Secondary
National Strategy
for school improvement

Using interactive whiteboards to enrich the teaching of mathematics

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department for
education and skills
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Contents

1. Introduction

What this booklet is for

This booklet provides practical guidance to secondary mathematics teachers in developing the use of interactive whiteboards (IWB) in their classrooms. It does not provide technical guidance on the use of any particular type of equipment. Instead, the emphasis is on using an IWB to make mathematics teaching richer, and mathematics learning more effective.

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Research background

This booklet draws on the findings of a research project carried out by mathematics teachers in seven secondary schools in England. All of the mathematics departments were introducing IWBs for the first time, and the teachers kept learning logs describing their experiences. An independent evaluation of the project was carried out by researchers from Keele University; see page 12 for further details. Extracts from the learning logs made by teachers involved in the project are included (as 'sticky notes') throughout this booklet.

Why use an interactive whiteboard?

There is growing evidence that IWBs, when used well, can enhance both teaching and learning in mathematics. Participants in the project found that the greatest gains were made when the IWB was the centrepiece of an interactive classroom experience that allowed learners to discuss, participate in and make sense of mathematics. When used in this way, the IWB can be much more than a presentational tool; it can help teachers to improve the pace of teaching and to make mathematical learning significantly more relevant and interesting.

> Slowly my confidence began to grow and I prepared more and more lessons on the IWB. I used several things as starters and plenaries, for example, pelmanism and number pyramids, which seemed to focus the children – and they liked coming up to the board.

How to use this booklet

Whatever stage you are at in developing your use of IWBs, it will be useful to read through the whole of this booklet before returning to the sections that are most relevant to you. Once you have gained an overview, you can concentrate on the areas that are of special interest.

- If you are planning to use an IWB for the first time, go to Section 2, 'Getting started', on page 4. You can then return to the subsequent sections as your experience and skills develop.

- If you have some experience of using an IWB, but want to concentrate on using the technology more effectively to enhance your teaching, then go straight to Section 3, 'Developing interactive mathematics', on page 6.

Wherever you start, you will find that this booklet contains a mixture of research findings, hints and tips, as well as suggested development activities. Although you can use the booklet on your own, working collaboratively with other colleagues is likely to be more rewarding, effective and enjoyable. The section, 'Planning and professional development guidance for subject leaders and CPD coordinators' on page 11, contains further advice for subject leaders and CPD coordinators.

> I am sure that there are many more ways in which I can use the IWB and I am constantly trying to think of different approaches. When the board enhances learning it is fantastic. When I get things wrong, the class and I work together to put things right.
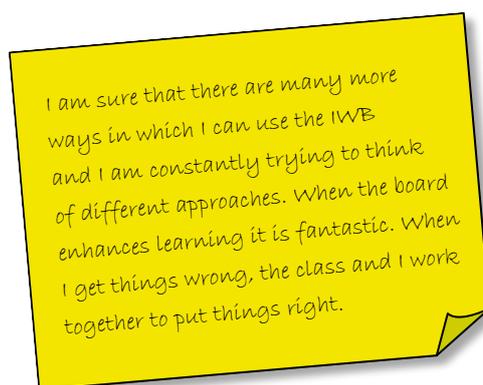
Before you start

For subject leaders planning to purchase and install IWBs for the first time, a little research is invaluable. Although colleagues in your school will have their own suggestions about the set-up you need, it is in everybody's best interests for you to be as clear as possible about your own requirements. The BECTA publication, *Getting the most from your interactive whiteboard* (see 'Further reading' on page 12), contains some very useful advice about the practicalities of installing and using the equipment. If at all possible, visit mathematics departments in other schools that are already using IWBs and learn from their experiences. If you have a choice of suppliers, try out different IWB models to decide which one best fits your needs. Make sure that you are happy with the practicalities of the location of equipment before installation – it may be impossible to move an awkwardly positioned IWB after the event!

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2. Getting started

Starting to use an IWB can be a daunting experience – and an exciting one. The experience of this teacher in the research project is probably typical of that of many new IWB users.

> Felt very de-skilled, pupils were very patient! Really needed to spend time just playing around and trying things out.

> Seemed to just use the board as a board, did try to use some of the games but not sure if this was actually just for the sake of it.

> Didn't realise I needed to orientate my board and had problems working out why the pen was writing somewhere different to where I put it!

> There were a lot of informal finding-out sessions and lots of texting for help. There was quite an excited feeling around but also felt frustrated at not being as fluent as I wanted to be.

