Developing the Mathematics Curriculum: Using ICT

Brett Coleman

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Choosing a project

Through discussion with my mentor, it was preliminary decided that my ICT project will be on something to do with shapes. I then went away and came back with some more specific ideas.

These were:

- An introduction to geometrical properties of quadrilaterals
- An introduction to geometrical properties of triangles
- Reflection and Rotation
- Angles

Once I had my ideas, I asked the teachers in the department what they would prefer the resource to be. Most thought that reflection and r otation was easier to teach than the others, and that more resources were available to them for that area of mathematics. The general consensus was that either of the other t hree was fine. So I have chosen to base my resource on angles with some properties of quadrilateral and triangles as supplement to the angles work . A factor in this decision was that angles were a topic coming up in the scheme of work. My resource will probably end up not being one resource, but several that when used together, hopefully creates a good lesson or series of lessons.

My mentor also added that my resource should be used on a Promethean interactive whiteboard, as the department were going to have two of them introduced into the department, and the teachers who were going to use them, are not very ICT literate and could find a good resource extremely useful.

My target year group is year seven. However, the resource will also be inclusive. By this I mean it can be used with mixed ability groups and possibly older year groups too. It has to be a fun resource that will capture the imagination of pupils and hopefully invite them into discussion, thoug ht and interaction.

Planning

The mathematical content involved

The yearly teaching programme from the National Numeracy Strategy states that in year 7, under the shape, space and measure topic - Angles , year 7's should use the correct vocabulary for angles. **They should know the sum of angles at a point, on a straight line and in a triangle,** and recognise vertically opposite angles. They should begin to identify and use angle properties of triangles and qu adrilaterals. The part in bold is a key objectiv e.
(NNS, section 3, page 7)

The use of the particular technology in mathematics teaching.

The technology that I shall be using for this resource is the Promethean 60"
interactive whiteboard, as this is what my mentor would like me to do. The boards are
equipped with ACTIVstudio software which I will make use of.

The computers attached to the boards are all using Windows based operating
systems; they all have internet access, and all have the full Microsoft Office package.

At the moment, there is only one interactive white board in the department. However
I have yet to see it be used interactively. It is only used to write on.

In the mathematics department there is also a set of laptops. However there are only
20 of these available. Scientific and graphical calculators are available also, but quite
often, there is not enough for one each.

Theories of Mathematical learning and Teaching and Learning Styles.

"You can think mathematically.

- Mathematical thinking can be <u>improved</u> by practice with reflections.

- Mathematical thinking is <u>provoked</u> by contradiction, tension and surprise.

*- Mathematical thinking is <u>supported</u> by an atmosphere of questioning, challenging
and reflection.*

- Mathematical thinking helps in <u>understanding</u> yourself and the world."

(Ref: Thinking Mathematically)

This quote is quite useful because I believe that mathematical learning and
mathematical thinking go hand in hand. I believe that being able to think
mathematically intensifies your learning experience because, as the quote says, it
helps you to understand yourself and the world. The quote also mentions reflection,
and that it can improve mathematical thinking. I guess that is als o true, as reflection
gives you the chance to lo ok back at things, maybe question them or understand
them a bit better. Either way, it all goes towards comprehension and understanding
of mathematics.

One aspect of learning I looked at was Vygotsky's 'Zone of Proximal Development'
(ZPD). He believed that the ZPD was the area between what is known and what can
be known. He suggested that the way to get to what can be known could be done
through guidance from teachers or peers. This zone is where Vygotsky believed
learning occurred.
(Ref: http://chd.gse.gmu.edu/immersion/knowledgebase/theorists/constructivism/vygotsky.htm)

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

I also looked into how the brain 'learns' too. There are many different explanations, but what I find common to most was that the brain needs to be stimulated in different neural zones in order for effective learning to take place. This suggests that for a pupil to learn to their maximum capability, they must receive more than one type of stimulus from the teacher. These neural zones also get tired quickly (usually between 3-5 minutes). After this, the brain will seek out a distraction. However, the neural zones do recover quickly, but need a rest to do so. They respond to short, repetitive stimulation, rather than sustained continuous stimulation. One important thing I read was that facts are not learnt unless to brain is able to link them to other concepts or contexts that are already there.

