IWB head on, but needed to seat them so that students who used the IWB out of turn were further away from the IWB.</p> <p>One IWB leader further commented on how the class team varied seating to suit the size of group, either seating students around three sides of a group table or in a semi-circle around the IWB.</p>
2. (c) Changes suggested to the IWB itself	<p>One IWB leader said they would make no change to the IWB, although all five IWB leaders said that the shadowing was an issue – one concluding that they would like a rear-projection IWB. Another IWB leader commented that although shadowing was such a big failing for younger students, the older students seemed to have learnt how to cope with it.</p> <p>The IWB leader who had a plasma screen, said that they preferred an IWB as the students found the glass difficult to use. Another whose class had trialled the plasma screen also expressed dissatisfaction with it compared to the IWB, commenting that the plasma screens were smaller, making it more difficult for students to find the navigational buttons and too sensitive, meaning that students easily navigated too many pages.</p> <p>An IWB leader stated that the IWBs were good quality – one student headbutted the IWB hard and although it had a slight dent, it still worked. His class also found it easy to clean.</p>
2. (d) Changes suggested to structured teaching approach	Four IWB leaders stated that they did not need to use TEACCH structure within IWB activity for their students. The fifth IWB leader did use structured teaching approaches within IWB activities, and gave the following examples: work system used to allow one student to predict order within the series of activities; 'jigs' used to allow students to experience success in weather and name-spelling activities; environmental marking to show students where to stand when working at the IWB
2. (e) Changes suggested to available software	Three IWB leaders said they were satisfied with the software available, and one further commented that she needed to explore this software further. One said that they needed as wide a range of software as possible, although they weren't sure what was available. One had difficulty with activating software, which often needed several tries before the programme opened.
AVAILABLE ACTIVITIES	
• OK	<p>Two IWB leaders stated they felt the activities created were satisfactory, one commenting that they needed to exploit what was available. Another IWB leader felt that they could go to the ICT Training Officer if they needed a specific activity to be created. One IWB leader asked for more activities on Sunfield curriculum themes (e.g. literacy set books). Another suggested that: the sound quality was variable – on some it needed to be better quality; that photos and symbols needed to be larger; that abstract symbols were not useful for his students.</p> <p>One IWB leader commented that the effectiveness of activities depended on who created and delivered them, and that finding the time to create and research resources was an issue.</p>

3. (a) Best experiences to date with IWB	<ul style="list-style-type: none"> The response of one student, who had previously shown little interest in the IWB, to a very personalised activity (1) Improvement in all students' concentration and engagement (1) Provided students with a richer learning experience (2) Students felt they were playing even while they were learning (1) Students have learnt skills using the IWB that they have previously spent years trying to learn (1) The effect of the IWB on turn-taking skills within the class group
3. (b) Best way of engaging students with the IWB when not hands on	<p>The most effective way of engaging students when they are not hands on with the IWB were:</p> <ul style="list-style-type: none"> Animated resources, video or music (2) Familiar, participatory activities that they enjoy (e.g. circle time, story) (2) Staff prompting / 1:1 support (2) Maximising accessibility (e.g. use of symbols to support story) (1) Providing supporting activity related to main IWB activity (1) Keeping IWB turn-taking short (1)
3. (c) Students' level of interest in IWB compared with when first introduced to IWB	<p>Four IWB leaders reported that students' levels of interest were high or had remained the same. Only one reported that students had become less interested – this class originally had an IWB in their classroom, and this was changed to a plasma screen in a separate room.</p> <p>Much higher than at the beginning (1) Levels of interest high – some students have increased level of interest (1) Students are more focused (1) Levels of interest have remained the same, whether very interested or little interest (1) Less interested – IWB in classroom has been replaced by plasma screen not in classroom (1)</p>
3. (d) Stages in introducing a new activity to students	<ul style="list-style-type: none"> Demonstrate activity (3) Prompt – faded from physical (hand-over-hand), to gestural support, to verbal depending on student need (3) Encouraged students to explore activity and gain interactive experience (1) Emphasise key aspects of activity as student engaged in it (1) Made activity part of the daily routine – the more students practised, the more proficient they became (1)
PEER-PEER INTERACTION OBSERVED	
3. (e) Has any peer-peer interaction been observed?	<ul style="list-style-type: none"> No peer-peer interaction observed (1) Staff mediated peer-peer interaction (2) Student proximity – first stage (1) Turn-taking (e.g. games, Jigworks puzzles) (2) Student helping a peer unprompted (1)
3. From experience, examples of how students have used the IWB	
• Achieving specific targets	All class teams used IWBs to achieve specific student targets (5)
• Contributing to a shared activity	Students in all class teams used IWBs to contribute to a shared activity based upon turn-taking (5)
• Recalling/revising prior learning or activities	Students in all classes experienced revision of prior learning using the IWB (5) One student in one class team recalled prior learning, and said what others had done, immediately after learning had taken place (1) Students in three class teams recalled prior activities with support (e.g. revisiting photographs of experiences; recalling activities during the week in writing letters home) (3)
• Building on prior learning	Students in all class teams used the IWB for building on prior learning (e.g. developmental next steps, extending the learning in the lesson, etc.) (5)
• Working with other students	Students in one class did not work with other students using the IWB. (1) Students in four classes worked with peers in turn-taking activities (e.g. making choices, games, etc.) (4)
• Planning work	Students in three classes used the IWB for working on planning activities (e.g. following recipes, making a flyer, contextualising lessons) (3) Two classes did not currently use the IWB for student planning activities (2)
• Sequencing steps in an activity	Students in one class used the IWB for sequencing steps in an activity (1)
• Prediction	Students in three classes used the IWB for prediction activities (e.g. the next step in familiar stories/rhymes; cause and effect; etc.) (3)
• Demonstrating	Students in four classes used the IWB for early demonstrating skills (e.g. showing favourite video clip; creating in front of class; showing a peer/adult how to do an activity)
• Presenting	Students in one class group were able to present material to an audience (e.g. photo sequence;