For new users, an important first step is to reach the stage where the IWB can be reliably used as a replacement for a traditional whiteboard (or blackboard!)

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> I am becoming a whiz at using the IWB for timed starters, with pupils using individual whiteboards and pens. I find this so useful – pupils get instant feedback. Amazing stuff.

The DfES publication, *Embedding ICT@secondary: Use of interactive whiteboards in mathematics* (see 'Further reading' on page 12), provides useful guidance for teachers taking the first steps with the IWB. Suppliers of IWBs generally offer on-site training with new installations, and they usually provide web-based 'getting started' guides to accompany their hardware and software. Although such resources are very valuable, you will also benefit from advice from more experienced colleagues, and time to practise!

With the right support, and the opportunity to experiment, most teachers will find that they can develop this kind of 'replacement' expertise fairly quickly – perhaps after just a few sessions of using the IWB.

A note on teaching styles

The Secondary Strategy has put a lot of emphasis on developing teaching approaches that encourage pupils to be engaged active learners. In mathematics, we have encouraged a range of approaches designed to promote pupil participation, including the use of mini-whiteboards, card-sort activities, games and paired and group discussion tasks. Although the 'replacement' stage is an important first step in using the IWB, the danger is that, in terms of teaching style, it could actually be a step backwards, with pupils becoming passive recipients of on-screen presentations. However visually enticing such presentations might be, the novelty of the new technology is likely to wear off quite quickly. Later on, you will want to use the IWB to enhance your use of active learning approaches. For now, remember that you will need to continue to develop and use these approaches, even as you gain proficiency with the IWB.

Things to watch out for

- Make sure that active teaching and learning approaches – rather than impressive presentations – are your priority for development.

- Keep doing all the good pupil activities you've developed – questioning, discussion, group work. Introducing an IWB should not mean that your lessons become illustrated lectures!

Suggested activities

- Identify an 'IWB expert', who can mentor you, and an 'IWB buddy', who can learn alongside you and share experiences.

- Make sure that you have some good-quality practice time on the IWB – not just a laptop. Set aside the time for an initial session without the pupils.

- Use the IWB supplier's training and materials.

- Ensure that you have the technical support you need.

- Set yourself a target of mastering the basic features: creating, saving and opening pages; using drawing tools and grid or graph papers.

Next steps

It is important to get to the 'replacement' stage, but it needs to be seen as a first step. At this stage, the IWB may simply be used as an expensive projection screen. In the next section of this booklet we shall start to consider the specific ways in which the IWB can support mathematical learning.

3. Developing interactive mathematics

Teaching with an IWB

Getting 'up and running' with the IWB is a vital first step, as described in the previous section. However, it's important to start to develop some more advanced teaching techniques if the full potential of the IWB is to be exploited. The most successful teachers in the research project quickly moved on from the 'replacement' stage and started to use key features of the IWB to support interactive teaching.

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At this stage, one important aspect to work on is the use of an IWB to help you manage and direct the classroom. The IWB provides a focal point for the classroom, where you can quickly provide instructions and reminders. Although this can be done with a conventional whiteboard, the IWB can, with practice, make the process much quicker and smoother. For example, rather than writing up a set of lesson objectives by hand (with your back to the class), you can use the IWB to display them instantly and start to explain them.

As you develop your use of the IWB, you will find other ways in which the technology can assist you in managing the learning environment. Here are a few suggestions.

- Display and review learning objectives and key vocabulary.

- Save screens and move between them.

- Remind pupils of materials covered in previous lessons.

- Set up group work and discussion tasks.

- Use the 'hide and reveal' features of the IWB software to work through the steps of a solution.

- Provide a 'count down' for timed activities.

An important part of developing interactive teaching with an IWB is to investigate the opportunities offered by these features, and to add to the repertoire of techniques that you use.

Media and presentations

We have already cautioned against producing IWB-based lessons featuring elaborate presentations with little genuine interaction. However, this does not mean that you should ignore presentational aspects. Indeed, you will want to learn how to incorporate various media sources (such as photographs, video and audio files, and material from the Internet or published sources) into presentations. All of these approaches can help to make lessons livelier and more absorbing. The challenge is to develop these positive aspects without lessons becoming repetitious slideshows.

Developing interaction

We have already discussed some of the features that facilitate classroom organisation and presentation. These are quite generic approaches, which could be used in teaching many subjects. The full power of the IWB in teaching mathematics becomes apparent as teachers start to use more of the genuinely interactive features to build and interact with mathematical models on the screen. There are various software packages that you can use to develop this approach.

