Raising achievement in Mathematics by enhancing the learning experience

Sarah Callender
Longbenton Community College
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Raising students achievement in A level Mathematics

The project aimed to:

- research pupils' experiences of A level teaching in Maths as well as other subject areas
- develop a wide range of teaching resources for use with A level classes
- improve the experience of pupils studying A level Maths and in turn increase the uptake of the subject in sixth form

Context for and dimensions of the study

The project began in January 2007 and covered an eighteen-month period, ending in June 2008. The research was funded by the National Centre for Excellence in the Teaching of Mathematics (NCETM). The research centred on two A level classes (20 students) throughout the duration of their A level study. A level Maths is a modular course; throughout the eighteen months new resources were developed collaboratively for each module as the class began to study them. During the academic year 2007/8 the resources were also used with the two A level classes in Year 12 (the original cohort were in Year 13).

We aim to have interactive teaching resources available for use with each topic of every module in the future. These resources have also been made available to other 6th form centres through our Lead Subject Professional (LSP).

The study grew from a concern that, too often in A level Mathematics, teaching was found to be largely didactic, which adversely affected pupils' motivation and had a negative effect on their achievement. Mathematics suffered when compared to other A level subjects such as Science which was becoming increasingly interactive and practical in nature.

Throughout Key Stage 3 and 4 pupils enjoyed a wide variety of teaching and learning experiences in Mathematics. Although a wide range of materials are available for Maths up to GCSE there are very few resources available for A level Maths.

Summary of main findings

- Our retention of pupils between Year 12 and Year 13 has increased (60% completed the 2-year course in 2008 compared to only 25% in 2006)
- Further Maths has run in both Year 12 and Year 13 for the first time
- There has been increased collaboration between teachers
- More pupils have elected to pursue mathematical study at University
- Pupils' motivation and enjoyment increased throughout the study
- More purposeful relationships developed between students and teachers

Background

Longbenton Community College is a specialist Technology College in North Tyneside. There are 991 pupils on roll; 113 of whom are in the sixth form. The college has a wide catchment area containing pockets of social and economic depravation. The number of pupils qualifying for free school meals is above average.

The Mathematics department is a team of 9 specialist teachers (6 full-time and 3 part-time). In both Key Stage 3 and 4 external exam results suggest the department is performing well with 58.8% achieving A*-C at GCSE and 81.5% achieving a level 5 or above in KS3 SATs. Past observations have found teaching to include a wide range of teaching styles such as class discussion, research tasks and maps from memory up to GCSE. However at A level there is an increased trend toward a lecture style of delivery.

Teaching processes and strategies

Student voice

The initial part of the research involved canvassing the opinions of the students who had opted to take A level Maths. We employed a researcher from outside the school who carried out a written survey (put together by the teachers) amongst all students and a videoed interview with a sample of pupils from each class.

The key finding from our 'student voice' survey was that students appreciated lessons in which they were enabled to work independently or in groups undertaking tasks which moved away from simply answering questions from a text.

Creating something new

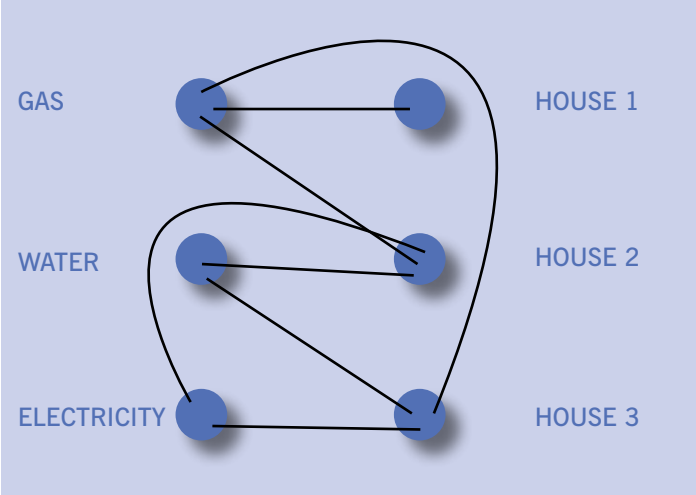
As a department we decided we needed to look at the variety of teaching materials already available to us and then spend some time developing our own resources. This would hopefully enable us to move away from the lecture style which was currently too prevalent. We increased INSET time spent on A level teaching

and worked collaboratively to develop new activities. The Lead Subject Professional (LSP) for Maths in North Tyneside also delivered INSET and showed us some high quality A level teaching methods. The input of our LSP was invaluable; she observed our lessons and gave us feedback and taught demonstration lessons which we videoed and discussed.

