Interns planning an activity for a peer-led problem session

SYMBoL Project

The SYMBoL project (Second Year Maths Beyond Lectures) aims to enhance the experience of second year undergraduate mathematicians through innovations intended to improve engagement, enthusiasm and satisfaction. In this article we hear from four students who have spent the summer working with staff to bring about pedagogical changes within two key second year modules: *Complex Variables and Vector Spaces*.

The four students, who have just completed their second year, are Naomi Parkinson, Robert Cleaver, John Cockcroft and Matthew Tranter. They secured their internships against strong internal competition. Early on in the project they conducted focus groups with fellow students to find ways of making learning more effective and modules more engaging.

During the summer they used their findings and worked closely with staff – improving lecture notes, advising on sections where clarity might be improved and producing additional resources. These resources include screencasts that illustrate step-by-step solutions to problems that students find particularly difficult, help sheets, and supplementary problems. Additionally, they are developing activities for use in peer-led problem sessions next year.

SYMBOL
Enhancing the second year experience for undergraduate mathematicians

The student voice

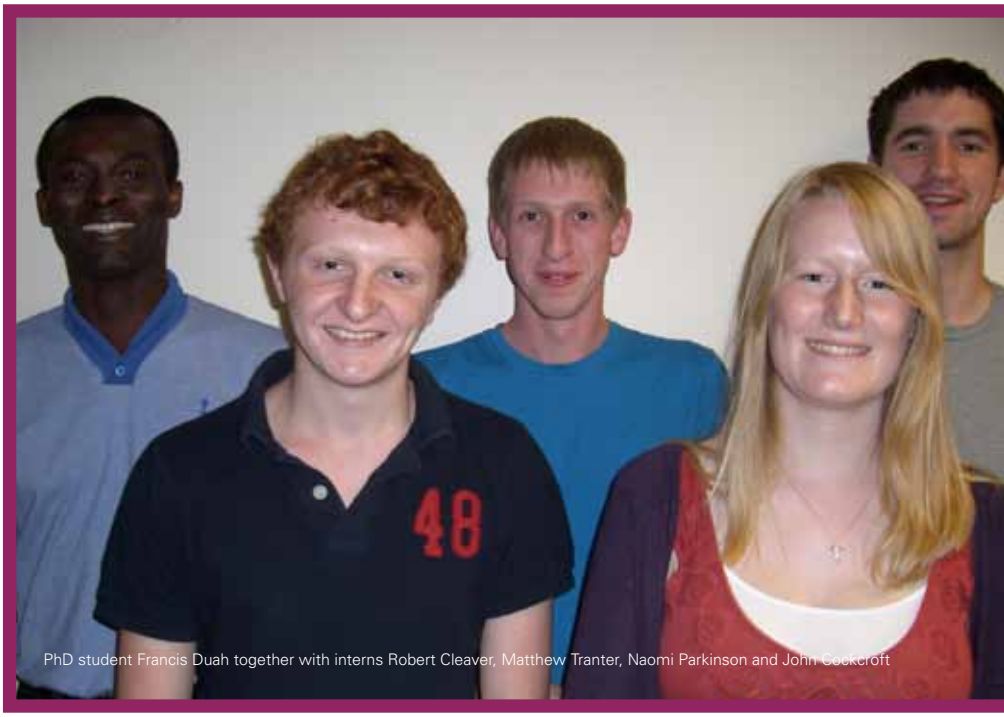
One of the most noticeable consequences of the internship is the way in which they now think about and approach mathematics:

I have only really become interested in maths in the past six weeks – for the first time in my life! I now appreciate that there is more to maths than just answering questions, and I have had chance to develop more of an interest in the subject by reading several different texts and seeing how many different ways there are to approach a topic. I am now more interested in maths in general and have got quite into talking through maths at the blackboard .

Also, I think the way I approach maths has changed and that will help me in the next two years of my degree. Having learned how to learn mathematics better, and what it feels like to really understand something, will make me more effective in studying.

There is little doubt that being immersed in a mathematics department and working alongside their lecturers has developed their confidence and their relationship with staff:

I have learned that lecturers are quite nice people really! I'm not scared of them anymore. Also, now if I don't know what I am doing I won't feel afraid to go and ask a lecturer questions. Now, I would be comfortable sending the lecturer an email or going to knock on their door.


PhD student Francis Duah together with interns Robert Cleaver, Matthew Tranter, Naomi Parkinson and John Cockcroft

It has also made me confident at talking with people at levels senior to myself – I have learned to hold my own when discussing my ideas with lecturers. I have also learned that it is not bad to be wrong!