Using mathematical software

By now, you will want to start using subject-specific software in your lessons. You are probably already familiar with some programs that are well suited to the IWB.
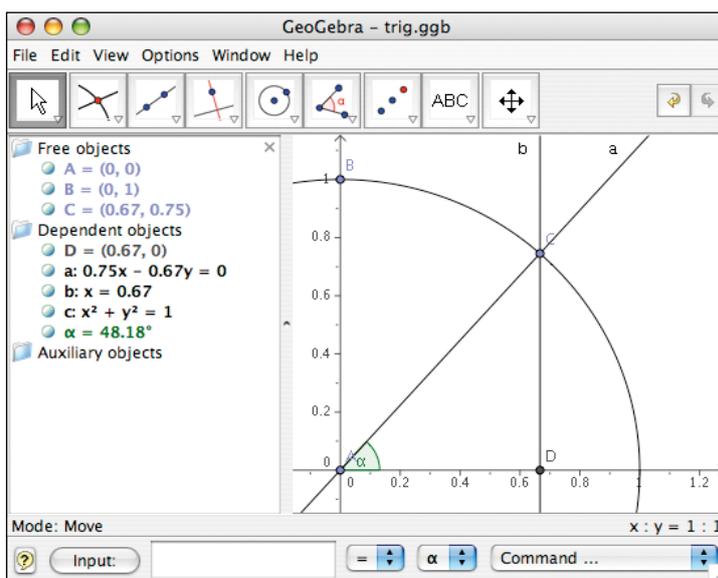

Interactive geometry programs work much more effectively with an IWB than they do with a simple projector and screen. Investigating geometric relationships by dragging points directly on the screen makes for a much more powerful demonstration than would the same exercise carried out via a 'remote' laptop. Pupils can focus on the teacher and the action on the IWB at the same time, and the teacher can use a much greater range of non-verbal communication (including gestures and hand waving) to indicate what is going on.

Although some aspects of IWB use can be developed with time and practice, others will require significant amounts of training. New users of interactive geometry software will benefit from a simple but structured development programme. For example, teachers could use staff development time to work in pairs on printed or online training materials provided for the software. There is more about staff development and training on page 11 of this booklet.

Spreadsheets can work well on an IWB. There is a huge range of situations in which a spreadsheet can be used to set up and experiment with simple mathematical models. This kind of model can support effective classroom approaches, such as promoting discussion: *'What will happen to the graph if I make this number 4 instead of 2? Convince your partner, and then we'll try it out.'*

It can be a little harder to make on-screen changes to a spreadsheet than it is with a geometry program but, with a little preparation, it can be done. The model shown here uses Excel's 'spinner' controls (accessible from the 'Forms' toolbar) to change the coefficients in a formula that is used to plot a graph.
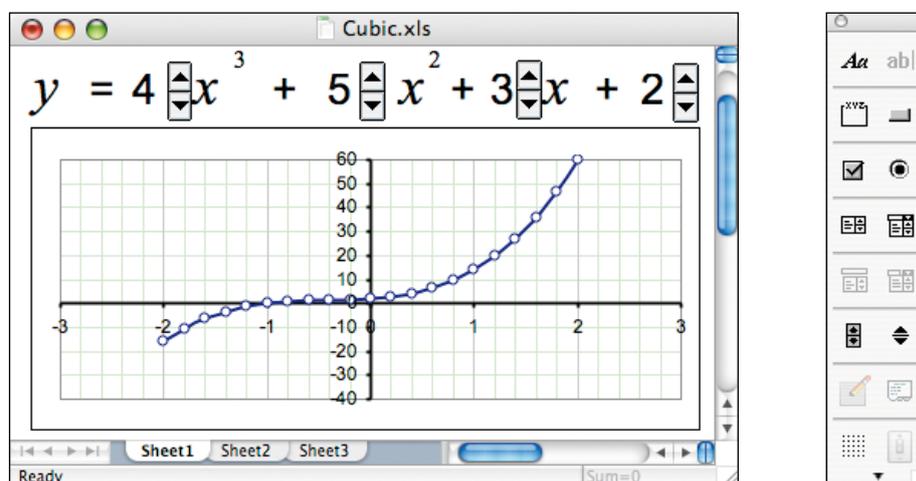
Some ideas to try

Lesson organisation

Spend some time building up a repertoire of skills that will enable you to use the IWB to manage your classroom more efficiently.

- Have starter activities ready to display at the start of the lesson.

- Use saved files to remind pupils of key points from previous lessons.