With all that in mind, it was quite obvious to me that my resource must be tailored to ensure all the neural zones in the brain are used. This will facilitate the learning and memorizing of the work. To do this, information has to be woven using different methods in different parts of the brain. This could be achieved by varying the type on content i.e. images, sound and text. By creating interaction that engages attention i.e. games and quizzes. Providing immediate feedback, because learning is built on prior knowledge, so if you do not give any feedback, the child could be building on incorrect knowledge. Preparing tasks that involve paired work, group work, discussion, presentation, problem solving and investigation also increase the stimulation of different zones of the brain. This way of teaching is known as 'The Bob and Weave'. (Ref. http://teacher.scholastic.com/professional/bruceperry/brainlearns.html)

For a previous assignment I interviewed two pupils about their learning of mathematics. Their responses are useful for this assignment too, as one stated they preferred group work, whilst the other preferred to work on their own. One preferred a more interactive approach with computers, laptops, calculators or any type of equipment, whilst another liked working through a text book and finishing all the answers. This really helps prove that the Bob and Weave is a useful tool as it goes someway to help stimulate all areas for all people, regardless of sex, gender or age.

Some pupils do not understand why they have to study mathematics, but I explained that mathematics contributes to many other subjects. So what I did was ask some teachers in other subjects to provide me with of the work they do that involves mathematics. The reason for this was so that pupils could see mathematics in other contexts that they understand. The most useful subject was resistant materials, as they use angles all the time in making objects.

The National Curriculum states that is a statutory requirement to use ICT in all subjects (Ref: NC page 84.). It also says that it must support the individuals work too. So with this in mind, I need to make sure that whatever resource I use, it actually supports and enhances teaching. It must not be a resource that simply uses ICT just because. I think the benefits of ICT must be apparent to use it.

So in summary, the needs of the learners are:

- Something that stretches their current knowledge into what they could know.
- A resource that is varying in content
- A resource that creates interaction with teacher and peers
- A resource which lends itself to providing immediate feedback

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

- A resource that can combine individual, paired and group work.
- A resource which gives the learners a chance to discuss, present work, problem solve and investigate .

The needs of the department are:

- An interactive resource or set of resources, for use with a Promethean interactive whiteboard.
- A resource based on shapes, and in particular, angles (around a point, on a straight line or in shapes for more able pupils)

So my objectives for the resource pack are:

- To fit the criteria set out by the National Numeracy Strategy into my resource pack. (as stated in the mathematical content involved)
- Create a resource that involves pupils in a variety of different learning styles.
- It must allow for differentiation for mixed ability groups.
- It must be fun and interactive.

The Products

I have 4 small resources to use.

- Angle estimation
- Sorting Shapes
- Shape Shifters
- Guess the Shape

I will explain each one separately, whi lst informing of their intended use, in addition to what learning styles they exhibit and how they allow for differentiation.

Angles Estimation. (See appendix) **incorporating teacher's guide**

This resource is one from the internet.
(Ref: http://www.standards.dfes.gov.uk/numeracy/publications/ict_resources/12886/)

 The reason for me choosing this one is that it closely follows a task in the frameworking text books that the pupils would have used instead of this resource.

I would use the 'make the angle game' in this resource. It would be a group activity whereby, in groups of 2-4, they have to send a member of their team to the board. The pupil is then not allo wed to look at the angle, but has to create an angle as close as possible to the des ired (and stated) degrees, by listening to his team mates telling him to make it bigger or smaller using the plus and minus buttons. If you are 14 ^{0} out, you get 14 points taken off your starting value of 100. If you are 5^0 out, you get 5 points deducted etc. after each team has had 5 rounds; the team with the most points left is the winner.