	simple Clicker 5 books)						
EXPLORING (E.G. THE INTERNET)							
• n/a							
• You Tube – v relevant to finding video clips							
• Needs supervision – but students can access YouTube independently							
SOCIAL INTERACTION							
• n/a							
• Playing games together							
• With staff							
• Turn-taking with supervision / leisure without							
• Turn taking with supervision (Jigworks)							
• Sharing space							
• See 'Comment'							
SHARED DECISION-MAKING							
• N/a						[working on choice?]	
• Staff mediated joint decision making							
• See 'Comment'							
LEISURE							
• DVD							
• Music							
• Games							
• Internet							
• 2Paint-a-picture							
• Digiblue videos – will ask for these to be played							
OTHER EXAMPLES							
• Computer skills – has given them the incentive to learn to access own favourite programmes							
•							
4. How did you find the following training approaches?							
Visiting IWB specialist – whole group / practical	Very useful		Very useful		Some use	n/a	Very useful
<i>Able to use advice in classroom</i>	Y		Y		Y	n/a	Y
Visiting IWB consultant – spent individual time	Some use		Very useful		A lot of use	Some use	n/a
<i>Able to use advice in classroom</i>	N		Y		Y	Too whizzy	n/a
Programme demonstrated during in-house training	Very useful		A little bit		Some use	Very useful	Very useful
<i>Able to use advice in classroom</i>	Y		N		Y A little – it's quite difficult and needs to be slower	Y ICTTO goes step by step – if lost, will come by	Y
Several specific activities demonstrated during in-house training	Very useful		A little bit		Some use	Some use - Whole day better	Very useful
<i>Able to use advice in classroom</i>	Y		N		Y A little – less than above	Y	Y

A single activity dealt with in detail to give a specific end outcome	Very useful		Some use		A lot	Very useful – esp hand out	Very useful
<i>Able to use advice in classroom</i>	Y		N		Y	Y	Y
SEE COMMENT BOX							
5. Written instructions to support training:							
Full manual (paper)							
Full manual (internet)							
Straightforward visual instructions (paper)							
Straightforward visual instructions (internet)							
See 'comment' box							
6. Future							
NEXT ACHIEVABLE STEP							
• Gather bank of resources to enable IWB to be used more frequently							
• Find out what is the next step on from 'Reveal'							
• Get access to more curriculum-based programmes							
• Do more curriculum-based work							
• Learning to use it in more depth							
• Putting own resources together based on what was provided							
• Creating more activities with Clicker 5 and Communicate by Choice							
ONGOING SUPPORT AT SUNFIELD							
• Termly training course with external IWB specialist			(1)			Possibly	Perhaps less often – 2c yearly (2)
• Termly individual consultation opportunity with external IWB specialist			(2)			Probably (2)	As above (3)
• Regular training sessions in house (x2 per term)	(2)				(1) – needs to be v specific	No – needs to be a training day	No
• Termly meeting with other IWB users at Sunfield to swap information						No – all at different levels, can ask others on ad hoc basis	Yes
• Group discussion with ICT training officer at the beginning of term to review what resources could be developed to support targets			(3)			No	Yes (1)
• Individual discussion with ICT Training Officer as above.	(3)				(2)	Yes (1)	No
• Advice from in-house specialist IWB trained TA or STA						Yes – but would it happen (like TEACCH person)	Should be available to all TAs
• Contributing resources which	Why					Yes	Yes – as

