

Enhancing Transition of Students of Mathematics by School – University Partnerships

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Abstract

School and universities are very different places when it comes to the teaching and learning experiences of students. As part of the **more maths grads** pilot project we have been working in local schools. This paper looks at activities to stimulate learning in schools and their applicability, or otherwise, to the university context.

The paper explores the potential of activities to raise student attainment, aspirations, confidence and awareness of the applicability of mathematics in order to facilitate the transition of students to HE. The opportunities to achieve the important aims of the project i.e. increasing and widening participation in the mathematical sciences in HE and groups which are under represented at HE are also explored. The results indicate a priority area for us to explore further that how we can address a significant number of students to make them more aware and confident about mathematics. This is the time to realize the extent of “**mathematics problem**”. A strong focus by Schools, universities and employers is required to build up “real partnerships” which lead to success in achieving the project goals.

Key Words: Mathematics; HE; Post-16; Tertiary; Transition

Introduction

Mathematics is perceived by many students as being boring, hard not relevant to their future with no promising employment opportunities (Smith: 2004). In addition to this there is clear evidence that the current curriculum in schools fails to stretch and motivate the more able students and it has been indicated that many stake holders believe there is a crisis in teaching and learning of mathematics (Smith: 2004). The three main areas of concern highlighted are; a serious shortage of qualified mathematics teachers in schools, the lack of infrastructure for the continuing professional development of mathematics teachers, and curriculum & qualifications (Smith: 2004). The standard of teaching mathematics is below the average standard for all subjects and there is lack of engagement and motivation in many key stage 4 pupils, resulting in limited uptake of the subject post-16 (Ofsted annual report: 2005).

The decline in the number of students studying mathematics consequently influences the intake of students onto mathematics courses in HE. Also affected are intakes on to Science and Technology courses such as Physics, Chemistry and Engineering due to their highly

mathematical nature. A '**Mathematics Problem**' has been indicated by university academics for some time, particularly at the transition from school to university. Furthermore the decline in the number of mathematical sciences graduates is not just a problem in the UK but is rather an international issue (European Commission: 2004).

The **more maths grads** pilot project has been designed by the mathematical sciences community of England to address the '**Mathematics Problem**' by the '**School-University partnership**'. This is a three year pilot project in three regions: West Midlands, Yorkshire & Humberside and London, funded by the Higher Education Funding Council for England (HEFCE). The universities involved are Coventry University, University of Leeds, and Queen Mary College, University of London. In addition Sheffield Hallam University will provide an investigation into the HE Curriculum theme and will work on national scale.

Educational partnerships between universities and schools have existed for over 100 years (Greene: 1999). "Many educational partnerships have been formed in the past, only to fizzle shortly thereafter, during this time". This trend is best explained by the firefly metaphor (Edens: 2001); "Similar to the firefly's iridescent light many educational trends, including partnerships seem to emerge and shine for a brief period and then fade away as new programs emerge. When educational partnerships have been formed to provide only temporary solutions to very complex and multifaceted problems, they failed to stand the test of time. But some educational partnerships have continued to shine and to become fruitful. What makes a difference in the success or failure of these partnerships?". "The most effective partnerships are dynamic and interactive, work toward common goals, and are characterized by a high level of commitment among group members" (Jenkins :2001). It is important for Schools and Universities to focus on those "real partnerships" which lead to success.

The work done on more maths grads project at Coventry University since August 2007 is presented and the findings so far are discussed in this article. The purpose of this article is to explore the potential of partnerships between Coventry University and local schools, in order to enhance the transition of students of mathematics to HE.

Aims and objectives of more maths grads

The principal aims of the project are;

1. To increase the number of students taking mathematics post-16 and progressing to mathematical sciences degrees, and to widen participation in mathematical sciences from the under represented groups in HE.
2. To increase the number of mathematical sciences graduates in England to fulfil the demands of Education sector, Industry and Commerce.

