Workshop on Innovations in University Mathematics Teaching

Venue: Cardiff University
Date: 7/8 July 2014
Organisers: Paul Harper (Harper@cardiff.ac.uk), Vincent Knight (KnightVA@cardiff.ac.uk), Rob Wilson (WilsonRH@cardiff.ac.uk).

Overview:

Robert Talbert (Grand Valley State University) gave the opening talk describing the flipped classroom. Robert has a great deal of experience in adopting this approach and gave an excellent insight in to the topic. Particular points of note were:

- A flipped classroom does not imply a flipped learning environment!
- A traditional classroom encourages the dependency of a student on the instructor.
- Flipped learning is not just videos out of class and homework in class.
- The importance of clearly defining realistic and concrete learning outcomes, being able to assess whether students are attaining those learning outcomes, and if they aren't attaining the learning outcomes, being able to change their practice.

Figure 1. Robert Talbert discussing the flipped classroom

(Robert's slides are available here.)

Vincent Knight (Cardiff University) spoke about how a flipped approach had been developed to introduce a new programming module to first year undergraduate mathematics students. He highlighted how the approach was a steep learning curve for students, but ultimately it allowed them to develop their skills through carefully designed activities and peer support. Other key points included:

- The importance of providing students with regular opportunity to measure their own progression.
- Setting out clear expectations of student engagement.
- Allowing students to apply the skills gained in group tasks.
- The opportunity to embed broader entrepreneurial skills in to the expected activities.

Figure 2. Vincent Knight introducing a flipped approach to programming

(Vincent's slides are available here.)

Toby Bailey (Edinburgh University) then gave an excellent talk about the flipped classroom / peer instruction that is used in his large (~400 students) first year undergraduate classes.

Figure 3. Toby Bailey discussing the merits of peer-instruction

In addition to presenting some interesting research on the effectiveness of peer instruction, real insight was provided by watching a video of the approach being used

in a live session. For example, students were asked to respond to a question using “clickers” and then break in to groups to discuss the particular problem in more detail before being asked to answer the question again. Some further points that were highlighted include:

- It’s not all about the lecturer.
- The importance of getting out of the way, and allowing student’s time to discuss and think through ideas.
- The importance of clearly explaining why a particular approach is being adopted.

Stephen Rutherford (Cardiff University) spoke about his approach to the flipped classroom in Bioscience.

Figure 4. Stephen Rutherford discussing the flipped classroom in Bioscience

This provided a different perspective to the previous talks which related specifically to mathematics. However, it illustrated how the same key principles applied. An important question posed during the session was ‘why am I better than a book?’. Further points raised were:

- A flipped classroom allows some control to be put in the hands of the students.
- The reason students are at university is to get an education and not necessarily a degree.

The final ‘talk’ of the day was by Chris Sangwin (Loughborough University) who talked about the Moore Method and how it had been adopted to encourage mathematical reasoning in undergraduate students.

Figure 5. Chris Sangwin explains the Moore Method approach to IBL

Chris highlighted the important role of the instructor in this framework, where students are given a set of problems to work through and present to their peers (there is no lecturing in a Moore method class). In particular, knowing when to pose key questions and when to “step back” to allow the students to develop their own approach. It was also noted that:

- In 2007, after his class finished, students found the book from which his problems originated and continued to work through them on their own.
- In 2008, students set up a reading group and started to read complex mathematical topics.

The remainder of the workshop was a natural continuation from Chris’s talk as Dana Ernst (Northern Arizona University) and TJ Hitchman (University of Northern Iowa) spoke about Inquiry Based Learning.

Figure 6. Dana Ernst and TJ Hitchman leading an interactive session on IBL

This was a great interactive session that ran over to Tuesday (following a superb 6+ course conference dinner). There were a number of points discussed in each of the sessions which included determining what barriers might exist and (more

importantly) what could be done to overcome them. Some further points arising from the discussions included:

- The importance of thinking about what we want to be as educators. For example, one question was ‘what do you want your students to remember in 20 years time’. (It was noted that nobody mentioned the actual content of the courses that they teach!).
- The importance of creating a safe environment in which students can fail (in order to learn). i.e. Productive failure.
- The various difficulties associated with implementing an IBL approach due to class size (this was a recurring theme with regards to UK vs US class sizes). It was suggested that an IBL approach could realistically be used in a group of 30-40 students, and possibly had greater success in courses that are not content driven.
- Another important distinction of IBL is that students take on more responsibility to generate content and also to critically review it.

All of Dana and TJ’s content is available on their github repository.

Finally, the link #innovcardiff provides details of what was being said online about the workshop.

(The above overview is adapted from a blog post by Vincent Knight at http://drvinceknight.github.io/unpeudemath/)