you have developed to a general database	should share work so others don't have to do work				(3)	(3)	long as all teachers contribute
• To become part of a specialist IWB team to help other teaching staff in school	(1) Time an issue					No – time/logistics an issue	Possibly – but additional time would need to be found
7. Any other suggestions?							
• No							
• Compulsory training for all TAs otherwise all IWB work gets left to the teacher – also many are scared to try							
• Classes should be grouped in 2s or 3s with a trained STA/TA who can trouble shoot and train informally within group. People could plan and share within group.							
• Training is key – training, training, training. And staffing!!							
• The person teaching needs to be properly prepared and know programme well							
• Training evening needs to be a substitution agreed with manager not an additional night – otherwise it's like a punishment.							
• Training in people's classroom once a term							
• Need written information in how to import symbols into different programmes							
9. What do you think about the SMARTboard Resource Bank?							
• Haven't found it							
• Really useful							
• Using all programmes created specifically for class, but haven't had time to explore others							
• Photos need to be bigger. Use only key symbols							
						Training session would be useful	

Additional comments

Class A	<ul style="list-style-type: none"> Interacting with peers: Student A6 had already done a couple of puzzles. It was then Student A3's turn at the plasma screen. STA turned around to get something, and when she turned back, Student A6 was showing Student A3 how to do the Jigworks puzzle. Timing and STAFFING a massive issue for implementing training; General training not as useful because don't have the time to explore – training with a curriculum focus is more useful Training needs to go much more slowly – when asking someone to click on a button, need to point to it until everyone has found it before clicking it and going on to what's next, otherwise people are still looking for the button when the trainer has moved on to something else. Training manuals might be useful, but it's having time to practise.
Class B	• n/a

Class C	<ul style="list-style-type: none"> • Would like to keep WWS on one of the class computers – much simpler and easier to use than Communicate in Print or Symwriter. • All can start preferred programmes and select favourites – IWB offers students more choice. Students C1 and C2 find it more rewarding than the computer. They use it as part of their reward system (tokens add up to a turn on the IWB). • The IWB is a good motivator – all students love using it. All students have learned to spell their names through drag and dropping (JigWorks) with different levels of structuring, although they have spent years trying to do so; the IWB teaches because of their motivation to use it. I'm certain that every student has progressed in dragging and writing skills. • It's important not to set sights too high – aim towards little goals. • • Some students can't cope with being in the group. (Two students cannot share the same space.) • Students C2 and C5 cannot usually tolerate being close to each other. Don't look at each other, but do tolerate being close to each other when working at the IWB. Student C5 will pull up a chair to sit beside student C2 if he is working at the IWB. • Students can all access favourite programmes through 'Favourites': 'Old woman who swallowed a fly' / Frog catching a fly / Logos on YouTube / Balamorey / Thomas the Tank Engine. • Training: Trainer moves too quickly and there is no opportunity to repeat and practice. • Happy to provide interactive whiteboard resources and internet links to activities: need to know how to transfer activities to Resource Bank • Would like more JigWorks training
Class D	<ul style="list-style-type: none"> • n/a.
Class E	<ul style="list-style-type: none"> • We have students who won't engage in reading books, but who will engage when the book is presented as a DVD or Clicker 5 on the IWB. • We have students who won't take any notice of the computer, who will engage with the IWB. • Turn-taking with YouTube is semi-independent [NQ] • Since using the IWB calendar activity, students have really come on with ability to recognise numbers beyond 10 and months. • Turn-taking and sharing: All enjoy choosing Digiblu videos – sharing the IWB as a common resource and taking turns in seeing the video they want. • With staff support, students E4 and E6 can come to a decision between them about whose choice of Digiblu video to view first. • In house training needs to be slower – otherwise when you get back to the classroom you find you're missing a step, and then can't continue. • Idea of small group training specifically for class teams would be very useful. • The project has been really useful. I've gained a lot more competence in using the IWB. I'm more positive about the IWB. The resources used have been really useful.
Class F	<ul style="list-style-type: none"> • • Need intensive one-day training on software available – the evenings after school doesn't work – too tired • Students not engaged on the IWB don't watch the IWB during curriculum activities • Easier for STA to show the other TA who wasn't confident what to do – just show one step at a time 'on the job' / Sometimes when I want to know how to do something I ask the teacher next door. • The boys have done really well in spite of the shadow and space issues. The IWB is very useful for curriculum subjects and leisure.
Class G	<p>Best way of engaging students who are not directly involved – video and music. 'But I do prefer to take a hands on approach and encourage them to get up and interact with the board.</p> <p>Resources on the Intranet very rarely meet needs</p>

