INCLUSIVE MATHEMATICS CLASSROOMS

Mike Ollerton explores the theme of inclusion.

Inclusion is one of the themes within the recent Qualifications and Curriculum Authority (QCA) publication: ***Engaging mathematics for all learners*** and I had the good fortune to participate in this project. This involved working with five schools which, frivolously, all had a capital B connection, either geographically: Burnley, Blackburn, Bolton and Belper, or by name: Baliol school in Sedbergh. Yes, this 'B' connection was only slightly amusing the first time I noted it.

Seeking to define the word 'inclusion' or 'inclusive', when applied to mathematics classrooms, is complex and I would imagine there will be a range of interpretations, representations and manifestations. My definition of inclusion pertains to what a school, a mathematics department, or an individual teacher seeks to do in order to provide the learners with their entitlement to the statutory national curriculum for mathematics. This entitlement is, or should be, made accessible to all students irrespective of notions of so-called 'ability', or socio-economic background.

I felt the title of the QCA project, *Engaging mathematics for all learners*, automatically has a sense of inclusion running through it. My definition above, however, is rather broad; it can be all too easy to talk or write in platitudes. So, in order to illustrate my definition, I intend to describe how two of the schools, Baliol and Belper, developed approaches to teaching and learning which demonstrated inclusive practices.

Baliol is a school which:

'… caters for boys with extreme behaviour, emotional and social difficulties. Many boys also have other learning difficulties and/or disabilities including complicated medical needs. All the boys have experienced major difficulties in mainstream and other educational settings and many have been excluded. The socio-economic background of many of the boys is one of disadvantage.'

(Ofsted, 2008).

It was, therefore, somewhere between amazing and fantastic that Baliol offered inclusion to those already excluded from mainstream schooling.

During the project I visited Baliol on four occasions, and each time there was a composed and relatively informal air about the school yet, at the same time, a conviction amongst staff that the boys were there to learn and to succeed in their learning. Because Baliol is a residential school the boys have opportunities to engage in a wide range of activities beyond the classroom. These involve different sporting, fitness, and outdoor pursuit type activities and day trips to a Fire Station, Kendal Castle and Williamson Park, Lancaster which contains Ashton Memorial – a famous folly, sometimes called the *Taj Mahal* of the North, with a tropical Butterfly House, a Foreign Bird House and Conservation Garden. Furthermore, the boys' social development is, in part, catered for by having access to many games which they play in the evenings. These games range from table tennis, snooker, darts and dominoes to a life-size game of Connect Four.

It was these games which the head of mathematics, the assistant head-teacher, wanted to exploit as stimuli for developing the boys' mathematics in timetabled lessons. He intuitively felt there was potential to use recreational, out-of-classroom activities as learning contexts which pupils could relate to, and use and apply, within their mathematics lessons. The main reason for wishing to use out-of-classroom activities inside the classroom was to find ways of working with 'real' data – data that is real to the students. Using such data was considered to be an effective way of

motivating pupils in their formal learning of mathematics; the boys at Baliol need to see how the mathematics they are learning can relate to life beyond the classroom, so making use of out-of-classroom activities was considered to be important.

We talked about the possibilities of students collecting information from some of the games they play. Examples were:

- when playing snooker, they could look at the ratio of the number of points scored compared to the number of shots taken.
- when playing darts, they could keep a record of the ratio of score against number of darts thrown.
- when playing Connect Four, the winning line could be recorded as a set of co-ordinates, particularly if a pair of axes were marked on the board.

To underpin the use of out-of-classroom activities the head of mathematics devised a theoretical model – see below – which connected together:

- the key processes as defined in the new programmes of study for secondary mathematics,
- personal, learning and thinking skills
- national curriculum level descriptions to locate the boys' achievements.

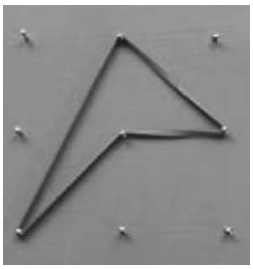
Gathering information based upon the key processes, personal, learning and thinking skills and national curriculum attainment which emerged from the theoretical model was an important step. These records are used formatively so the boys are kept well informed about their achievements and what their next steps might be, they also allow staff to identify teaching priorities.

An integral part of the success of this project was to work with evening support staff to explain how they could encourage students to gather information from the games they played, without this being perceived as an imposition on the boys' social time. During the course of the pilot, staff reported positive outcomes and this led to a short film being made to illustrate approaches the staff developed and the boys engaged in, both inside and outside the mathematics classroom. A key objective was to enable students to see how mathematics is not something which exists only in a mathematics classroom. Already, the use of out-of-classroom activities as a context for mathematics has had a positive impact on the boys' attitudes and achievement. However, the head of mathematics believes that the activities utilised so far are only the 'tip of an iceberg'.

Belper High School is an 11-18 mixed community school with 1500 students on roll – 240 in the 6th form. Belper is a specialist technology college and is strongly committed to teaching in mixed-ability tutor groups. The mathematics department wished to develop a wider range of investigative approaches in lessons and build such approaches into schemes of work. The motivation for change was to develop approaches:

- where students take greater responsibility for the work they do,
- where students develop their mathematical thinking skills through engaging with rich mathematical tasks
- where students play an active role and find things out for themselves
- that support and enable differentiated learning
- that reflect the requirements of the new secondary curriculum programmes of study for mathematics, particularly key concepts and key processes
- that reduce the need to use exercises from textbooks.

