

## **A mathematics intervention project: A level students working with children in years 5 to 8**

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Nationally there is an acute shortage of mathematics teachers. In central Manchester, performance in mathematics is close to national average in primary, but lower at GCSE. There is a shortage of teachers of mathematics and high turnover amongst those teachers that schools do manage to recruit. One large sixth form college with 1000 A level mathematicians wanted to develop an intervention that would help to raise the profile of mathematics in local schools. Students were invited to apply to be part of the intervention and out of 120 applicants, sixty were selected following an interview. The college timetabled a regular slot to facilitate the participation of students in both preparatory tasks and the intervention. As tutors, we were asked to prepare the students. We describe the intervention and the students' responses.

**Keywords: mathematics intervention; sixth form mathematicians; upper primary; lower secondary**

### **Background**

Nationally there is an acute shortage of teachers of mathematics (Weale, 2015). In primary schools, there are few teachers with expertise in mathematics (Williams, 2008). Manchester city has near national average achievement in primary school but lower than national average performance in GCSE (MCC, 2015). Teachers from a large local sixth-form college with 1000 A level mathematicians worked with academics from a local university to design a mathematics intervention aimed at 10 to 12-year-olds in local primary and secondary schools. We describe the intervention and summarise the data collected from the student participants about their experience.

The intervention was in the form of a mathematics road show, offered to local primary and secondary schools and designed to promote enjoyment of and engagement with mathematics. The proposed benefits of the intervention are summarised below:

#### ***For the student participants***

The project should enable the students to gain some understanding of conceptual development in mathematics. It should also develop their skills and confidence in working with others, both at the planning and the delivery phases and enable them to see themselves as 'champions or ambassadors of mathematics'. The experience could contribute to a community outreach award (e.g. as part of the Duke of Edinburgh Award) and be referred to in their university application form and Record of Achievement. For students who aspire to teach this will provide valuable insight into working with learners in school.

### ***For the children***

For the children involved, the roadshows should provide rich, enjoyable and memorable experiences of mathematics that contribute to developing positive attitudes towards the subject, the development of mathematical resilience and collaborative skills and an increased enthusiasm and willingness to engage with the subject, both now and in the future. They may also gain specific insights into mathematical strategies and develop fluency and conceptual understanding.

### ***For the college teachers***

Involvement in the project may result in the development of professional networks and a clearer understanding of the key transition phases in mathematics education. Teachers from the sixth form college, who are involved in supporting their students, may also choose to apply to have this work accredited, through an accreditation of prior experiential learning (APEL) claim, towards a Masters degree.

### **Implementation**

Sixty students were selected following a written application and interview in the college. They were expected to commit to the project for the entire autumn term and their timetables were written so they could spend Friday mornings preparing and then running road shows in local schools. The preparatory sessions included one on safeguarding, three led by university academics (tutors) with college teachers in attendance and one for preparing resources and finalising preparations. The tutors were used to working with beginning teachers in both primary and secondary and conscious of the challenges of early teaching experiences. Consequently, we selected accessible practical tasks that could be adapted to learners aged 8 to 12. We envisaged students working together on some of these tasks and, through reflection and discussion, beginning to appreciate some of the subtleties and complexities. We then wanted them to work in pairs on one task, in which they would develop some expertise, as they worked with small groups of children during the roadshows. In the first tutor led session, we considered some of the issues around working in a classroom with children. Issues such as ‘mathematics anxiety’ (Buxton, 1981), and the range of needs the students may encounter. We analysed video evidence of children and teachers at work in a mathematics lesson. We modelled one of the mathematical tasks to be used in the road show and students explored it for themselves. They were asked to consider the mathematics that underpins the task in preparation for the next session.

During the second session, students shared their thinking about the mathematics task. Tutors modelled a second task, which students worked on. Tutors supported students in ‘unpicking’ this task, in detail, looking at the aims, rationale, underlying mathematical concepts, the use of questions to draw out learners’ ideas, any likely mis- (or partial) conceptions that might occur and practical management (Ball, 1988; Brown & McNamara, 2011). At the end of this session, clear outlines and descriptions of other tasks to be offered in the road show were shared. Pairs of students selected a task to explore and were asked to prepare to introduce this in the final session.

In the third session, students presented their tasks to their peers. This gave them an opportunity to gain experience in running the tasks and receive feedback

from their peers. They were encouraged to reflect on this experience, and the implications of what they had learnt, prior to going into schools.

### **The road show**

Each road show lasted for 90 minutes and involved approximately sixty children with their teachers. The children worked in groups of four on a carousel of six practical mathematical tasks. Two students 'taught' each task, so thirty students attended. The tasks were the same for each road show allowing the students to become experts, although adjustment was necessary depending on the context. Time was devoted to a full debriefing at the end of each road show, so students could reflect upon what had happened and what they had learnt.

### ***Follow up work, after the road shows***

Having gained the experience of working in other schools in a very structured way by running the road shows, the students are likely to be in a much stronger and better-informed position to work with individual learners, offering one to one support. They would have insight into some of the difficulties that learners can experience in mathematics; something that they, as high attaining mathematicians, may have never considered before. The contacts made, as a result of the road shows, may serve as an introduction to this.

### **Feedback from students**

Towards the end of the term when most students had participated in five or six road shows, they were invited to complete a questionnaire about their experiences. The questions were open response "to invite an honest, personal comment" (Cohen, Mannion & Morrison, 2000, p. 255) and avoid any suggestion of required topics. We classified the responses in the light of emerging commonalities but also include specific quotes to illustrate the variety of responses. There were 49 respondents, of the 56 who had participated in the project throughout, but many responses included more than one of the identified themes.