Drama

Use of board as a back drop – mnemonic

Training

Need to have prepared training

APPENDIX 9
Continuing Professional Development Handouts
Relating to the Use of Interactive Whiteboards with Students Diagnosed with ASD and Severe and
Complex Learning Disabilities

HANDOUT 1: Environmental checklist

HANDOUT 2: Optimising IWB learning resources

HANDOUT 3: IWB Teaching Approaches for Students with ASD and Severe and Complex Learning Disabilities

HANDOUT 4: Summary of Range of Interactive Whiteboard (IWB) Training for Teaching Staff

HANDOUT 1
Environmental Checklist
Relating to the Use of Interactive Whiteboards with Students Diagnosed with ASD and Severe and Complex Learning Disabilities

KEY: **Particularly relevant to students with ASD;** **Health and safety issue;**

Lighting

To consider:

- Fluorescent lights are an acknowledged source of physical discomfort for students with ASD; alternatives should be explored
- If the projector light beam source is in the sightline of the person using the IWB, it can cause damage to eyesight.
- Students learn better if blinds do not completely block out daylight.
- Many students who have ASD may not instinctively make appropriate compensatory body movements to eliminate glare or avoid casting a shadow (Structured teaching advisor's report)

Potential issue	Impact on students			Possible solutions	Action / Comment
	insignificant	students	students		
Fluorescent lights in classroom				<ul style="list-style-type: none"> • Switch off lights • Change lighting 	
Light glare obscuring image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Re-site IWB 	
Reflection obscuring image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Re-site IWB 	
Faded image on IWB				<ul style="list-style-type: none"> • Translucent blinds needed • Check/clean projector lens 	
Blurred image on IWB				<ul style="list-style-type: none"> • Adjust projector 	
Light beam from projector in IWB user sight line				<ul style="list-style-type: none"> • Re-position projector (e.g. ceiling mount) • Replace projector (e.g. short throw projector, rear-projection screen) 	
Shadowing interferes with the student's interaction with the IWB				<ul style="list-style-type: none"> • Teach the student strategies to manage the shadow • Change the projector to an effective short throw model to reduce shadowing • Select a rear projection interactive board 	

Physical arrangement of classroom (furniture)

To consider:

- For IWBs to transform classroom learning, teaching staff need IWBs in their classrooms (Levy, 2002 and Greiffenhagen, 2000, in Smith et al., 2005)
- Pupils should be sitting comfortably so they do not have to angle their heads (Sharp, 2006)
- All students should have free access to the IWB (Higgins, 2006)

Potential issue	Impact on students			Possible solutions	Action / comment
	insignificant	students	students		
IWB in a room other than main classroom				<ul style="list-style-type: none"> • Introduce IWB into main classroom to allow integrated use 	
IWB does not allow whole-class access				<ul style="list-style-type: none"> • Reposition IWB and plug sockets 	
Students need to turn their heads to view the IWB				<ul style="list-style-type: none"> • Re-orientate or extend seating to allow all students to face forward to view the IWB • Optimise seating so maximum number of students can face forward 	
Student access to IWB impeded (e.g. by furniture below/adjacent to IWB)				<ul style="list-style-type: none"> • Re-site obstructing furniture 	