The department chose to develop the use of one specific resource rather than a range of ideas and resources.



The resource was the square 9-pin geoboard with problems based upon this resource. The ideas were piloted in the summer term of 2008 with Y9 classes.

This work was evaluated in terms of what worked well, and what changes the department would make for using a 9-pin geoboard with Y7 students in the spring term of 2009.

Quite 'simply' the students were presented with the problem:

'How many quadrilaterals can be made on a 9-pin geoboard?'

This gave rise to a wide variety of other geometric issues to be worked on – which were:

- Properties and names of the quadrilaterals produced
- Congruence
- Transformations
- Classifying quadrilaterals according to properties
- Calculating area
- Calculating, by measuring or symbolising, perimeter
- Calculating and/or measuring angle

Students were encouraged to work in a variety of ways – individually, in pairs, in small groups and to participate in whole class discussions. Utilising this range of learning approaches the teachers made ongoing assessments which determined the kind of questions teachers posed to individuals and to groups. This was all intrinsic to working with mixed-ability groups; what occurred in one lesson inevitably impacted upon plans for the next lesson. While there was a significant depth of outline planning over the course of the project, lesson-by-lesson plans changed according to ongoing developments and student reaction.

Student evaluations were collected from the Y9 pilot in the summer term and these evaluations were used to inform developments for using geoboards with Y7 students in the autumn term. Subsequently these Y7 students were asked to evaluate the project and these, in turn, shaped further developments for working with other Y7 groups in the 2009 spring term. Teachers felt there was a high level of engagement by students, and the quality of discussion enabled students to develop a robust understanding of the concepts under consideration.

Working inclusively with all-ability tutor groups means the issue of differentiated learning is not, supposedly, masked or 'dealt with' through the usual organisation within schools by setting according to notions of 'ability'. This being the case, mathematics teachers at Belper are aware of the need to use ideas and resources which enable different students to achieve different outcomes naturally. Different outcomes manifest themselves through students working on more complex ideas as well as working to different depths of understanding.

The mathematics department at Belper are now in the process of reorganising their schemes of work into units of study that last between two and three weeks. The idea is that each unit will draw together different aspects of the KS3 programme of study in a coherent way to enable students to make links between connected areas of mathematics. The intention is that for each unit there should be at least one 'rich task' to engage students, and enable them to focus on mathematical processes, for example – systematising, seeking pattern, conjecturing, generalizing, as well as learning mathematical content. The department has planned INSET where they will discuss, as a team, exactly what constitutes a rich task, do some mathematics together and de-construct existing ideas to consider how the use of rich tasks might require a different pedagogical approach to their teaching.

Inclusivity for Baliol School means enabling students to access learning through meaningful and engaging opportunities. Before coming to Baliol students have been unsuccessful, and many lack confidence in their capabilities. Seeking to support these students' learning of mathematics requires imaginative and creative approaches. Drawing on experiences beyond the mathematics classroom is likely to prove motivating and engaging for all learners, see for example cases studies in QCA's ***Engaging mathematics for all learners*** which include using the playground, dance, fashion and architecture as contexts for learning mathematics.

Inclusivity is more than just finding tasks for students to engage with; though tasks themselves are important. It is the underpinning pedagogy, and the desire to provide students with opportunities to achieve as highly as possible, irrespective of their current circumstances, and without the constraint of expectations based on prior attainment that drive an inclusive approach to the teaching and learning of mathematics.

Mike Ollerton is a freelance consultant.

The work that went into the research, production and preparation of this document has to be supported somehow.

ATM receives its financing from only two principle sources: membership subscriptions and sales of books, software and other resources.

Membership of the ATM will help you through

Now, this bit is important - you must read this

- Six issues per year of a professional journal, which focus on the learning and teaching of maths. Ideas for the classroom, personal experiences and shared thoughts about developing learners' understanding.
- Professional development courses tailored to your needs. Agree the content with us and we do the rest.
- Easter conference, which brings together teachers interested in learning and teaching mathematics, with excellent speakers and workshops and seminars led by experienced facilitators.
- Regular e-newsletters keeping you up to date with developments in the learning and teaching of mathematics.
- Generous discounts on a wide range of publications and software.
- A network of mathematics educators around the United Kingdom to share good practice or ask advice.
- Active campaigning. The ATM campaigns at all levels towards: encouraging increased understanding and enjoyment of mathematics; encouraging increased understanding of how people learn mathematics; encouraging the sharing and evaluation of teaching and learning strategies and practices; promoting the exploration of new ideas and possibilities and initiating and contributing to discussion of and developments in mathematics education at all levels.
- Representation on national bodies helping to formulate policy in mathematics education.
- Software demonstrations by arrangement.

Personal members get the following additional benefits:

- Access to a members only part of the popular ATM website giving you access to sample materials and up to date information.
- Advice on resources, curriculum development and current research relating to mathematics education.
- Optional membership of a working group being inspired by working with other colleagues on a specific project.
- Special rates at the annual conference
- Information about current legislation relating to your job.
- Tax deductible personal subscription, making it even better value

Additional benefits

The ATM is constantly looking to improve the benefits for members. Please visit www.atm.org.uk regularly for new details.

LINK: www.atm.org.uk/join/index.html