In our INSET time (roughly one and a half hours per half-term) we developed a range of game-based activities; these included pairs games and sequencing activities. We aimed to use one of these resources at least once per fortnight and discussed their effectiveness in departmental meetings. Although these activities were not always central to a lesson they were a particularly effective method of introducing a topic. For example, in discrete Mathematics we consider 'the 3 utilities problem'.

There are three houses which each have to be connected to the three utilities; gas, water and electricity Can the three houses be connected to each of the three utilities without any of the lines or pipes crossing each other?

This problem is usually tackled in the method shown below, simply with pen and paper.



Instead of introducing the topics in this manner we used peg boards and string to demonstrate that the task was impossible.

And now, for something completely different…

Having implemented new resources to consolidate pupils' understanding of topics we each continued to develop these materials and disseminate them throughout the department. As a team we decided that having improved the 'diet' of lessons we needed to consider revision techniques used by the students. We decided to set up a revision event for the Year 12 students in the weeks leading up to the second modular exam in June (Core 2). Having discussed various possibilities we decided to arrange an overnight 'revision retreat' to undertake a variety of activities aimed at assisting the pupils with their revision.

On Friday 11th May 2007 we took 16 Year 12 students to a youth hostel near Alston for 24 hours of uninterrupted Maths revision. Over the weekend we completed a variety of activities ranging from floor jigsaws to treasure hunts. Aside from the benefits the students found from the revision time, the informal setting afforded us the opportunity to get to know the pupils on a more personal level.

Findings and outcomes

We have now completed the research tasks and have seen clear effects in the department. The students who have been the main focus of the study have now completed their studies. We have found that our retention of pupils from AS to A level has improved; a key reason for this seems to us to be the increased interactivity of Maths lessons. In 2006, only 25% of those electing to study A level Maths completed the two-year course. In 2008, that figure was 60%, which doesn't include the two students who went back to retake modules in Year 12. The uptake of A level Mathematics in Year 12 has also improved; 12 students began the course in 2005, 20 in 2006 and 16 in 2007. As a school we now have Further Maths running as an option in both Year 12 and Year 13 for the first time; this has become feasible due to a greater number of students from our two partnership schools electing to study Maths at Longbenton.

Pupils appear to be enjoying Maths lessons more; they particularly appreciate the inclusion of interactive materials. We have also established better relationships with the sixth form students who, through the revision retreat, have got to know all of the sixth form teachers and have been prepared to seek help from teachers other than their own. The development of the 'revision retreat' has perhaps, been the most influential part of the project. Last year's Core 2 revision session was so successful that this year we offered it to both Year 12 and Year 13. The retreat was extended to cover both Core 2 and Core 4 and due to the level of interest we had to relocate the weekend to a larger venue.

The project is also having an impact beyond the confines of Longbenton. Many of our students are choosing to continue their study of Mathematics at University; several students are applying to study Mathematics and many others are opting to pursue a degree with some level of mathematical content. The students have also developed as learners and can appreciate the advantages of different learning styles.

What the students think

"I used to prefer working on my own, but now I enjoy talking in pairs and group work more"

"Pair and group work give us more confidence"

"I can express myself much better now"

"Initially it was more confident ones dominating – now there is more trust and openness so everyone takes part"

When asked about the relationships with the Maths teachers;

> "Spot on! - really helpful, especially with Further Maths"
>
> "Very friendly and approachable"

Implications for us

As for the department, we are sharing our resources and good ideas more than ever before. Not only are we working collaboratively to develop materials for A level topics, but we are extending this development to Key Stage 3 and Key Stage 4. During the first few months of the project we decided to set up a central area in the department to catalogue and store materials we have found to be successful in our own teaching. We also set aside time at each departmental meeting to share new ideas.

The resources we have developed will be shared with other department in North Tyneside through the LSP and the North Tyneside Learning Portal.

April 2009 will see the next of what we hope to become an annual revision retreat which will hopefully be every bit as successful as the previous two years!

Suggestions for further reading

The NCETM website contains more information on the research, which can be seen at:
http://www.ncetm.org.uk

The Association of Teachers of Mathematics;
www.atm.org.uk

Free download of Tarsia which allows jigsaws to be produced easily:
http://www.mathsnet.net/jigsaw/index

Author's contact details

Sarah Callender

Longbenton Community College

Hailsham Avenue

Longbenton

Newcastle upon Tyne

NE12 8ER

e-mail: sc@lblearning.com

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To find out more please email: research.summaries@dcsf.gsi.gov.uk

National Teacher Research Panel
engaging teacher expertise