IWB access for students

To consider:

- The IWB height needs to be adjusted for students using it (Painter et al., 2005; Higgins et al., 2007)
- Some students with an ASD may have difficulties with gross and fine motor control, and need to be able to reach the entire surface area of the IWB with ease while standing on the floor. Being above floor level may be an uncomfortable experience for students with vestibular sensory differences (Structured teaching advisor's report)

Potential issue	Impact on students			Possible solution	Action / comment
	insignificant	students	students		
Student cannot reach icons/buttons to access programmes				<ul style="list-style-type: none"> • Adjust positioning of icons on IWB or within programme • Re-position IWB to suit • Introduce step to allow access to IWB (not recommended) 	
IWB screen confusing for students				<ul style="list-style-type: none"> • Reduce number of icons / choices / information displayed 	
Sensitivity of IWB interface				<ul style="list-style-type: none"> • Support student hand-over hand • Match type of interactive board to student need (see Appendix 6) 	
Level of fine motor skills make access to IWB programmes/ activities difficult				<ul style="list-style-type: none"> • Support student hand-over hand • Match type of interactive board to student need (see Appendix 6) 	
Pen/finger out of alignment with mark made				<ul style="list-style-type: none"> • Recalibrate IWB 	
IWB repeatedly goes out of alignment				<ul style="list-style-type: none"> • If from interference/tremor from adjacent activity, consider repositioning the IWB if possible • If no mechanical cause, seek specialist ICT advice 	

Distractors

To consider:

'Sensory distraction (e.g. flicker of the image, misalignment of board and projector), audible distraction (e.g. white noise from the sound system, projector hum), odours (e.g. from electrical equipment) and tactile issues (e.g. from the board texture, accessories and the cleanliness of these) will all need additional consideration when working with students with ASD... it is also necessary to consider the potential distraction that may be caused by displays surrounding the IWB and items in the immediate area of the student.' (*Structured teaching advisor's report*)

Potential issue	Impact on students			Possible solutions	Action / comment
	insignificant	students	students		
Student distracted by laptop display				<ul style="list-style-type: none"> Set the laptop settings so it remains on when the lid is closed, and keep it closed Screen the laptop from student view using a screen or roller top trolley 	
Student interferes with IWB accessories (e.g. laptop, speakers, USB ports, etc.)				<ul style="list-style-type: none"> Put laptop in a lockable cabinet Ensure speakers are stabilised and out of reach Block access to USB ports 	
Student responds negatively to projector sound / smell				<ul style="list-style-type: none"> Reduce amount of time student is exposed to IWB projector Match type of interactive board to student need (see Appendix 6) 	
Cleanliness of IWB				<ul style="list-style-type: none"> Keep appropriate wipes available 	
Student targets IWB				<ul style="list-style-type: none"> As above 	
Wall displays in close proximity to IWB area				<ul style="list-style-type: none"> Re-position displays away from the IWB area to allow students to focus on learning without distraction 	
Clutter in close proximity to the IWB area				<ul style="list-style-type: none"> Put unnecessary materials away to allow students to focus on learning without distraction 	
Proximity of other staff / students				<ul style="list-style-type: none"> Address student needs on an individual basis bearing in mind other constraints (the need for students to face the IWB) Ensure they are seated in a place where they feel safe 	
IWB malfunction				<ul style="list-style-type: none"> Address issue with IWB specialists Train teaching staff to cope with malfunction 	
Computer system interference (e.g. pop-ups)				<ul style="list-style-type: none"> Address issue with IWB specialists 	

Health and safety issues

To consider:

Potential issue	Impact on students			Health and safety alert / solution	Action / comment
	insignificant	students	students		
Students need to climb on step to reach IWB				<ul style="list-style-type: none"> Re-position IWB to make step unnecessary. The step increases: <ul style="list-style-type: none"> Possibility of student or staff falling or tripping especially those who have vestibular or sensory difficulties Likelihood of projector beam shining in student's eyes 	
Eye strain				<ul style="list-style-type: none"> Reduce length of time student is exposed to IWB Use muted colour backgrounds in created activities instead of white 	
Projector light beam in sight line of IWB user				<ul style="list-style-type: none"> Reposition projector so the light beam is out of user's sight line (e.g. ceiling mounted or short throw) 	
Child protection				<ul style="list-style-type: none"> Monitor/restrict internet access 	

HANDOUT 2

Optimising Interactive Whiteboard (IWB) Learning Resources for Students with ASD and Severe and Complex Learning Disabilities

To maximise effectiveness, it is important that IWB resources are identified and created within a school-wide, strategic, planned approach to IWB resource development which will support students across a range of ability to access the school curriculum.