- Use your IWB software's 'hide and reveal' facility to work through a problem or solution with several stages, for example, simplifying algebraic expressions or solving equations.

- Prepare instructions for group work or discussion tasks that can be quickly displayed to minimise 'set-up' time.

- Use an on-screen timer to set deadlines for pupil activities.

Using mathematical software

Aim to increase the range of mathematical software that you use gradually. You will certainly find plenty of interactive programs on the Internet but the variety can be overwhelming. It may be best to concentrate on using a few versatile packages well – maybe a spreadsheet application, an interactive geometry program and a graph plotter.

> It made a huge difference to the pupils' understanding – I could change the size of the circles, change the point where the tangent met the circle. Pupils could physically see the theorems 'being true'. I am starting to realise just how powerful IWBs are.

Next steps

Allow yourself time to gain confidence in using the IWB to support the organisation and content of your lessons in the ways described here. Focus on interactive teaching and don't let your lessons become illustrated lectures. Some more advanced approaches, developed by teachers in the research project, are described in the next section.

4. Going further

Our research project found that the most effective use of interactive whiteboards occurred when teachers integrated the IWB into a rich, cohesive learning environment where pupils could explore mathematical ideas and develop their mathematical thinking. The best practice involved linking activities on the pupils' desks (perhaps of a practical or concrete nature) with the ideas and visualisations presented on the IWB.

A range of 'virtual manipulatives' are available for IWBs: these are on-screen representations of items of practical equipment often used in the mathematics classroom. They include measuring and construction tools (such as rulers and protractors), calculators, pinboards, dice and cards for sorting or matching activities.

For example, consider how an IWB can be used as an important part of teaching about relationships in algebra. Card-sorting activities can be a good alternative to 'traditional' approaches and will typically involve asking pupils to sort a mixed set of cards, like those shown below, into sets.

$$4x = 6y - 12$$

$$2x + 1 = 3y - 5$$

$$4y - 10x = 28$$

$$5x$$

$$2y + 4 = 5x + 10$$

$$3x + 2y = 9$$
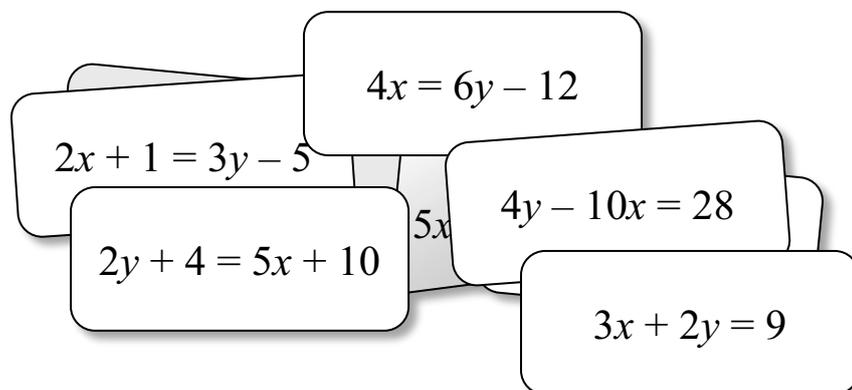
- You could use images of cards on the IWB to introduce this activity, perhaps just showing two 'cards' on screen to stimulate a discussion about similarities and differences.

- Pupils could then work in pairs to sort a set of (real) cards at their desks.

- You could follow this by bringing the whole class together to provide solutions on-screen – perhaps asking pupils to come up and drag cards into appropriate 'piles'.

- After this you could ask some 'higher-level' questions, for example, *'How can we decide whether any two cards are equivalent?'*

- You could then use the IWB to explore alternative representations of some of the information – for example, using a graph plotter.

Used well, an IWB can play a vital role in modelling practical activities, supporting questioning and discussion, and encouraging pupils to explore different approaches and alternative visualisations of mathematical ideas.

The IWB at the centre of interactive mathematics teaching

Throughout this booklet, we have stressed the importance of pupils being actively involved in their mathematical learning, and not just passive recipients of mathematical knowledge. We have seen how the IWB provides an opportunity to establish a classroom environment in which teaching and learning activities are coordinated to support pupils' developing mathematical ideas and imagery. For the most effective learning, the linkages shown in the diagram below need to be established.
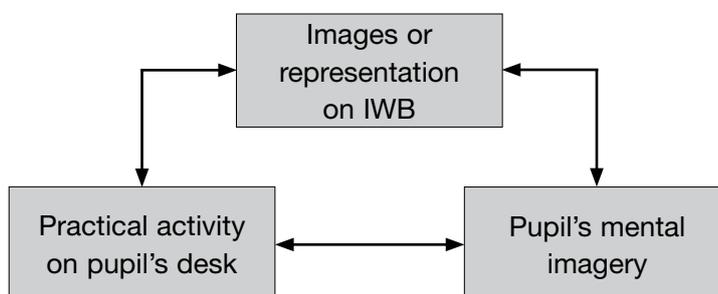
It is useful to think how each of these linkages can be established and strengthened. Here are some examples.

