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Improving student learning in engineering discipline using student– and lecturer–led assessment approaches

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Abstract

This article investigates the effectiveness of two distinct formative assessment methods for promoting deep learning and hence improving the performance amongst engineering students. The first method, applied for undergraduate students, employs a lecturer–led approach whereas the second method uses a student–led approach and e–learning for postgraduate teaching. Both studies demonstrate that the formative assessment and feedback has a positive effect on the performance of engineering students, especially those lying on the middle and lower grade tail. The mean exam marks increased by 15 to 20% as a result of introducing formative assessment to the case study modules. The main catalysts for performance improvement were found to be the feedback provided by the lecturer to the students, and by the students to their peer partners. Comparison of the two practices leads to the conclusion that whilst both methods are equally effective, peer assessment requires less time commitment from the lecturer.

Keywords: *Formative assessment; Peer assessment; Feedback; Engineering education; Teaching, learning and research*

1. Introduction

It is well established in the literature that assessment practices significantly impact upon student learning. They have a profound influence on what, how, and how much students' study (Gibbs and Simpson 2004). Assessment can be broadly divided into two categories: summative and formative assessments (Biggs and Tang 2007; Bloom et al. 1971). The former is generally in the form of exams and/or coursework, used to make a judgment of students learning by assessing achievement during a module or an entire course. It usually takes place at the end of a taught period to evaluate how well the students have demonstrated the intended learning outcomes. Formative assessment is a means of giving feedback to the students on their current progress and to determine their way forward (Harlen and James 1997). Timely and effective feedback is useful in enhancing students' skills and understanding (Black and Wiliam 1998a). Hence, formative assessment is particularly useful in promoting deep learning (Marton and Saljo 1976a; 1976b) by helping the students to identify and overcome gaps in their current knowledge, and achieving intended learning outcomes (Ramaprasad 1983; Sadler 1989). From a lecturer's point of view, the formative feedback can be used to establish the extent to which planned learning has been achieved, and to seek run-time improvements to their teaching strategy (George and Cowan 1999; Threlfall 2005; Yorke 2003).

Over the years, many formative assessment approaches have been developed. These range from classroom questioning and comment–only marking to peer– and self–assessment, formative use of summative tests, and discussing success criteria with students (Black and Wiliam 2009). The common thread of these diverse approaches is an attempt to quantify students' learning, and identify a way forward to achieve intended learning outcomes (Black and Wiliam 2009; Wiliam and Thompson 2007).

One of the most extensive studies into the effectiveness of formative assessment was carried out by Black and William (1998a) which showed that the average test scores of students were improved as a result of formative assessment; the highest improvement was observed in the low–score achieving students (Black and Wiliam 1998b). Using a broad literature survey, Shute (2008) demonstrated that the effectiveness, and hence the selection, of a particular formative assessment and feedback technique depends on the nature and individual characteristics of the learners and aspects of the learning outcomes. Feedback in the form of specific comments on the student's progress and performance against learning outcomes and specific suggestions for improvement are more helpful than generic comments (Bangert-Drowns et al. 1991; Hattie and Timperley 2007; Phye and Sanders 1994). Numerous examples of the successful application of formative assessment and feedback practices have been demonstrated in the literature, e.g. Juwah et al. (2004), McDowell et al. (2004), Burrow et al. (2005), Roselli and Brophy (2006), Costa et al. (2010). Taking advantage of technology, many of the cases presented in the literature have been applied through electronic systems.

Despite the benefits of formative feedback in enhancing student progress, the time constraints associated with their preparation and implementation are often a challenge. Higher education institutions world–wide are experiencing growth in student enrolments and the class size has increased significantly over the years (Biggs 2003).

As a result, academic staff workloads have increased dramatically, especially in the area of assessment. Large classes and limited resources result in less access to tutorial support and in many cases, less detailed feedback on assessment tasks (Gibbs et al. 1997). Non-traditional assessment methods, led by students rather than the academic staff such as 'peer assessment' can be useful in these circumstances (Kumar et al. 2010). It not only increases quality and quantity of comments but also reduces marking and feedback time for academic staff (Topping et al. 2000).