For students with ASD and severe and complex learning disabilities, the entry level of many commercial products is at too high an educational level or age inappropriate. It is therefore important to generate the capacity to create resources which are appropriate to pupils' personalised learning pathways. This can be done by purchasing a core package of programmes in which staff are trained.

Sunfield's core package of programmes, as advised by the IWB Specialist Researcher, includes:

- SMART Notebook (SMART)
- Symwriter (Widgit Software)
- Communicate in Print (Widgit Software)
- Clicker 5 (Crick Software)
- Jigworks (Crick Software)
- Powerpoint (Microsoft)
- Paint (Microsoft)
- Photostory3.

It reflects students' learning need for highly visual resources and symbol supported text.

Advice on resource creation emerging from the Review of Literature and action research suggests:

- Inclusion of symbolled text where appropriate to support student learning
 - Where text is used in activities, this should be used in conjunction with symbols for key words
 - Non-key words should not be symbolled as this confuses students
 - Abstract words should be simple only and used minimally.
 - Symbols need to be large enough for students to comprehend them.
- Where possible, structured teaching principles should be followed:
 - Working from left to right and top to bottom
 - Visual clarity, e.g.:
 - Using colour (taking into account autistic sensory responses to colour) to indicate different areas of a task. For example, in a sorting activity, the areas into which the virtual objects were to be sorted were of a different colour to the general task background colour
 - Cutting out any non-essential information or illustration which may confuse students, and where possible ensuring a plain background
 - Making different elements of the task distinctive
 - Structural differentiation to support achievement (e.g. the use of templates or 'jigs' to support a student in spelling out their name using drag and drop) which is gradually faded as the student becomes more proficient

- Individualisation of tasks to support specific targets, learning styles, structuring needs, inclusion of motivational elements/rewards (e.g. individual interests), etc.
- Use of realistic representation (e.g. photographs rather than illustration; simulations).
 - Photographs need to be large enough for students to identify them
 - Objects should be photographed against a plain background to reduce visual confusion.
- To reduce any potential eye strain, muted colours should be used instead of white for task/activity backgrounds (cf. Sharp, 2006).
- When appropriate, errorless learning should be built into activities.
- Resources should be designed to be appropriate to students' ages and individual needs and interests as well as their abilities.
- Within-activity rewards:
 - To increase motivation, activities need to incorporate animated and auditory rewards at different levels. For example, in some programmes (e.g. Bugz) the placing of a picture in a correct category is accompanied by a brief auditory 'reward'; the successful completion of a whole task or sequence of tasks culminates in an extended auditory reward and/or a piece of animation.
 - These rewards can be tailored to students' individual interests to increase their motivation to engage with learning through the IWB when necessary.
 - Rewards associated with incorrect responses were not found to be successful – some students can lose confidence, or chose the negative option to get the 'reward'. The most effective option is when an incorrect response elicits no reaction at all.

HANDOUT 3

Interactive Whiteboard (IWB) Teaching Approaches for Students with ASD and Severe and Complex Learning Disabilities