### ***Why did you volunteer for the project?***

The most popular responses included interest in teaching and/or wanting experience with children (20 each). Ten respondents were keen to share their love of mathematics. Nine saw the experience as being an enhancement to their CV or university personal statement. Six said that they thought it would be an interesting experience. An equal number were keen to build personal skills such as communication and confidence. Two are involved in personal tutoring and were keen to learn more about how to teach. A further three were interested in learning about how to teach.

### ***What has been your most memorable experience?***

The majority of students (31) described the responses of children. Below is a small sample of the responses:

It was really lovely to see how his mindset (from “We’re no good at maths.” to “Yeah Miss I get tessellations.”) had changed so quickly.

Kids saying, “Maths is fun”.

The excitement of the children when they work out an answer

A girl could perfectly explain all the solutions very quickly. It showed me I had possibly underestimated them.

When a child finally understood the puzzle and was very happy.

It was very rewarding to see that they are having fun and being enthusiastic towards maths.

When children can accomplish everything they struggled with initially.

Three commented on learning from the children, four particularly enjoyed revisiting their previous school, five felt the first road show was the most memorable – they could do it! One mentioned working as part of team, another mentioned a particular mathematics task and another “learning to let the pupils figure things out on their own rather than telling them the answer like I was used to.”

### ***Anything that surprised you?***

Quite a few (12) commented on the way the children engaged with the tasks and really enjoyed themselves (6). Several (11) commented on how quickly some children completed tasks and really understood what they were doing. Some were surprised by the range of ‘ability’ (4), the pleasant and polite manner of the children (2), the way children accepted them as a teacher (1), how competitive the children were (2) and how some children didn’t think they were ‘doing maths’(3). Others were surprised by the challenge of getting the children interested or keeping them interested (5) and the difficulty of explaining the task.

### ***Anything you found particularly challenging/confusing?***

The biggest challenge was dealing with children who were not interested (16) followed by adapting the task to individuals (9). A few mentioned initiating the task (3), explaining the task without “giving too much away” (6) and one mentioned feeling inadequately prepared. One student had to lead a task alone as their partner was ill and found this particularly daunting. Two students found maintaining their own motivation a challenge e.g. “trying to stay motivated and enthusiastic when I was exhausted”.

### ***To what extent has your experience matched your expectations?***

The vast majority of students said the experience had met (16) or exceeded (29) their expectations, with words such as amazing, challenging, enjoyable, fun, important, rewarding used to qualify their response. Several commented on how impressed they had been with the children’s behaviour and manner, “I thought it would be more manic, when in reality almost all of the children were calm and polite.”

Five said that it was very different to what they expected

It was a very different approach to teaching maths that I hadn’t expected. It was different, in a positive way.

The experience was different to my expectations as we didn’t really teach any maths.

A couple expressed indifference, one said it was easier than expected while another said it was harder.

***What have you gained from participating in the project?***

Several students said they had gained an insight into teaching mathematics (23) including “a greater appreciation for my maths teachers”. Others included a worthwhile experience (12), the development of personal skills including communication (12) confidence (8), team working (1), patience (1) and a better understanding of themselves (3).

***Do you think the project has made you more or less likely to be a teacher in the future?***

Almost half the students said that they continued to be interested in teaching or were more interested in teaching as a career.

I would say more likely...the more time you spend running the activity the more you are able to improve your teaching style and try new things.

I am more likely to become a teacher now as I enjoyed that sense of accomplishment when a student finally understands what you are teaching them.

Sixteen said that they continued to lack interest in becoming a teacher, although some added that they had really enjoyed the experience (4). Ten said they were less likely to become a teacher after their experience, reasons included that it was too hard, too stressful and too much responsibility:

Less likely but in the best way possible. It has taught me and reassured me in what I really want to do. I have learnt that not every day is going to be a good day teaching and I could not take on the guilt if my mood/understanding had such a great influence on a developing individual.

On the other hand, one student said it was “too easy”.

***Is there anything that could improve the project?***

The most popular response was nothing (10). Some would have liked more time to work on their task with the children (7), some would have liked more tasks to do with the children (7), others would have liked better resources (5), some wanted more time to get to grips with the tasks themselves (4) and others would have liked to be responsible for more than one task (5). There were some suggestions from individuals: make the road show longer; include Years 8 and 9; work with the same school again; go to more schools; more communication with the teachers and better rewards. Two students suggested teach “proper maths”.

**Discussion and conclusion**

Devising an intervention in which sixth form students can make a contribution to the mathematics experience of younger children is fraught with difficulty. As experienced teacher educators, we know that preparing student teachers for their first lessons is challenging and demanding. The road show was intended to allow students an in depth experience with one task where their own understanding of the mathematics involved was secure and they had the opportunity to explore the difficulties that might arise in advance. Despite this, some students said they would have liked more

preparation time; and several found initiating the task and adapting it for individuals challenging.

One of the most heartening outcomes for us is the reality of working with schools and schoolchildren. The enthusiastic response to mathematics, which was reported by many of the students, the willingness to persevere, even when the tasks were challenging, and the impact on confidence of both the children and the students were impressive.

A large proportion of the student participants were keen to pursue teaching as a career and their resolve was strengthened by the experience. Others who did not wish to pursue teaching had enjoyed the experience and greater awareness of what teaching involves, including greater respect for their own teachers.

We are hoping to synthesise our own reflections on the experience and that of the teachers in a more substantial piece about the intervention.

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