Peer assessment is defined as the process through which groups of individuals rate their peers work (Dochy et al. 1999). This approach requires students to consider the value, worth, quality or success of a piece of work produced by peers of similar status (Topping et al. 2000). The criteria for assessing may or may not have been agreed or discussed earlier and the feedback from peers may be qualitative (i.e. comments) or quantitative (i.e. marks) in nature (Kumar et al. 2010). Dochy et al. (1999) present a concise overview of new assessment forms including 'peer assessment' within the context of higher education. The benefits of using peer assessment has also been summarised in Ballantyne et al. (2002). Peer assessment enables life-long learning skills due to the active involvement of students in the assessment experience (Biggs 2003). These tasks are cognitively demanding and actively engage students with new knowledge, promoting deeper learning amongst student assessors (Topping 1998). Peer assessment has the potential to improve students' verbal communication, negotiation skills, and their ability to give and receive criticism (Topping et al. 2000).

Most students took assessing the work of their fellow students seriously and included the peer feedback in the revision of their work (Berg et al. 2006). The method has also been criticised in the literature. For example, Ballantyne et al. (2002) have summarised several studies that suggest the students lack confidence in both their own and peers' abilities as assessors. Another important consideration is related to the time and effort required by students whilst assessing the work (Davies 2000). This has also been reported by Topping et al. (2000). Peer assessment can also be time consuming for staff because of the effort involved in developing documents to support the process (procedural guidelines, criteria sheets, marking scales) (Pond et al. 1995). However, most of the issues associated with peer assessment may arise due to its 'newness' as a formal assessment tool in higher education.

This article compares two different formative assessment approaches which are applied for different levels of engineering teaching, undergraduate and postgraduate. Following the conclusions of the study by Shute (2008), the case study related to undergraduate teaching was lecturer–led in the sense that all feedback was provided by the lecturer. The peer assessment approach, which was employed for postgraduate students, was student–led. Assessment in many engineering courses is mostly summative in nature (Roselli and Brophy 2006) and the work presented here provides the means of investigating the applicability and effects of the two approaches on students' learning and performance. Another objective of this study was to examine the feasibility of e-learning resources in assisting towards providing formative feedback to the students. The effect of the both approaches on student learning, study habits, performance, and satisfaction is investigated in detail in the following sections.

2. Methodology

2.1 Lecturer-led approach

The first of the case studies presented in this article demonstrates an example of a formative assessment and feedback provided by the lecturer. The study was carried out on a level 2 structural design compulsory module that contained 79 students in academic year 2009-2010. The main teaching method used was 'lecturing' using power point presentations, besides a number of 'tutorial' sessions. Since all feedback was provided to the students by the lecturer, this case study demonstrates an example of a lecturer–led approach towards improving student performance.

The formative assessment consisted of two in–class quizzes in weeks 6 and 9 of the semester. The quizzes were arranged a week after two main topics of the module were covered. The students were informed at the beginning of the module about the quizzes and given time following the relevant lecture to prepare. Each quiz consisted of three sections to assess the performance in different knowledge areas. The first section was multiple–choice questions related to theoretical aspects of the lectures, knowledge of which is fundamental towards the use of the more practical and numerical methods employed for the design purposes. The second section consisted of testing the design guidelines knowledge of the students. Design calculations are carried out using these guidelines and it is essential that the students have an appropriate background in their use. Finally, the third part of the quiz involved a detailed numerical question that would be found in a traditional summative examination. The division of the in–class tests into these three parts provided an opportunity for the lecturer to offer formative feedback on each section, assisting students to identify areas of strength and weakness. It is worth noting that the quizzes did not contribute to the overall module mark but it was emphasised as a good opportunity for students to identify strengths and weaknesses, and receive feedback from the lecturer to potentially improve their performance in exams. One of the potential flaws of this approach is the fact that students tend to ignore activities that do not directly contribute towards their final grades (Higgins et al. 2010). This was also partly observed in this study as only 37 (out of total 79) students participated in at least one of the two quizzes; there were only 16 students who participated in both these tests. Nevertheless, such participation offered us the opportunity to make comparisons between the performances of students taking the formative assessment exercise with those who did not. This would serve as an indicator of the effectiveness of the formative assessment method employed.