The main objectives to fulfil these aims are;

1. Increase the aspiration, confidence and motivation among school and college students for mathematics.
2. Enhance the confidence, enjoyment and knowledge of teachers for mathematics and its applications, in order to help them to stimulate interest in post-16 study of mathematics in their students.
3. Increase the awareness of applicability and career opportunities available for mathematics graduates.
4. Broaden the scope of HE curriculum nationally to allow choices for a wide range of students.

Delivery of Project and Activities

The work undertaken includes intensive interventions with seven widening participation partner schools and large scale events open to all schools in Coventry & Warwickshire. The project is being delivered on four major themes:

1. Career Theme

The career awareness activities include career fairs, career profiles with professionals who are utilizing mathematical techniques in wide variety of exciting fields. These profiles will be made available to students, teachers and member of the public through the more maths grads and maths careers website. We are also hosting public events for the region to increase the awareness of the applicability of mathematics among key individuals, such as parents and teachers influencing the decision of students to take post-16 mathematics. In addition to this, structured career materials are also being prepared to be made available for educational institutions.

2. Student theme

The enrichment activities for students aim to encourage them to raise their aspirations and attainment levels in mathematics, and to continue with the subject post-16. These include one-off events with interactive hands-on mathematical activities, plus regular interventions where undergraduate mathematics students of Coventry University are working in schools as Student Ambassadors.

3. Teaching Theme

The support given to mathematics teachers aims to enable them more effectively to raise the aspirations of their students in mathematics. This support is given through the Student Ambassador Scheme, Teacher Workshops and curriculum enrichment and interactive resources and Teacher Excellence Fellowships.

Initial Findings

The main purpose of this pilot project is to investigate resources and activities which could prove to be useful in raising the aspirations and attainment of mathematics among students and enhancing the quality of teaching of the subject. This is important to increase the number of students making the transition from secondary to tertiary learning of mathematics.

The results discussed in this paper are based upon three interactive hands on mathematics activities for year 9 & 10 students from 25 different schools located in Coventry and Warwickshire. The students took part in the activities at Coventry University and at a partner school. These were high ability students, and each activity was 3 hours long. The activities included, logic puzzles, “Who wants to be a millionaire” focusing on ratios and percentages, shape and space paper folding and poster making and building a Mars rover. The events were evaluated by questionnaires, completed immediately after the activity, from 220 students and 25 teachers.

The evaluations indicated that 98% students understood the activity and 93% students found it interesting. A student remarked that: **“It shows Maths can be fun & isn’t boring at all”**

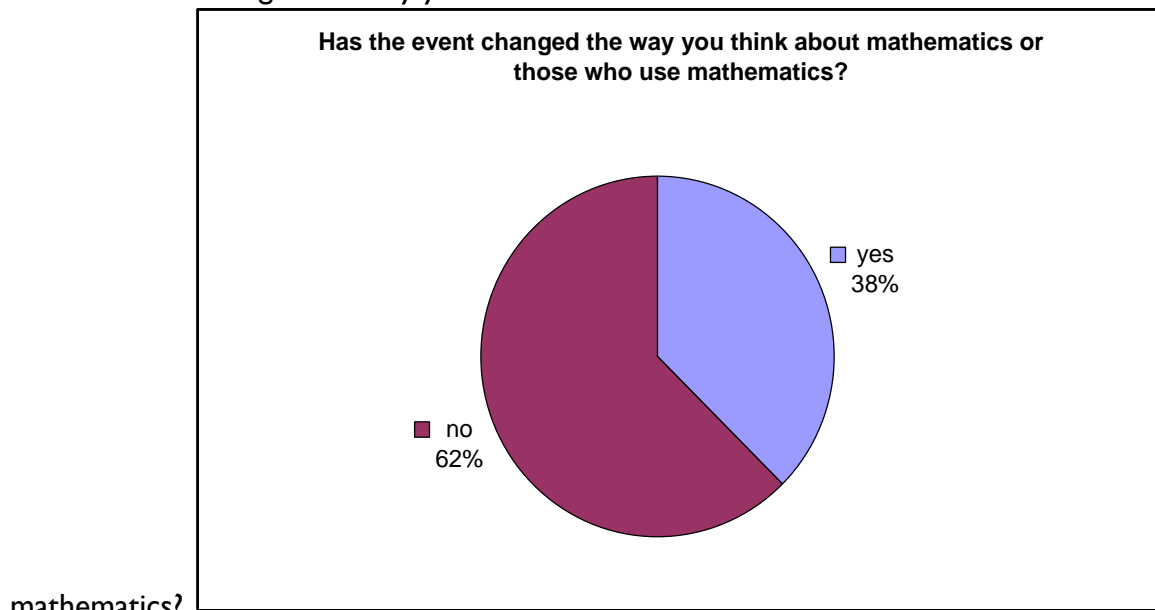
Other students commented that:

