Mathematics in STEM - transition issues

Improving students' mathematical transition from A levels to STEM degree courses

Charlie Stripp, MEI Chief Executive

Increased uptake of A level Maths and Further Maths

'The increase in the take-up of A-level mathematics and further mathematics has been dramatic.'

Mathematics: made to measure, *Ofsted, May 2012*

University offers

- Fluency and confidence with maths is a vital element in students making a smooth transition from school/college to university in STEM subjects
- Prospective undergraduates in Engineering and Physics should be made aware of the importance of mathematics on these degree courses
- University departments should require A level Maths their offers and encourage or require AS/A level Further Maths
- This would help drive continued increases in uptake

Aberystwyth University

Physics: '*We strongly support the idea of encouraging students to choose Further Maths for their A level studies and schools to offer this option to their pupils.*

Our students who had A level Further Maths coped with the transition from school to university much better than those who had only standard A-level Maths. It is our policy, when other factors are equal, to prefer candidates holding qualification in A level Further Maths over candidates holding A level Maths at the same grade.'

Swansea University

Engineering: *'The College of Engineering at Swansea University is pleased to support the Further Mathematics Support Programme Wales.*

Further Mathematics is not a requirement. However, we encourage prospective students to take Further Mathematics, either at AS or A level. The College is prepared to be more flexible with students who have studied Further Mathematics but have not met the standard offer.'

Mechanics modules

'The topics taught within a subject at A level did not always coincide with the knowledge requirements of higher education. For example, Engineering first year undergraduates with A level mathematics qualifications did not always study Mechanics at A level. This led to a greater variety of knowledge among first year students and also gaps in their knowledge.'

Fit for Purpose? The view of the higher education sector, teachers and employers on the suitability of A levels

Ipsos Mori Social Research Institute, April 2012

Mechanics modules

- The 2008 report, *Newton's Mechanics: Who Needs It?*, highlighted the advantage to Physics and Engineering students of having studied mechanics modules within A level Maths
- Studying mechanics helps develop students' modelling and problem solving skills
- University prospectuses and offers could encourage students to take mechanics modules
- Taking Further Maths gives students more opportunity to take mechanics modules

The Extended Project Qualification (EPQ)

- Introduced in 2009, ~5000 candidates; in 2011 there were ~25 000 candidates
- Equivalent to half an A level
- Students research a topic of their choice, produce a report and make a presentation of their findings
- Can be an excellent vehicle for students to develop/demonstrate modelling and problem solving skills
- Universities could encourage prospective students to undertake EPQs involving mathematical modelling and problem solving

Outreach

- Outreach can help get across the message of the importance of maths in physics and engineering
- MEI is working with an HE STEM project on mathematical modelling and problem solving, to provide outreach at the universities of Keele, Leeds, Manchester and the West of England
- The FMSP works with universities across England to support outreach work related to mathematics

Curriculum development

"I do not envisage the Department for Education having a role in the development of A-level qualifications. It is more important that universities are satisfied that A-levels enable young people to start their undergraduate degrees having gained the right knowledge and skills, than that ministers are able to influence content or methods of assessment."

Michael Gove, April 2012

Curriculum development

- Opportunity to improve the mathematics students learn pre-university, to improve transition to Physics and Engineering
- How can we tackle ‘teaching to the test’?
- MEI, as an influential curriculum development body, is keen to engage with universities to inform its work
- The examination awarding bodies are also keen to consult with universities
- A level Maths and Further Maths serve many disciplines in HE and it is vital that representatives of different subjects engage

Support for new undergraduates

HE STEM pilot project - Wales

- MEI worked with the universities of Cardiff, Glamorgan and Swansea to develop tailored online materials for new undergraduates
- Resources were made available to engineering and mathematics students from the end of August
- Students were able to reinforce their technical fluency with important A level Mathematics topics before they started at university and during their first term

Support for new undergraduates

HE STEM pilot project - Wales

Feedback from students on the pilot project:

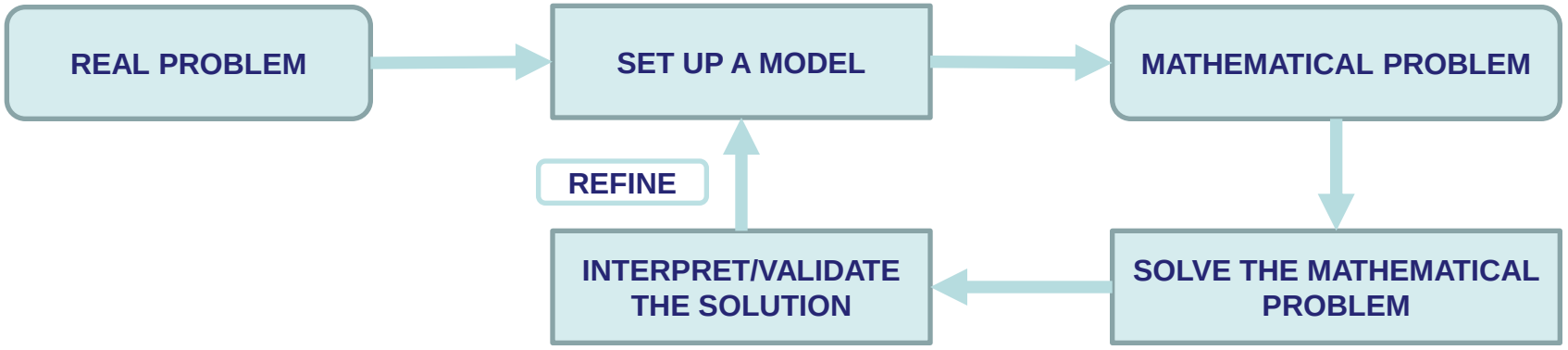
- *'Having not done any Maths since the summer examinations, the website allowed me to read over concepts and test myself, which refreshed my memory.'*
- *'It helped to reinforce A level material which I am now using as building blocks for the material I am studying in lectures.'*

A full report on the pilot will be published later this year.

Support for new undergraduates

HE STEM project in Mathematical Modelling and Problem Solving:

Leeds University has developed a module for 1st year physicists using a mathematical modelling cycle



Support for new undergraduates

HE STEM project in Mathematical Modelling and Problem Solving:

- The students had to use the ‘Modelling Cycle’ to investigate the motion of cars/bikes on either (i) banked, horizontal tracks or (ii) tracks with vertical circles, refining their models
- Students wrote a final report, following the stages of the cycle
- The students were positive about the course and the physics department is pleased with the results

Conclusions

- *Be clear about the importance of mathematics in degree level study of Engineering and Physics in prospectuses and offers*
- *Engage with pre-university mathematics education through outreach and involvement with A level curriculum development*
- *Emphasise the importance of maths to first year students and provide tailored support*