2.2 Student-led approach

The second case study demonstrates an example of a student-led formative assessment and feedback study that was carried out at level M on a bridge engineering module. The module is common for three MSc courses (i.e. bridge, civil, and structural engineering) and 88 students enrolled during the studied academic year. A considerable number of the students (24 out of 88) take the module through distance learning mode. Because of the varying interests of the students (i.e. civil, structural or bridge engineering) and that a significant number are international students, their background knowledge of the subject varies considerably. The main teaching method is 'lecturing' using power point presentations and intermediate 'question-answer' sessions, with the last hour of the three hour weekly session a 'tutorial'.

Three peer assessment tasks were distributed uniformly throughout the semester. The tasks and the guidelines for their assessment were developed in advance by the lecturer, as described below. At the end of the semester, the students were requested to fill in a feedback form. Their responses were used to quantify the success in achieving the desired objectives and to study their learning approaches and experiences. The assessment results provided evidence for their achievements in the module.

The guidelines recommended by Ballantyne et al. (2002), Dochy et al. (1999), and Gibbs and Simpson (2004) formed the basis of this assessment. These included 11 conditions that support learning (Gibbs and Simpson 2004), procedural guidelines for implementing peer assessment in large classes, and tutor and student checklists to appropriately implement the peer assessment. These conditions aim to promote conscientiousness amongst students, a significant predictor for achieving higher performance (Bragt et al. 2011). A number of factors were identified that had potential to impact on learning.

2.2.1 Class vs Distance Learning students

The distance learning students use the University's virtual learning environment (VLE) as a primary mode of communication with other students and their lecturer. Hence, peer assessment had to be implemented through the VLE for these students. Eight groups of three students each were created in the VLE for the purpose of the peer assessment. The VLE is used only to supplement the traditional classroom teaching for the full-time students. Hence, it was decided to implement the peer assessment within the class room for these students. Students were asked to bring their solutions in the class. These were randomly re-distributed to their peers and assessed in the presence of their lecturer, and were returned back to the students.

2.2.2 Assessment tasks and Criteria for marking

Three tasks were given to the students and these were distributed uniformly throughout the semester. These tasks covered crucial concepts necessary to achieve the modules' learning outcomes. The first task did not carry any marks. The second task constituted a small part of a summative bridge analysis assignment. This was used for the validity and accuracy of the received peer comments, as explained in Section 2.2.4. Only 10% of the summative assignment marks was assigned to the peer assessment, primarily to encourage active students participation. The students were encouraged to assign comments to the report, highlighting areas of good work and pointing out any areas of weaker design practice.

Fox (1989) suggested that assessment related guidance should be given to the students. Later, Biggs (2003) proposed to include criteria for assessment, evidence on the criteria, and judgement on the evidence for such guidance. These were provided to the students for the given tasks.

2.2.3 Distribution system and Anonymity

Students' anonymity was not used primarily because of difficulties associated with its implementation in the VLE for distance learning students, and for the extra amount of time required to carryout this for the class students. For class students, the reports were collected by the staff member, and then re–distributed to the students for peer assessment purposes. Sufficient time was given to the students to assess the task

and mark comments on the reports. Once marked, these were returned back to the students by the lecturer.

For distance learning students, the submissions were through the VLE within their assigned groups. The two other members were required to assess the work and provide comments in the discussion areas of the VLE for each group. The submission and discussion posts were only available to the peers from each sub-group.

2.2.4 Validity and Accuracy

Peer assessments have been found to have as good as or better effects on student learning than teacher assessment (Topping 1998). In order to ensure validity and accuracy, the peer assessed tasks were reviewed by the lecturer for the second task, which was required to be submitted alongside the summative bridge analysis assignment task.

3. Results and Discussion

In the following sub–sections, examples of qualitative feedback provided to the students are presented. The impacts of the different approaches on student attainment are also presented.