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

The resource is suitably differentiated because they are working in groups and it involves a lot of discussion and compromise with each other. They will have to listen to their team mates and trust them. So this is also a great game to encourage citizenship. Hopefully they will also have to argue their case with team mates as to why an angle should be made smaller or larger, using mathematical reasoning. This is where there where it is also suitably differentiated as it does not matter how mathematically articulate a pupil is, as they will all have their own ways of communicating an idea across.

The learning styles are paired or group work, discussion, and independent thought also.

Sorting Shapes. (See appendix) **incorporating teacher's guide**

This resource does not use ICT. It is purely meant to support the learning from ICT. The reason I have chosen to include this in my selection of resources is due to the research beforehand. If variety implies different forms of stimulation, then surely the sole use of ICT should not be favoured, but a sleek combination of ICT and 'normal' interactive resources. I also found that pupils' neural zones will tire within 3 to 5 minutes, so it is my belief that you should not use ICT all the time.

The resource itself consists of an A4 sheet of paper with eighteen shapes on it. They are different shapes, different sizes with three different colours. The idea of the resource is to work in groups of 2-4 pupils. They have to cut out the shapes and arrange them into three groups. There is not a definite answer to this. They have to discuss in their groups reasons for putting them in their chosen groups. They also will have to convince the teacher as to why they have chosen this grouping.
This activity is suitably differentiated for because there are obvious groupings there for less able pupils, i.e. simply putting the shapes in groups of colour or the number of sides they have. But for the more able, I would challenge them to think more about angles in the shapes. Possible questions to prompt thinking are:

- What about right angles?
- What about the symmetry of shapes?
- Parallel Lines?

Once they have decided on the groupings, they will present their ideas to the class, which will allow for further discussion.

The learning styles in this resource are extensive. They have to think independently as well as in a group. They have to discuss within their groups as well as with the teacher and other groups as they present their findings. The resource is also investigational as you could ask some to find out many possible grouping there are.

My inspiration for this resource was taken from the DfES website
(Ref: http://www.standards.dfes.gov.uk/numeracy/publications/ict_resources/12882/sorting_2D_shapes.swf)

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

But I thought that this would be done much better in groups in a more hands on approach, with the production of something material that they could hold, touch and show.

Shape Shifters (See appendix) **incorporating teacher's guide**

This is a PowerPoint resource whereby the pupils are required to watch a video style presentation with sound. The resource consists of over 700 slides that have been altered to move on the next slide immediately after the previous slide has been shown. This creates the illusion that the shapes are moving. It starts with a square in the middle of the screen that breaks up into different shapes which move around the screen and make new shapes. Then it comes back together to form the square again. It is accompanied by the song 'Lola's Theme' as it was sung by the group 'Shape Shifters'. I think that pupils will really like this as it was one of the most popular songs of last year. The presentation only lasts for one minute, but will repeat until you stop it. The task would be to write down as many different shapes as you can see. The regular shapes that are in the presentation are square, rectangle, equilateral triangle, isosceles triangle, right-angled triangle, hexagon, trapezium and parallelogram. There are also some irregular shapes during the last part of the presentation. These are irregular hexagons, pentagons, octagons and other quadrilaterals. This provides suitable differentiation for the more able students of the group. I think this would make a great starter to a lesson as it would immediately grab the attention of all. Hopefully it would get the excited too. Some teachers would frown upon this, but if pupils get excited in my lessons, I can only see this as a positive aspect. This resource requires you to work on your own and to record down the shapes you recognise. It will probably need to be played though at least twice in order for the pupils to have enough time to write down the names of the shapes. The resource contains audio and visual stimulation which is important for keeping pupil's attention and stimulating those different areas of the brain.

Guess the Shape incorporating teacher's guide

This resource is for use with the interactive whiteboard. It consists of a flipchart with different shapes on each flipchart. The shapes are regular and some are rotated so they do not look as usual as they often do. Each flipchart is covered with the hide screen tool. I will then slowly lift up a bit of the hide screen to reveal a part of the shape. The pupils (in groups) will then see if they can work out what shape it is based on sides and angles. If they guess wrong at this point, they are frozen out until the next shape. If nobody guesses right, I reveal a bit more of the shape, as so on until a group guesses it. If they have a guess, they must say why they think it is this shape using mathematical words.

