



Moving to regular use of

ICT

in maths classes

In the first of a series of articles, these three short accounts

introduce a project taking place in thirteen Leeds schools. We hope to give further reports on this project in future issues of *Micromath*.

Overview...

John Monaghan

'Moving from occasional to regular use of ICT in mathematics classes' is a project supported by the Economic and Social Research Council. It aims to explore:

- patterns of teaching and learning
- teachers' preparation and use of resources
- teachers' and students' attitudes and teachers' confidence

as teachers manage the move to regular use of ICT with their classes.

Thirteen secondary maths teachers from the wider Leeds area have made a commitment to move to regular use of ICT in this school year. All have a little experience of using ICT in their classes but none have made extensive use before. This article gives an overview of the project. The

next two articles describe the initial preparations of two team members. Future articles by other team members will explore issues arising as the project unfolds.

What is regular use? Well, trying to unpick that is another aim of the project. Questions related to these aims are:

- how does regular use of ICT affect teachers' lesson planning, classroom interactions and use of written support materials?
- how do teachers cope when regular ICT use threatens their technical and/or mathematical authority?
- what factors create tensions for them and how do they address these problems?

Our starting point is that many good teachers have not had the opportunity to explore sustained use of ICT with their classes; curriculum constraints and problems of accessing computers have limited use – a two week block experience being one norm. The students' experiences in such cases are of something we did rather than learning to use a tool that can be used in further mathematical study. Arguably, greater curricular freedom at GCSE level and greater availability of ICT facilities in schools and colleges of late have contributed to an atmosphere where more extensive use of ICT can be planned.

ICT use in maths classes is an incredibly large area so we focused down on something common and manageable, using general tools in upper secondary maths. By tools we mean things like spreadsheets, graphic packages and calculators, algebra and geometry systems, etc. We saw these as having a wide variety of uses. Individual team members chose the tools they thought would be most appropriate for use with their classes. We chose upper secondary classes, Years 10 - 13, because we thought these tools would have the widest use in classes exposed to substantial amounts of algebra. Each team member specified one of their classes, which would be the main focus for the purpose of recording their preparation and the class' activities.

Although our focus is really on the teacher, learning is obviously crucial. Defining what learning is and monitoring it is not a simple task. We have several ideas about how to address this. A hope, rather than an aim, of the project team is that the students will reach a threshold of ICT use that will produce instances where students who have been using, say, a spreadsheet and are working on a maths problem without a spreadsheet will say "Aha, a spreadsheet will help to explore this" and go off to a computer to explore. *Micromath* readers who already make regular use of ICT in their teaching may be thinking "but using technology is such a natural thing to do, why is he making such a song and dance about this?" Well, I think it all depends on where you are; your personal background in maths and computers, and the accepted ways of working in your school are both important. The Impact report (Watson, 1993) looked at teachers using ICT in some depth and suggests that teachers who make high use of ICT do not typify the practices of their colleagues. Bottino & Furinghetti (1996) looked at secondary mathematics

teachers' roles when faced with ICT curriculum reform; they conclude that "The introduction of informatics in mathematics teaching works only when it is perceived as an answer to questions already present in teachers' minds." Heid (1995) and Zbiek (1995) show how ICT can threaten teachers' perceived command of their subject knowledge and how teachers may bypass modes of effective teaching to ensure they exhibit a command of their subject knowledge to students in ICT lessons.

What we hope to produce is a framework which highlights benefits and problems attending regular teacher use of ICT tools in upper secondary mathematics. Much of what we hope to cover is extremely practical. For example:

- how much extra time do teachers spend planning lessons?
- how does ICT work fit in with textbooks like SMP or ST(P)?
- how does regular use of a spreadsheet, say, compare to regular use of a graphic package/calculator or geometry package?
- will we get half way through the year and think "ah, I need to drop this so I can cover the syllabus for the exam"?

The effect of time is very important and we expect different attitudes and practices as the project unfolds. This is why we will be reporting developments in *Micromath* throughout the year. We will be very interested to hear your reactions to our reports.

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TEACHER/RESEARCHER...

Janet Tindale

In my school, I represent the maths department on the school's ICT committee. Before getting involved in this project I had been on two INSET courses on spreadsheets. I was feeling quite enthusiastic about the possibilities of incorporating ICT into maths teaching, without really having a clue about how to do it in practice. With the prospect of an OFSTED inspection looming, and being very aware that my school had spent a considerable amount of money on my spreadsheet INSET, the climate seemed right for me to take the plunge. My headteacher and head of maths were, and remain, very supportive of me in this venture. I think such support is critical and is a factor anyone considering the move towards regular use of ICT should check on.