“I thought it was really hard, by now maths look a little easier”

“I thought mathematics was really boring and mostly writing but I was wrong”

The questions were;

Has the event changed the way you think about mathematics or those who use



mathematics?

Figure 1: Results of question 1

Not surprisingly the effects of just one event did not affect the way the majority, 62%, felt about mathematics. Rather more surprisingly over a third, 38%, said they had changed the way they thought about maths. However it must be noted that the results could be an overestimation of the true effect of the intervention. What has not been taken into account is the tendency of individuals to try and answer in a way which they think they should i.e. to please the teacher or facilitator of the activity. There is also the fact that the feedback was obtained immediately after the intervention so it is possible that the feedback is biased by the short lived positive feelings of the students based on fun (e.g. a day out, not having to be in school etc.) of being involved in the activity rather than by any longer term change involving their feelings about mathematics.

Would you like to know more about mathematics and what you can do with it?

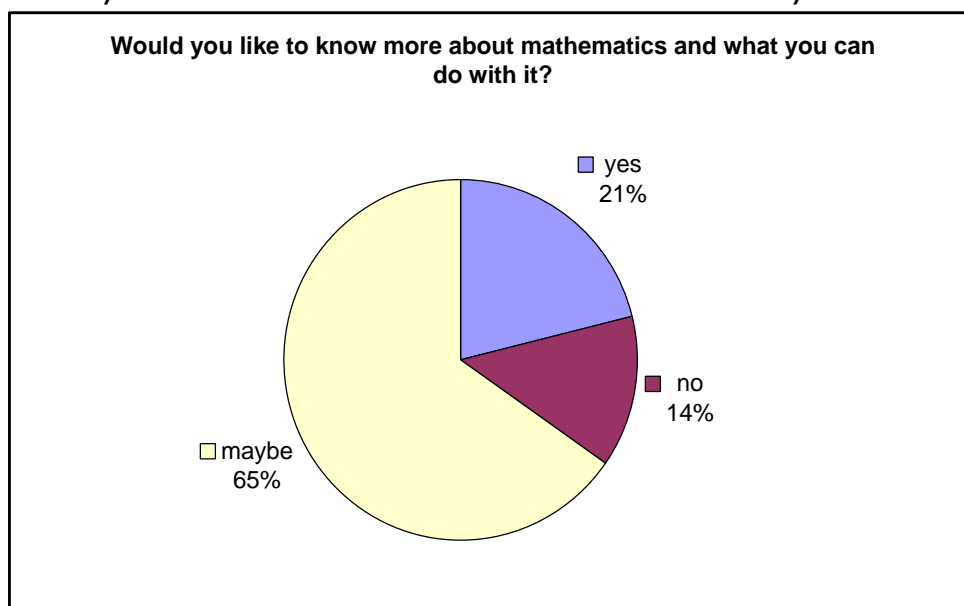


Figure 2: Results of question 2

This result is encouraging as a fifth (21%) of students said they would like to know more about mathematics. 65 % were not sure; this is an important group, maybe in a position where their ideas can be changed. In addition

Following this event , what are your thoughts about studying mathematics further (e.g. A/AS level, Mathematical Sciences degree)?