It provides suitable differentiation again as it involves group discussion as well as their own thoughts. It also involves some problem solving as they have to be able to visualise all the different shapes it could be and why it could be that.

The learning styles here are paired/group work, discussion, visual stimulation.

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

I could not include this resource in the appendix as the software is not available. But all it is are 5 flipcharts, each with a different shape on it. You can prepare this in less than 2 minutes too.

Can my materials be understood and used quickly by another teacher?

I believe that all the resources can be used quickly by another teacher. I think I have stated reasonably how they are intended to be used and how to use them. I have also stated how to suitably differentiate tasks for the less and more able of the groups. The only resource that could be difficult is the 'Guess the Shape' resource. This would only prove difficult for a teacher who had never come across an interactive whiteboard before. If I was setting this as a task for a supply teacher, I would perhaps leave some large cut-out shapes, so they could do it manually behind a screen if they could not use the board.

Evaluation of Materials

I will evaluate each resource separately.

Angle estimation

This was a very successful group activity. My plenary for this lesson was to talk to the pupils about what they thought of the activity, which has given me plenty to talk about.

Firstly, the main point raised by the pupils was that it was much better than having to estimate out of the text book (Key maths 7 [1]). They liked the fact that it was a 'competition' and that the winners received "Angle expert" certificates (see appendix). The idea of the competition did create a friendly competitive environment, something I know they were not used to.

Concerning the curriculum, one thing that the resource includes is the chance to measure angles on the screen with an on-screen protractor, which can be used to help teach how to measure angles.

One thing I noticed was that if you have too many groups you may well get some groups getting bored as they have to wait a while for their turn to come around again. This has led me to implement a limit on how much time a group has to make the shape. I think that between 10 and 20 seconds is a suitable amount of time to complete a round.

The LSA in the lesson I tried it in said she thought it was fun and she enjoyed being in the lesson. The class teacher also thought that it was a good idea, but was concerned about the noise level. However, I have always had disagreements with

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

him over what he constitutes noise and I constitute discussion and collaboration. I do think that you need to have good classroom management skills before letting a class do this who do not usually participate in group or class work.

This resource could be used as a starter, main activity or plenary I found. It is easily extendible (in terms of time) for a main, but can be short enough for starters or plenaries. One thing I thought of using it for was for when you keep pupils back after the lesson. They could take it in turns to try to match the angle, and if they are within 5^0 of it, they can go. If not, they keep taking it in turns until they do.

Sorting Shapes

I really liked this activity myself and so did most of the pupils. Again, it is important to have good classroom management before attempting group work with a class who has not participated in group work before. They liked being able to work in a group. Some groups quickly sorted them into colours, but I asked them to then see if they could do it another way. Most groups then went on to decide to put them into groups dependent on the number of sides. However, some groups were stuck because there are shapes with 1, 3, 4, 5, 6 sides. A few of the more able pupils recognised on their own to create a group that contained all the shapes that weren't either 3 or 4 sides , which was really nice to see as a teacher.

Perhaps on a lighter note, and something to perhaps think about in the future, the boys did not like that I had only pink and orange sugar paper. They thought it was too girly and wanted blue or green.
I think that this was an excellent task as it incorporates what the ICT tasks do. It also got the pupils to actually talk about the mathematics. Perhaps this resource is not suitable for this assignment, but the ICT resource I got my ideas from, did not seem to be as strong as this one.

The appendix contains one of the posters a group did.

Shape Shifters

Firstly, do not use this after lunch as the pupils are already hyperactive enough. All the pupils liked this activity, but not all actually did what was asked. Some were happy to just sing along with the words. Most also said that the shapes moved on too fast, so next time I use this I will perhaps let the presentation run through 3 times, after all that's still only 3 minutes long. It may also be useful to offer a prize to anyone who names all the shapes, or who gets the most. I would definitely use this again as it at least got them excited in the lesson and in what they were doing. I found it important to follow this with something interesting. I used this starter twice, once followed by text book questions, and once by the sorting shapes activity. Needless to say, they were high after Shape Shifters, but the text book did not go down too well with them. But do text books ever go down well?