Once I found out that the ESRC bid had been successful the reality of being a teacher-researcher started to catch up with me. I had targeted a top set Year 10 class as my project focus, but how on earth was I going to plan and deliver one ICT-based lesson per week with them? It was all very well feeling enthusiastic about the principles behind the project, but putting it into practice was a very daunting prospect indeed. My immediate concern was what software to use besides the spreadsheet, Excel. I had intended to use existing software that we have at school, but none of this was particularly appropriate to the shape and space work that I would be doing with my year 10 class. Being aware of this difficulty, John suggested having a look at the graphical package, *Omnigraph*. I was very impressed by *Omnigraph*, particularly because it is so easy to use. We use the SMP 16-19 A-level course at our school, so I am quite familiar with using graphical calculators. *Omnigraph* is more user friendly than the calculators, as well as being a lot more powerful and versatile. So our school made a commitment to buying *Omnigraph*, both for the research work and in the hope that other maths teachers would use it.

About this time I met my fellow teacher-researchers. This was very helpful as it made me realise that they generally had the same worries

about the project as I did. This is another confidence, or support, factor to keep in mind. It was also interesting to compare experiences of ICT provision at our respective schools. A common problem seemed to be limited access to computer facilities. Technical support was also not generally available to my colleagues. It appeared that I had some advantage in these areas. At my school we do have access to the computer facilities, including a suite of PCs, through a booking system. This is not perfect as there are some periods that are pre-booked, but it works well most of the time. We also have an ICT technician at school who, along with the ICT co-ordinator, provides excellent support. So I had no excuses: support from school, relatively good ICT facilities available to use and a new toy in the form of *Omnigraph*. Yet I still felt unable to do what was required of me for the project.

A turning point for me was the delivery of *Omnigraph* to school. 'Janet, your software has arrived' made me feel quite important, and helped me to focus my mind on lesson preparation. At this time we were approaching the end of the summer term, and I was to produce some initial lesson ideas. So I decided to get to know *Omnigraph* and to refresh my quite distant memory of Excel with the help of year 7, 8 and 9. As one year 8 pupil excitedly put it: 'it's great, we're not doing maths today, we're going to the computer room!' They did enjoy 'playing' with *Omnigraph* and Excel, and didn't necessarily realise that they were doing maths. It gave me an opportunity to learn something about what worked and what was not that successful. So I was able to start formalising some of my ideas into lesson plans. The proposals that I produced were still quite vague though.

In the last three or four weeks of the summer term I was probably spending about two hours per week looking at *Omnigraph* and Excel in my own time. Having access to computer facilities over the summer holidays, I was able to continue with this at much the same rate. I deliberately did not plan my lessons too far ahead, because I

had no real idea about how successful they would be, and therefore how I might have to modify my plans as I went along. What I did do was to plan for the first half of the autumn term, aiming to start ICT work as soon as possible in September. I did produce some worksheets at this stage. One difficulty that I had with this lesson preparation was finding work within the SMP Y3 textbook that could be done using ICT. Some topics in the book seemed very appropriate. The linear equations chapter and the work on transformations were suitable for *Omnigraph*; some proportionality and possibly Pythagoras could be approached using Excel. I was less sure about how to cover percentages. Being numerical, percentage questions can be done with a spreadsheet, but would I end up using Excel here just for the sake of it? I resolved to address that problem once I had more experience of using ICT in my maths teaching.

I am now at the stage of having started the ICT work with year 10. The two lessons that we

have had, at the time of writing this, were on linear equations with *Omnigraph*. The pupils are quite excited by the prospect of having one lesson per week on computers. The novelty of the first ICT lesson saw some of them spending more time creating screen savers than actually doing the work that I had prepared. This left me feeling quite dejected, not only because I don't know how to make a screen saver, but also because I thought the pupils had not learned much maths in that lesson. However, the second lesson was better. The pupils stayed on task and they got further with the work than I anticipated. Some of their efforts are now proudly displayed in my normal teaching room, so that the OFSTED inspector and I can be reminded that maths work is being done on computers in my school!

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THE NEXT STEP...