Their experience, both with the focus groups and with their own resource development, puts them in a rather special position to give advice on how to improve mathematics modules. Here are some of their suggestions:

Organise your content better; have a good structure and make the structure obvious.

Organise the chapters of your lecture notes by a few principles – move from easier to harder; review first before moving on to new ideas.

Give some opportunities for students to think and interact in lectures by, for example, providing places to write in the notes (gapped notes) or by posing a question and giving students sufficient time to think about it before discussing the answer.

Keep students actively engaged in tutorials by, for example picking out two or three key problems to have the students work on, and then discuss these one by one as students work through them.

Put supplementary material on the most difficult topics on the module website.

Look at your reading lists and make sure they are up-to-date and relevant to the module.

Don't say "this is obvious", or "this is elementary" as students find this condescending.

In solution sets – it is better to give a few carefully chosen, full solutions, than a lot of half solutions!

And what was the most surprising thing they learned?

That I like maths! Yes, after two years, "wow, I actually like it".

I now have about half-an-hour of things to talk about in an interview!

I have really enjoyed the debates about how people teach – it is interesting to see that lecturers don't agree on things! I have learned that an important purpose of a university is research, and that lecturers spend most of their time outside of term working on their research. I also learned that lecturers know more than one subject! They know a lot about all sorts of things!

And what has been achieved?

Lecture notes and problem sheets for the two modules have been re-written – intern input has ensured that where students found things less than clear, the explanation has been improved. Additional illustrative examples have been included. There is now improved signposting and reviewing.

The students have developed screencasts – videos of examples that their fellow students found hard. Next year these will be available alongside lecturer-provided resources on the VLE.

Student-friendly handouts have been developed – these will be available not only for particular modules, but also in the support centre for others to use.

The students have gained insight into the workings of a mathematics department:

Staff too have learned from the students, have enjoyed the opportunity to explain why things are as they are, and to consider how they might take onboard the many sensible suggestions coming from the student body.

A very worthwhile professional development exercise!

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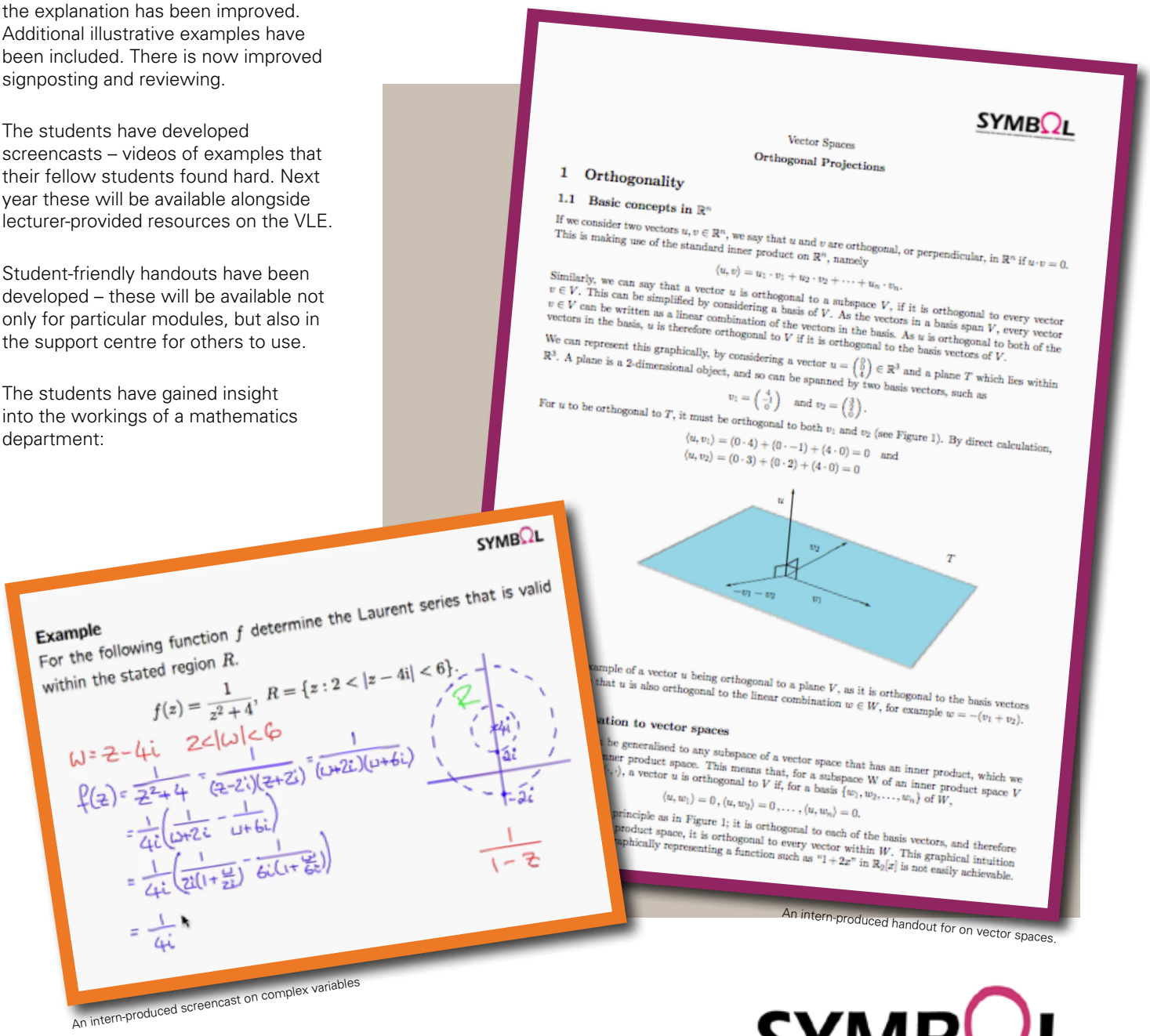