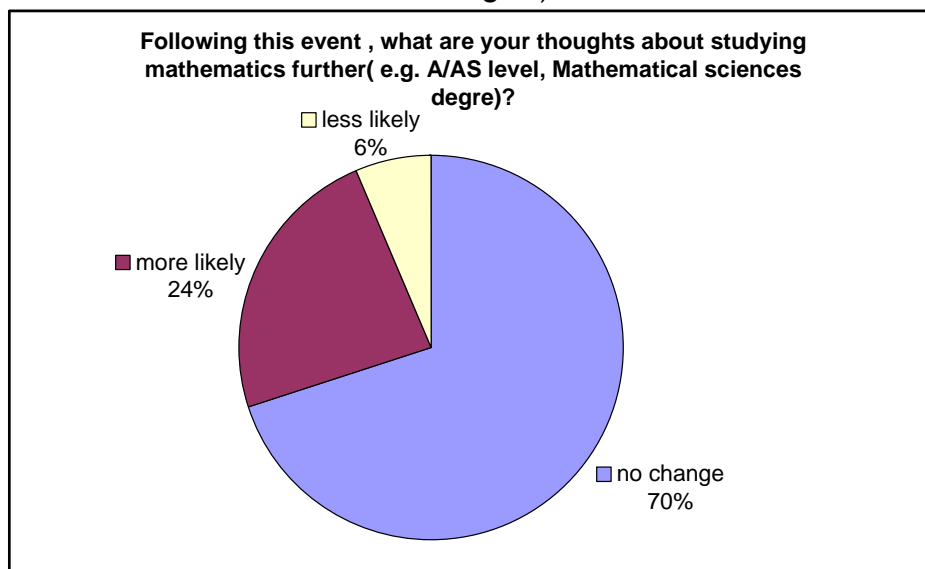


Figure 3: Results of question 3

70% students felt no change (in figure: 3) in their thoughts about mathematics.

It can be suggested from the above results that a significant percentage of students were uncertain about their aspirations regarding mathematics. Bearing in mind the limitations on the accuracy of the data, some of those who reported “uncertainty” could actually mean “don’t want to do maths, but don’t want to offend”. The target group would be students who are interested in mathematics, these students may be considering post-16 mathematics as one of their options, however they are in the process of being “turned off” the subject. It is suggested that the group whose feedback was obtained was composed of students not just from the target group but of students, who are already turned off or who have other aspirations such as the study of other subjects at HE or employment.

The teacher evaluation indicated that 100% teachers considered the activities useful for their students and 95% indicated that the activities were useful for them. The results also indicated that 47 % teachers thought the activities will raise the aspirations of some of the students towards studying mathematics.

Ongoing Activities

In order to explore further the activities which can motivate and inspire the students to study maths post-16, feedback was collected following on from a 10 week student ambassador placement at a partner school, from both the ambassador and mentor teacher. The feedback indicated it to be a valuable experience for all the parties involved and the teacher remarked:

“The increase in number of resources can never be done by the school alone as well as the expertise acquired by the partnership.”

It was recommended by the participating teacher that an extended, continuous and structured scheme of work targeting a specific group of pupils is required **“so that pupils can develop relationships and raise their subject attainment”**.

To investigate further the effective activities to raise awareness of mathematics and its application, a selected group of Yr12 students from partner schools will be placed in industry and HE to work on a structured mathematics project for 6 weeks. The effects of this placement on student aspirations will be studied in detail.