Gareth Edwards

When I joined my current school in September 1997 the ICT facilities consisted of two Acorns, one serviceable monitor and a broken printer. Much of the year was spent trying to improve this situation to the present state of a room equipped with fifteen PC's and a set of graphical calculators. However this presented a new problem; we now had the facilities to use ICT but were unsure of the next step. The ESRC project seemed to be an excellent opportunity to look at that next step, and try to ensure that we made effective use of the hardware we had brought into the school. In many ways my interest in the project began from a selfish point of view - what exactly could the mathematics department gain from being involved in this research?

The initial preparation involved a careful look at what ICT work we, as a department, could deliver to our students. In hindsight, this was a real eye-opener. I began to see possibilities throughout the school, and realised just how under-used

the resources were. The focus of the research on looking at ICT as a tool in the classroom struck a chord. I began to think about the way students use traditional mathematical tools - rulers, pencils, compasses, protractors, etc. - in lessons. Why could the computers and calculators not be used in the same way? I realised that I was using technology as a crutch in many ways. Computers were a Friday afternoon treat for classes (and for me) and I was not integrating them into the teaching I did in any real form.

Working with Gillian, who is my partner in the project, I began to focus on the two Year 10 intermediate groups that would be our focus groups in the research. We went through our schemes of work looking for topics that had potential for ICT work. Taking the time actually to sit down and think felt like a real treat! It became apparent that there was a great deal of potential across all the attainment targets. I also found myself thinking that the crucial aspect was

that the students would not just be using computers to 'do sums' but would be using them in an interactive way. My head was filled with visions of students manipulating sequences on spreadsheets, plotting and transforming graphs on the computers and calculators and joyfully entering information into databases to be analysed. I reluctantly pushed aside these visions of IT utopia, and put a graphical calculator in my bag with the intention of learning how to switch it on by the end of the weekend.

This was when I felt that the project had truly begun. This was also when I realised that I had agreed to create new lessons from my imagination, a daunting task for a mathematician! I had realised at the beginning of the project that extra work would be required in lesson preparation, particularly at the start of the year when the momentum of the work was being created. In many ways I was quite looking forward to the challenge of creating lesson plans, which would now have this extra dimension to them. However, my mood began to change as I began my quest to fathom the programmable capabilities of my calculator. My partner and I had agreed to begin the project by using the calculators to look at inputs and outputs from simple number functions such as $n^2 - 2n + 3$. As this particular Sunday afternoon wore on I found myself losing touch with the aim of the exercise and, instead, became embroiled in a 'person versus machine' battle, whereby I tried to speak to the calculator in its language, and it steadfastly refused to understand anything I was saying to it. After four hours the phrase from my old computer studies lessons, 'Garbage In, Garbage Out', had never seemed more appropriate. Eventually a breakthrough was made, and on the Monday I sat down with my partner to compare notes. To the relief of us both, we had similar stories to tell! So, was all the work worth it? Yes is the simple answer. The students took to the calculators like naturals, nothing broke down, and what is more important, the calculators were being used to focus the lesson on determining the number functions, rather than just becoming another exercise in number-crunching. Another benefit that was noted was that the calculators had speeded up the delivery of the topic and not slowed it down. This had been a slight concern at the start of the project, with the feeling that on no account could the project take up too much of the student's time. With the first lesson out of the way however, this worry is receding as I feel that

the computers and calculators could be instrumental in speeding up the delivery of the syllabus.

As the project continues, I expect the extra work to diminish, with familiarity breeding confidence, not contempt, but we shall see! Even at this early stage I have found myself re-thinking the way I teach mathematics, and I realised how static mathematics can be on the printed page. If my students want to know what happens when you reflect a shape in the x -axis, or what happens when you combine transformations then why should they spend time drawing the whole thing out when they can choose to use the computers to see immediately for themselves? The added bonus is that, if they are wrong, they do not have several pieces of paper to throw away; they have only two buttons to press and they can start again.

I feel that the idea of ICT as a tool, like a ruler, compasses or protractor, is one that I have only just begun to see the potential of. The problems that may materialise now seem no greater than anything else does that could go wrong in a classroom at any time! I am determined to move away from the vision of the computer as the focus of attention for Friday afternoons and instead to make the mathematics become the centre of the students' attention. Now wouldn't that be an achievement for a Friday!

These hopes are important but it is equally important that I evaluate my success in attaining them. So watch this space and see how we get on at the halfway stage in the next issue.



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