The resource could either be used as either a starter or plenary. The LSA said she loved it and that it really caught the imagination of the statemented pupil she was

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

with. Again, the class teacher was a bit more conservative about the idea of the song in it, but I think it would have been boring with no sound.

Guess the shape

I did not really like this one. I think it could be best used with cut out shapes behind a screen. It was not really interactive enough for my liking. Many times, the shape became obvious after a very short while. I would have liked to be able to rotate the shape whilst still hiding most of it, so I could show a different part of the shape each time, however the software does not allow for this. If I was to do it again, it would definitely be with cut out shapes that I could rotate. I think this would need the pupils to think harder and to try to visualise the shape more.
This was the least enjoyed activity of them all, but was still enjoyed by most. I was just thinking all the time that it could be better.
This activity also lends itself to be a starter or plenary. One thing I was pleased with was the interaction in groups. Whereas in previous lessons where we had done group work, this time they were more aware that they had to keep quiet about what they though or else other groups would be able to hear. This was nice for me as it was quieter than the other lessons!
Although the activity was not as I hoped, I was proud of the fact that my pupils were beginning to accept the fact that group work did not mean mes s about time anymore.

Reflection on the process of developing materials.

For me, I do not find making, creating, or altering exiting resources difficult. I believe I have a natural ability to come up with activities, games etc which inspire, or capt ure the attention of pupils. I think still being young myself , I can relate to pupils and understand what they like and what they do not.
Something I do is to try to make sure that resources are as rich as possible, or are used in a rich way. However, there have been times where I have overcomplicated the matter by trying to either do too much or expect too much.
I already had a good understanding that pupils learn in different ways, and if you ask pupils, they all seem to know what kind of learner they are (i.e. kinetic, logical). But after looking into how people learn best, I have consciously kept in mind that pupils will not have a long attention span, and the fact that their neural zones will tire quickly. This has altered my approach to preparing re sources in the way that I realise they should not be made to last too long. Using ICT has also allowed me to introduce sound into my lessons which I had not previously done. The was one form of stimulation that I had neglected before, but after reading abo ut the Bob and Weave learning , I realise that sound, images and text work extremely well together and build in several areas of the brain which result in better retention of the knowledge.

An aspect of resources that I am still very aware of is making s ure that they can be suitably differentiated for lower and higher ability pupils. I believe discussion and group work goes along way to overcome differences in ability.

Brett Coleman 3BSc(Hons) Mathematics with Education and QTS
Developing the Mathematics Curriculum: Using ICT

I have found ICT is very strong in differentiating for pupils who are visually or audi bly impaired. Text size can be increased easily on the board and I read that the text, Century Gothic is the easiest to read for impaired or dyslexic pupils.
(Ref: http://64.233.161.104/search?q=cache:mWPq5BqN4kcJ:www.henley-cov.ac.uk/public/advice/addsupp/Dyslexia.doc+century+gothic+dyslexic&hl=en)
So obviously using text on the board in this font is bett er than handwriting.

I know that ICT has to be used in mathematics, but one thing I have seriously learnt is that you should not use ICT just because you think you should. I can clearly see the benefits of some uses of ICT, but if you can see a better way of doing something, I think you should follow your instincts as a teacher and not just use ICT when it does not add anything to the learning process, or even takes something away.

When I was at school, we always worked in grouped tables or circles, neve r in rows. I was told that pupils behave better in rows. Perhaps so, but I am not sure that the learning is better in rows. Developing these resources, it was my natural reaction to develop resources that were to be used in groups. How can you expect pupil s to fully engage and learn when you will not let them discuss and interact with the mathematics or each other? I have never understood why teachers still do not want pupils to talk about mathematics. The Bob and Weave also said that you need to be able to link facts to other concepts and ideas to enable you to learn. Surely working on activities in groups is a sure way of opening a pupil up to different ideas and concepts that other pupils have.
Overall, I think the more group activities the better, and t hat ICT is a powerful tool, but only when used in the right way.