Exploitation of IWB learning opportunities

Teaching approaches	Range	Student development
Scaffolding IWB learning prerequisites	<ul style="list-style-type: none"> Attention to IWB – active (IWB manipulation) and passive (observing IWB) 	Initially via 1:1 support, prompting in conjunction with personalised incentives/rewards
Exploit the range of class groupings to meet different teaching and learning outcomes <i>Criticism from literature:</i> Teachers did not exploit the different learning opportunities offered by varying class groupings	<ul style="list-style-type: none"> One-to-one staff/student 	Introduction to the IWB, new activities, building skills, building motivation (e.g. through personal interest-based tasks)
	<ul style="list-style-type: none"> Small group teaching/learning 	Introduction to group learning situation Social learning skills practice (e.g. turn-taking, cooperation, etc.) Build confidence in group situation, Practise attentive behaviours Experience co-construction of learning
	<ul style="list-style-type: none"> Large or whole-group learning/teaching 	Similar to above within a more socially demanding environment
	<ul style="list-style-type: none"> Independent (with supervision) 	Encourages autonomy, exploration Increases competence, self-esteem
Exploit the range of learning modes and progressions <i>Criticism from literature:</i> Teachers tended to be unimaginative and lacked variation in delivery of teaching using the IWB.	<ul style="list-style-type: none"> Building of technological and conceptual competence and proficiency 	Student learning experiences and competences extended More advanced learning skills structured and scaffolded Associations constructed between IWB learning and real-life activities and situations.
	<ul style="list-style-type: none"> Revising Recalling Building on prior knowledge 	
	<ul style="list-style-type: none"> Making choices Exploration Prediction 	
	<ul style="list-style-type: none"> Sequencing Planning 	
	<ul style="list-style-type: none"> Social interaction with peers 	
	<ul style="list-style-type: none"> Working at the IWB Demonstrating Presenting 	
Exploit the versatility of the IWB	<ul style="list-style-type: none"> IWB main teaching focus IWB as vehicle for contextualisation or mnemonic backdrop to lesson 	

Adaptation of teaching approaches to accommodate the needs of students with ASD and severe and complex learning needs

Areas of student support need	Related difficulties	IWB strategies adopted
Learning behaviours	<ul style="list-style-type: none"> Information processing 	Use structured teaching principles: <ul style="list-style-type: none"> Present learning in one mode at a time (e.g. do not speak and visually demonstrate to students simultaneously) Minimise verbal communication – use simple key words When extending learning, only change one element in a task at a time Maximise learning through ensuring consistency of seating, support and teaching approach. Manage change incrementally so that student anxiety is minimised, and their learning is maximised.
	<ul style="list-style-type: none"> Attention 	<ul style="list-style-type: none"> Introduce IWB activities to students individually or in paired work when they can sit closer to the IWB and take time to explore the activity. Gradually extend the distance between the student and the IWB, encouraging the student to attend to the IWB.

Learning behaviours <i>(ctd)</i>	<ul style="list-style-type: none"> Attention <i>(ctd)</i> 	<ul style="list-style-type: none"> Use IWB activities which incorporate student interests or photographs of themselves or familiar people. Stimulate attention by incorporating sounds (e.g. recorded voice of student or staff, related noises, etc.) and animation either integral to learning or as a reward. However, ensure through staff guidance that students focus on learning targets rather than solely the reward. In group IWB situations, make turn-taking short to allow students observing to maintain attention Intersperse short, focused IWB activities with related practical activities using physical resources Within the lesson, include a high proportion of familiar activities so that students anticipate turntaking and gain proficiency and confidence. 1:1 staff support – prompting attention; relating physical activities to IWB; prompting response to teacher Maximise accessibility of IWB materials for all students.
	<ul style="list-style-type: none"> Organisation 	<p>Use structured teaching approaches (advocated by TEACCH) to:</p> <ul style="list-style-type: none"> Make the student aware of the order of activities (i.e. visual work system) Cue the student to and from the IWB (i.e. using a visual cue) Indicate visually where the student should stand for relevant IWB activities (e.g. a taped area on the floor) Create a clear beginning, middle and end to IWB activities Use visual IWB task instructions if necessary
	<ul style="list-style-type: none"> Achievement 	<ul style="list-style-type: none"> Set small-step targets within a learning progression Regulate time required on task and differentiate the task so that learning targets are achievable Take account of students’ sensory difficulties relating to the IWB – e.g. colours used, projector noise/smell – and regulate their exposure accordingly
	<ul style="list-style-type: none"> Waiting 	<ul style="list-style-type: none"> Where possible pre-open and then minimise IWB activities needed for the lesson. Create interim activities to fill the time waiting for programmes to open (e.g. counting forward/back).
	<ul style="list-style-type: none"> Perseveration / obsession with IWB activity 	<p>Use structured teaching approaches (advocated by TEACCH) to:</p> <ul style="list-style-type: none"> Create IWB activities with a clear beginning, middle and end. Use an on-screen timer if necessary and draw students’ attention to it regularly. Use visual schedule cues to prompt students to move between activities. Select a preferred activity to follow the IWB activity.
	<ul style="list-style-type: none"> Responding to questions 	<ul style="list-style-type: none"> Students with ASD find it difficult to respond to questions. Use a ‘cloze’ approach (e.g. Rather than asking, ‘What is the weather today?’, model the response ‘Today the weather is...’ and allow the student to complete the sentence). Provide students with a visual choice of possible, understood answers (e.g. photos, symbols) from which to make a selection.
	<ul style="list-style-type: none"> Anxiety levels 	<p>Manage introduction of new learning to minimise student anxiety:</p> <ul style="list-style-type: none"> Prior to teaching the activity, preview the activity from the student’s perspective and plan the support needed according to that student’s needs and interests Demonstrate the activity to the student – staff can model the part of the exploring learner for the student Support the student to carry out the activity with a gradual fading of prompts from physical prompt (i.e. hand-over-hand), through gestural to verbal depending on their need Prompt student engagement: e.g. if the activity includes computer-generated speech (e.g. task instructions), prompt the student to listen and repeat key words supported by sign or gesture. (NB the student will not be able to process speech at the same time as performing actions or taking in other information; prompt their full attention, before returning to activity.) Allow students to explore/experiment with the activity for themselves (with supervision) to gain knowledge, experience and enjoyment from it Initially, make the activity part of a daily routine so that the student can gain in proficiency (1).

