FLIPPED TEACHING AS A METHOD FOR ENGAGING LARGE GROUPS

DR SAM MARSH AND DR NICK GURSKI

Abstract. We implemented a flipped approach to teaching mathematics to engineers and it was better.

1. Background

This is some stuff I have copied from my CiLT 2 portfolio, we can include or not.

The teaching that goes on in the old MAS140/151/152 was very task-oriented: the lecturer would outline a range of tasks the students would be asked to perform, and then give them explicit tools for performing those tasks. This is a level of teaching that is concerned primarily with *execution* rather than *theory*; here the focus was on learning particular methods and not the theory that gives rise to those methods. Now, there was some theory presented in this module, but that theory was not the top priority for either lecturer or student. Thus this teaching was really about *problem-solving*, and not about *problem-understanding*. While from some perspectives this might seem shallow, it is appropriate, given the audience, for at least two reasons: first, on the whole, engineering students respond well to the idea of solving specific problems and getting an answer, and second, the module is intended to prepare them to solve the kinds of problems that will come up during their engineering degree.

In practice, this means that the there were two primary learning activities. The first was the lecture, of which there are two per week, and these lectures were executed in an entirely traditional fashion. The second learning activity was the weekly tutorial sessions. Each student was assigned to a tutorial group, and a group was usually about 20-30 students per staff member or postgraduate assistant; thus some tutorials would have 40 students with one staff member and one assistant, while others would have 80 students with one staff member and three assistants. These tutorials are "mandatory" in the sense that we claimed they were, but this was not enforced explicitly. Attendance was kept, and we often correlated poor attendance with poor performance, but beyond that very little was usually done with this information. Attendance numbers would usually start quite high, but then drop off as time progressed.

For many of these modules, feedback for students was somewhat limited. In one case (MAS153) there were a few marked homework assignments, but for many of the modules there was nothing as direct as an assessed piece of work during the semester, simply due to class sizes and available resources. Many students sought feedback during the weekly tutorials, and others would attend lecturer office hours, but both of these methods only provided feedback if the students took the initiative. Assessment, then, was largely or entirely by exam. In previous years, this would involve one exam each semester, but our Engineering Faculty changed all of their modules to only having a single exam after Semester 2 and thus we had a single, 3-hour exam covering all of the material from the entire year. The contents of this exam were split evenly between material from the first and second semesters, and we kept a similar format as in previous exams. When changing from two exams to a single exam, results were far worse than in past years; the mean dropped dramatically, to the point where we were essentially forced to scale up the exams for the first time in years. Note, however, that there were not particularly clear trends indicating that students were not understanding certain topics, rather that they performed poorly throughout the exam.

Up until exams, this cohort seemed roughly similar to previous years' in terms of ability, background, and motivation. Assessing only once at the end of the year instead of each semester seemed to have a noticeable impact on how students approached learning the mathematics involved. At one Engineering exam board meeting, it was suggested that these low exam results are perhaps more in line with the students' actual learning than in the past, the hypothesis being that students tended to put off doing any work during the semester, leaving it all until right before an exam. Students were unlikely to retain any real understanding of the mathematics involved, but with only a single semester's worth of material they were able to pass an exam.

End history of engineering teaching, begin some random theory I found

Williams makes the argument in [W] against the "final exam" as the ultimate means of assessment, bringing up how this method can lead to very shallow learning, and we certainly believe that this phenomenon contributed to the poor exam performance we witnessed. This brings up an important consideration, namely how to get students engaged with the material over the entire year even though the exam is not until May. In [**?**], Elton considers student motivation from the perspective of a motivational theory of work pioneered by Herzberg. One conclusion to draw from this research is that poor student motivation can result from the poor management of extrinsic and intrinsic motivating factors. In particular, Elton discusses how students often are positively motivated by being able to show off achievement throughout the learning experience, and the focusing on a single exam can change the motivator of "academic achievement" from a positive motivator to a negative one by overly stressing failure instead of rewarding success.

Next paragraph doesn't seem useful:

Golden and Stripp describe a teaching situation at the University of West England in [GS] which was similar to ours in Sheffield. They discuss a first year mathematics module for Engineering students coming from a wide range of programmes, and outline a teaching strategy that is very similar to our current one with a single important difference. Their module consisted of two hours of lecture per week, and one hour of tutorial, just as ours did, and most materials for the module can be obtained directly by students from a website. The main difference between their module and our Engineering modules is the use of routine computer testing. The particular strategy used by those authors is to have online tests at the end of each

"Learning Unit", and they say that generally means about every four weeks. These online tests are generated randomly from a bank of appropriate questions, and are marked immediately once the student completes a test. Each student has two weeks to complete their tests, and they may make three attempts in total, each one a new, randomly generated test; the highest mark is recorded, and this contributes a full 50% to the final assessment of the module.

A study [NK] by Nguyen and Kulm looked at web-based practice and assessment tools in middle school (age 11-13) children. These kinds of software will automatically produce mathematics problems of a particular type which students are able to work, submit an answer and receive an immediate mark together with certain kinds of feedback. Students are able to repeat a certain kind of problem until they are comfortable, with new wording and random number values generated each time. In this study, the children who worked with the computer-generated problems scored significantly higher than the children who continued working problems with pencil and paper in the classroom. The process of getting immediate feedback helped the students correct errors and recognise common mistakes which they were then able to avoid in future work.

It is important to remember that there is not necessarily a clear divide between online learning and traditional, face-to-face learning; any learning experience that has some duration could easily contain elements of both. In many ways, online learning faces many of the same obstacles that face-to-face learning does. One framework for studying the social learning experience is the Community of Inquiry model [GA] which describes and explains three crucial features of a social learning environment: social presence, teaching presence, and cognitive presence. Students view teacher presence as very important in online education, and there is a correlation between the perceived learning by students and the quality and amount of teacher presence in the online learning environment [JT]. But this should not be a surprising result, as the same is true for face-to-face learning environments [RA]. Thus in many ways, studying online learning is done using the same methods and asking the same questions as one might in studying traditional educational methods.

A study [KWSC] done at the University of Alabama considered three groups of students taking a graduate-level mathematics course for engineers. In this study, all three groups performed very similarly, with the students in the blended group outperforming those in the traditional group on exams and with students in the online-only group performing the best on analytical, take-home assessments. For the first of these results, that authors suggest that students having access to both online and traditional methods will choose the method that best suits them, thus increasing overall performance. For the results on the analytical assessments, the authors suggest that students in the online-only group were required to work harder and understand the material at a deeper level since they did not have easy access to an outside source of knowledge (i.e., the instructor) to supply hints or solutions immediately.

2. Methodology

Here we outline the nature of the pilot and the data which would form our assessment of effectiveness.

3. Analysis

Here we present our findings.

4. Conclusions

Here we sum up.

5. References

References

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