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Formative Assessment in First-Year Mathematics through Peer Review and Reflection

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Description | What was done?

The mathematics module for first-year aerospace, mechanical and product design engineering students is taught over 24 weeks with three hours of class time per week. The class typically has about 170 students, most of whom have entered university directly from school. A large majority (~90%) of them have achieved at least grade B in A-level mathematics but the class usually includes a small group of students with alternative qualifications in maths. The diverse nature of the class is emphasised by a few students with A-level further maths (about 5% of the total).

The University's education strategy seeks "to develop our students to be confident, resilient, creative, critical thinkers and problem solvers, with strong employability skills, prepared for leadership and citizenship in a global society and for the increasingly complex and challenging world into which they will graduate." A key aspect of this involves engaging students as partners in the development and enhancement of their educational experience. There aims to be a greater focus on continuous assessment and less reliance on examinations with an assessment strategy that ensures a balance between assessment of learning and assessment for learning. With these goals in view, the delivery and assessment of the first-year mathematics module was redesigned for 2016/17. The aim was to build student confidence by encouraging them to take greater responsibility for their learning through the use of self assessment, peer review and reflection on the quality of their work and learning.

Motivation and Aims

Chickering and Gamson's (1987) seven principles of good practice in undergraduate education emphasise time on task, cooperation among students and prompt feedback as beneficial to learning. Academic learning time has to do with quality; it is the amount of time students spend actively working on tasks of appropriate difficulty. Peer assessment requires students to think about the criteria used to evaluate work and make judgements (Falchikov and Goldfinch, 2000). The ability to produce peer review of high quality is a fundamental graduate skill (Nicol et al., 2014). Reflection influences meaningful learning but it also helps develop important aspects of learning behaviour (Moon, 2004). These ideas have helped shape the learning and assessment approach in the first-year maths module to promote a deeper understanding of the mathematical skills required by engineers.

Methodology

A formal teaching style is generally employed in lectures with numerous worked examples, many of which have been recorded in class using the visualiser for students to review in their own time. The transformed assessment strategy is focused on the feedback session. Students keep a log book in which they attempt a worksheet each week before the feedback session. This ensures engagement with tasks on a weekly basis.

They work in groups of four in the feedback sessions where a postgraduate student demonstrates the solutions and students review each other's work and leave feedback alongside. Thus, feedback is provided weekly (frequency) in the feedback session from other students and while they still remember

what they were doing (timely). It is low risk for the students: if they find the tasks easy, they benefit from the teamwork in class, teaching others and learning to give feedback on their peers' work; if they find the work more challenging, they can receive help both in class and outside class through the School's PAL mentor scheme.

After each feedback session, students write a few bullet points of reflection in their log book. Log books are submitted at two intermediate points for review by staff and are submitted at the end of the module for marking. The log books form 50% of the assessment with the remainder through an exam (although this will change for 2019/20 to 40% log book and 60% exam).

Attending at least 75% of feedback sessions and attempting at least 75% of worksheets is necessary to pass the module and it is necessary to pass both the log book and exam elements individually.

Successes | Challenges | Lessons Learned

Impact of the changes could be represented by improvements in the student experience, improved exam performance, students being better prepared for second year and being more confident in their academic ability. Data gathered to evidence impact has come through mid-module evaluation, focus groups, post-module feedback forms and exam results.

Benefits noted by students included being better organised and learning through explaining. There was greater effort in laying out their work, which is very important in mathematics, and some of the weaker students reported increased confidence. Student comments on questionnaires referred to both subject knowledge and generic skills:

"Opportunity to see other people's methods and working."

"Shows me different ways to do questions, increasing my understanding of the concepts."

"All working is kept in one place and that allows me to track my progress."

"Feedback and reflection has been useful as it has encouraged me to review my work after class hours."

"Self reflection is important, allowing me to easily identify certain topics that I need to work on, and those that require less attention."

"Makes each student want to improve each week."

"Having a feedback session provokes a sense of urgency with the worksheets, therefore they are always completed on a weekly basis."

"Provides a way to talk to others so you can find out if you are the only one struggling with something or not."

Comparison with previous exam data indicates that the new assessment strategy has had little impact on exam performance, especially for students with high grades in A-level maths and those without A-level maths; there is some evidence to suggest that any positive impact was greatest on the students with A-level maths grade B.

Student concerns included the difficulty in giving feedback on correct answers, difficulty in giving a variety of feedback, and whether the feedback is appropriate or helpful to others. The module coordinator agrees that the quality of student feedback is a key challenge.

There are challenges associated with allocating students to groups. This was based on prior mathematical achievement; students with lower qualifications were mixed with those with higher A-level grades to maximise learning opportunities. However, due to the academic background of the class, this left some groups containing all grade A students. Some students were concerned that the feedback sessions were not efficient, especially when all members of the group have the correct answer to a question. Some felt that leaving feedback on correct answers was a waste of time but this is not necessarily correct as there is opportunity to check for more concise methods. Only the difficult questions should be covered in class to minimise time wasted. Detailed solutions to all the questions on the worksheets are provided on the intranet after the feedback sessions to enable students to review their work further in their own time. This is important since there is time to review only a selection of questions in the feedback session. A bonus question (challenging problem not on the worksheet) was introduced to the feedback session to ensure that even those who had the worksheet completed had a new problem to try.

Scalability and Transferability

This practice could be applied to other subject areas and would probably be easier to apply with smaller classes. Having conditions of a minimum attendance at feedback sessions and a minimum number of attempts at worksheets in order to pass the module means that accurate records need to be kept each week by the module coordinator. In our experience so far, the module coordinator has required most of the feedback session hour to check each student's attendance and attempt and therefore he has had little time to intervene or advise on the students' work. It is planned to have a second lecturer present in the feedback sessions to give students extra direction on what to look for when reviewing particular questions and what their feedback might include. Demonstrators need to have skill in teaching and controlling a class and trying to maintain students' interest. It is important to keep explaining to the class the value of reflection and the purpose of the assessment approach. It is important to note that the lecturer, when marking the log books at the end of the module, is not marking the questions but is assessing the reflection. Students' ability to solve mathematical problems is tested through the exam and so the lecturer does not need to mark the questions in the log book also.

References

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