An intern-produced handout for on vector spaces.

An intern-produced screencast on complex variables

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STEMNET STEM Clubs

Influencing the subject choice decisions for 14 year old pupils is a longstanding challenge for schools and parents. Possibly the best advice any pupil at that age can receive would be to keep all options open.

With this thought in mind several universities across the Midlands and East Anglia region of the Programme have developed a range of approaches to excite and enthuse those pupils with ability but little interest in STEM subjects beyond secondary school, and those from families where going to university has not previously been considered an option.

The Universities of Derby, East Anglia, Staffordshire and Wolverhampton have developed partnerships with up to eight local secondary schools to either set up and establish new or enhance existing STEM Clubs, each comprising 8-15 pupils aged between 11 and 14. This work is primarily extra-curricular and not intended to satisfy formal secondary curriculum requirements. The creation of a local 'cluster' will encourage cross sector and interdisciplinary interactions both within the HEI and the schools, and programmes of practical hands-on activities are being developed and managed by HE Ambassadors to meet the needs of the schools. Ambassadors engaged on planning, schools liaison and delivery are from across the institution, some are academics, some undergraduates, postgraduates or even HE staff – the most valuable prerequisite for engagement being enthusiasm for STEM subjects and a passion for inspiring the next generation.

If HEIs recognise their current capability and capacity to develop a model which is individual to their institution they will be in a strong position to maintain a sustainable programme of activities from which to grow to meet future needs of all partners. Some will work with the schools on a weekly basis throughout a term or academic year whilst others are running individual Challenge Days with pupils at the institution.

To further add value all HEIs are encouraged to:

- **Develop a common cluster challenge to create friendly competition between schools**
- **Support pupils to achieve the British Science Association's nationally recognised and well respected Bronze CREST (CREativity in Science & Technology) Award to be presented at a mock graduation ceremony at the HEI for pupils, parents and teachers. CREST Awards are of intrinsic value to pupils, and the award of a Gold Award also carries UCAS points. They are well recognised by employers as a differentiator on job applications.**

The HEIs involved will be the first to admit that they have undergone a steep learning curve in establishing contact and links with schools, and discovered how challenging that process can be. In all cases it has provided valuable experience for sharing both within and beyond their own institution.

HEI staff have developed a better understanding and a range of skills such as the improved communication and planning demanded by working with bodies outside their normal sphere of activity, and learnt how to enthuse pupils to consider studying STEM subjects and the opportunities going to university may offer. Fostering greater collaborative working and learning by responding to the actual needs of schools has been essential as has an awareness of the importance of understanding your audience to ensure effective delivery.

One key message they would all share with you is -

Never underestimate the amount of time required to develop a successful partnership!

With support from the National **HE STEM** Programme institutions have an opportunity to enrich the STEM experience for around 500 Year 7/8 pupils aged 12-14 per year at the initial stage of their secondary education, and therefore potentially influence their ultimate subject choices. This is also a way to involve parents, particularly those with no family history of going to university, by offering an opportunity to visit a university in an informal way to celebrate the achievements of their offspring.

Look out for news of mock graduation events in future issues as STEM Club Clusters celebrate the achievements of the pupils involved and HEI staff share their models and experiences!

Annette Smart
Regional Officer for Widening Participation and Outreach, Midlands and East Anglia spoke