- The link between IWB representations and pupils' mental imagery can be supported by good teacher explanations and modelling, as well as skilful questioning and whole-class discussion.

- Practical activities need to be carefully designed to provide a version of the mathematical ideas presented on the IWB with which the pupil can interact. In some cases (for example, with dice or activity cards) this may be a direct 'translation' – pupil materials are 'concrete' versions of the 'virtual' materials on the IWB. For other activities, they may be somewhat different, for example, an IWB demonstration with a dynamic geometry package could be followed by a pupil activity based on paper-folding.

- A good practical activity should support the development of pupils' mental imagery by providing opportunities to experiment with and discuss mathematical ideas. Tasks suitable for work in pairs or small groups are particularly useful.

Next steps

The development of this approach, where the IWB is at the centre of an active and coherent teaching and learning environment, needs to be led and coordinated across the whole mathematics team; it should not be seen as a job to be done by individual teachers in isolation. Collaborative planning by groups of colleagues can provide valuable opportunities to share resources, compare approaches and develop skills. The next section provides some guidance on planning and staff development issues.

5. Planning and professional development guidance for subject leaders and CPD coordinators

Most mathematics subject leaders will find that IWB implementation is a key part of their development plan, whether their team comprises experienced users of IWBs or complete novices. The best practice will not be developed overnight. Our research confirms that teachers need some time to develop their skills and assimilate new approaches as they work through the stages of development set out in this booklet. The following list indicates some areas that should be considered for inclusion in a plan.

Hardware purchase and installation

- If you are installing new equipment, make sure that your plan includes a timeline for this process and identifies the key actions to be taken, and the people responsible. See the BECTA guide, *Getting the most from your interactive whiteboard* (see 'Further reading' on page 12), for practical guidance about purchasing and setting up IWB hardware.

- Contact other mathematics subject leaders and visit their schools, if possible.

Collaborative planning issues

- When will it happen? You should consider making collaborative planning a key focus for department meetings.

- Decide who will lead and coordinate developments.

- What will you aim to achieve, and by when?

- Will you focus on particular classes/year groups?

- How will you maintain the necessary focus on teaching and learning – and avoid the temptation of producing 'illustrated lectures'?

- What arrangements will you need to make for efficient network storage and access of materials? For example, do you need an area on the school network where materials are stored? How would this be organised and used?

Staff training and development

- Have all teachers had access to initial training on using the hardware and packaged operating software?

- How will teachers develop their skills in using other software packages (perhaps starting with a minimum set of a spreadsheet, dynamic geometry program and graph plotter)?

- Are there any training needs for teaching assistants?

- Where is there good practice (in the department, the school or outside) that can be shared?

- Do you need to think about coaching or mentoring arrangements?

Although this is not an exhaustive list, it should provide a useful starting point for the discussions that will need to take place in drawing up an effective deployment plan.

6. Further reading

There is a wealth of web-based material available on the use of IWBs in mathematics; there is also a wide – perhaps bewilderingly wide – range of activities available. One difficulty that many teachers find is that they simply do not have the time to sift through the huge amounts of materials that can be identified by a simple web-search. The approach recommended in this booklet is to avoid making things too complicated and to concentrate on developing a few key aspects of using IWBs in a systematic way, while keeping the focus on the development of teaching and learning.

The documents below are referred to throughout this booklet and provide useful additional guidance.

- The BECTA guidance document, *Getting the most from your interactive whiteboard: a guide for secondary schools* (2004), can be downloaded from:

www.becta.org.uk/corporate/publications/documents/whiteboard_pri_.pdf

- The DfES publication, *Embedding ICT@secondary: Use of interactive whiteboards in mathematics*, is available for download at:

www.teachernet.gov.uk/wholeschool/ictis/resources/secondary

- Finally, the research done by colleagues from Keele University was a valuable contribution to the project that informed this booklet. The full project report and its summary are available at:

www.standards.dfes.gov.uk/keystage3/respub/ma_iaw_eval

The university's continuing research in this area can be accessed at:

www.keele.ac.uk/depts/ed/iaw

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