Recognizing that teachers are the most important pillar in bringing about a significant change in attitudes towards mathematics and career prospects at school and college, we are offering Teacher Excellence Fellowships. Under this scheme the teachers will work in collaboration with the Mathematical Sciences Department at Coventry University and the more maths grads team to find effective ways of enhancing the teaching and learning of mathematics and to help build a strong relationship between Schools and HE to increase the uptake of maths at both post 16 (A-levels) and undergraduate level. The implications of this scheme on the mathematics departments involved will be further reported.

The transition to university

Writing in 2000, Neil Challis, who is associated with the more maths grads project, commented on the difficulty of recruiting to mathematically based courses, the greater diversity in the academic backgrounds of students, and the fact that many students arrive at university lacking confidence in mathematics. He argued that university mathematics education can be improved by adding flexible approaches to a range of teaching strategies.

Lowe and Cook (2003), looking at the transition to HE indicated that their results showed that many students expect that elements of university teaching would be of a similar nature to that encountered in school, with one third of their sample appearing to expect teaching styles associated with school. These styles though were more formal: they went on to write “Indeed the greater rigidity and formality of teaching in schools appear to have led to an expectation among students prior to arrival that university teaching would be the same, with only 43% of students expecting a relaxed and informal style at university.”

Laing, Robinson and Johnston (2005) pointed out that student expectations of the teaching and learning environment in higher education are partly driven by their previous educational experiences and that the mismatch in expectations and lack of preparation may mean that many prospective students may find the transition from secondary education to higher education difficult. “Retention and progression rates may suffer unless the reality of the student experience can be aligned with their prior expectations and perceptions.”

Within Coventry University the modules associated with first year mathematics and related degrees offer a range of learning styles but specifically includes a module on problem solving and modelling designed to be more hands on and interactive in approach and thus similar in nature to some of the more maths grads activities in schools. The module gives students the opportunity to develop the ideas of problem solving at a relevant level and in a quantitative context. This involves the description of real open-ended problems of a simple nature in mathematical form and the subsequent analysis and interpretation needed.

Student reaction has on the whole been very positive, as one student commented “This module so far has turned out to be something that I wasn't quite expecting. I thought that it would fairly similar to the mechanics module I did at A-level, which I was not that keen on.

However, this module is very different from mechanics, as it is more about solving real problems that could be faced by real people.”

Another wrote “The most interesting module without a doubt, as all is applicable to real life scenarios. This module is the most fun in terms of actual thought processes, and teaches many valuable skills mostly using Microsoft Excel. I also like the write-up aspect of this module, as I’ve always held an interest in the English Language, and this gives a chance to show skill outside of mathematics.”

Further comments include “I am glad that I chose to do this instead of accounting. Problem solving and modelling has become one of my favourite modules. I’ve previously not done any kind of academic working a similar field but I enjoy the problem solving part of the module.” “This module has been extremely interesting. Because the work has been different to what I’m used to, it has been enjoyable.” “I like this module as it gives real world examples and exercises to do with quite obscure mathematics.”

Those who enjoyed the module did not do so just because they found it easy; they didn’t: “I do enjoy how it links maths with real life situations, however I find this by far the hardest module I do.”

The use of modern technology in the form of an interactive voting system added to the engagement of students: “The sessions when we can use keypads to vote for an answer on the whiteboard added an element of fun which I enjoyed.”

Summary

We can suggest from the initial findings that while schools and pupils appreciate one- off interactive mathematics events, the more intensive structured presence with pupils, schools, teachers and the local community is required to achieve the aims and objectives of the more maths grads project.

We can also see that activities designed to stimulate learning in schools have applicability in the university context. The mathematics of such activities may be of limited scope, but the abilities required to tackle open ended problems are developing rapidly as a student makes the transition from school to university. Part of the mission of more maths grads is to re-evaluate the curriculum in mathematics in higher education and to look at the learning, teaching and assessment methods used by university mathematical science departments to see if students can be better supported in their studies.

This is the time to realize the extent of the “**mathematics problem**”. A strong focus by schools, universities and employers is required to build up “real partnerships” which lead to success in achieving the project goals.

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