Social issues	<ul style="list-style-type: none"> Proximity 	<ul style="list-style-type: none"> If students find it difficult to cope within a group situation, initially allow them to bring favoured object/activity to the group table, and gradually increase the students' participation/ fade the favoured object/activity Work with students in pairs initially, and gradually increase the group size Minimise impact of proximity issues on students' learning by arranging seating to take account of sensitivities.
	<ul style="list-style-type: none"> Interaction with peers 	<ul style="list-style-type: none"> Use IWB as a motivational focus to promote such activities as turn-taking, negotiating, etc.

HANDOUT 4

Summary of Range of Interactive Whiteboard (IWB) Training for Teaching Staff Working with Students with ASD and Severe and Complex Learning Disabilities

Recommendations for IWB training

- Training should take place for all teaching staff – teachers, ITT students, Higher Level Teaching Assistants and Teaching Assistants.
- Personalised training pathways should be developed and implemented to take into account staff abilities and learning styles so that everyone achieves at their own level.
- Training should be recorded and certificated to recognise staff achievement.
- Training should include both out-of-class learning and in-class practice in creating and delivering resources.

IWB training support structure

Personnel	Roles
ICT training co-ordinator	<ul style="list-style-type: none"> • Maintain high levels of IWB expertise through course/ conference /exhibition/etc. attendance • Liaise with ICT Curriculum leader about IWB training strategy and staff training pathways • Develop, agree and implement personalised IWB training pathways with staff • Co-ordinate outside trainer visits • Co-ordinate IWB specialist consultant visits • Co-ordinate/train/organise training for/liaise with/delegate to internal IWB Specialist Staff Support Group • Deliver IWB internal training in a variety of ways • Map IWB skills and training needs of class teams
Outside trainers	<ul style="list-style-type: none"> • Extend/reinforce existing IWB knowledge among staff
External IWB specialist consultant	<ul style="list-style-type: none"> • Make agreed periodic school visits • Monitor and evaluate IWB use in school • Mentor ICT Training Coordinator and ICT Curriculum leader
IWB specialist support group	<ul style="list-style-type: none"> • Maintain and extend IWB skills through training and classroom practice • Monitor training needs for their group of classes • Provide IWB support within their group of classes • Deliver training on an on-demand, one-to-one basis
Class teams	<ul style="list-style-type: none"> • Nominate an IWB Lead person • Extend skills of class team members • Explore team training needs
Individual staff	Maintain and extend IWB skills through: <ul style="list-style-type: none"> • Classroom practice • Agreed ongoing training

Summary of IWB training modes

6. Day courses run by external IWB specialists
7. Individual consultancy sessions from an external IWB specialist
8. Regular twilight sessions delivered by an internal ICT trainer
9. Overview of two or three activities possible using a specific programme by an internal ICT trainer
10. Opportunity to swap IWB information and expertise among the staff group
11. Class-based training for class teams
12. Support of a group of classes by IWB specialist staff
13. Individual peer training

IWB training record

Training focus (programme/activity)	Mode of training delivery	Learning outcome	Dates		
			Taught	Supported (in class)	Independent (in class)