3.1 Lecturer-led approach

Following the quizzes taken by the students in class, detailed feedback on the performance of the students was provided by the lecturer. At the end of the semester, the students were also asked to fill in a feedback form as an attempt to examine the efficiency of this approach.

3.1.1 Feedback on formative assessment

The formative assessments were designed to enable the lecturer to provide feedback in different learning areas. These included theoretical background, practical and numerical aspects of the design code, and the working knowledge to efficiently design steel members (see Section 2.1). Typical formative feedbacks provided to the students with *average performance* are listed below:

> *"You have shown a good performance on the theoretical background in relation to the behaviour of compression members (Euler's theory). However, a deeper level of understanding can be achieved by concentrating on the effect of imperfections on columns as well as the theoretical background in relation to the estimation of effective lengths of the columns. You also need to have a bit more practice on the effective use of the code requirements for the design of compression members".*

> *"You have answered correctly the questions which referred to Euler's buckling theory and the concept of slenderness demonstrating a good background in that area. However, you need to concentrate more on the theory regarding cross-sectional classification of members and estimation of effective lengths of the columns. I was also disappointed with your performance in relation to the use of design code; you should improve that by thoroughly studying the code requirements in order to gain a deeper level of understanding and more confidence in solving exam questions".*

Examples of feedback received by the students that have shown a *poor performance* are as follows:

> *"You need to study harder on the design of compression members as your level of understanding is not acceptable. Also be careful with the units e.g. when calculating the critical slenderness. You will need to increase both your understanding of the subject as well as your design skills using the code in order to be successful during the final exam".*

> *"Your performance shows that you need to give considerable attention to the topic of design of compression members. Very few questions have been correctly answered on the Euler's theory hence you need to develop a deeper conceptual understanding of the subject. Also make sure to practice the use of the code for design purposes".*

Typical examples of feedback provided to the students that have shown *excellent performance* are listed below:

> *"You have shown an excellent performance on design calculations for compression members demonstrating a very good understanding of the area. You have also answered correctly most of the theoretical questions you have attempted. However, you have missed some of the basic questions indicating that you may have some knowledge gaps in the theory and you can definitely improve in the area related to Euler's theory, slenderness and effective lengths".*

> *"You have demonstrated an excellent knowledge in the area of compression design, both in terms of theoretical background as well as design calculations. Keep up the good work and method of studying".*

As can be seen from the examples outlined above, the feedback reflected an overview of each student's performance. This feedback aimed to enable each student to understand his or her current level of subject matter understanding. Suggestions given to them emphasised what they need to do to improve their examination performance.

3.1.2 Quantitative assessment of the effect of lecturer–led formative assessment

Figure 1 compares the exam results of the cohort including formative assessment in the module with the previous year's cohort which did not participate in any formative assessment exercise. It is evident from the exam results that feedback provided through formative assessment has considerably improved (53.2% compared with 44.2%) the performance of the students (Fig. 1). A similar trend can also be seen for the coursework marks where the average has increased from 61.9% to 77.7% (Fig. 2). Furthermore, a greater number of students gained higher marks in both types of assessments (i.e. exam and quiz), as can be seen from the distributions depicted in Figs. 1 and 2. The most pronounced effect of the formative assessment was its impact on the weaker students (left hand side of histograms); the number of failing students reduced from 28 to 19 (see Fig. 1). A significant reduction in the number of students at the borderline of failure (30–39 marks range) was also observed. This suggests that employing the formative assessment practices had an overall positive effect on the weaker and average students. However, total numbers of first class students (with a mark above 70) were similar during both academic years. Although it can be argued

that the comparisons between the two different cohorts cannot be compared in absolute terms due to the difference in quality of students, the impact is mitigated by other factors. For example, the level of difficulty of the exam questions and coursework was intentionally designed in such a way that these have negligible differences in style and difficulty between the two academic years. Moreover, the entry level qualification for the students to get admission in the University was the same during both years.

The effect of formative assessment on student performance is further investigated by comparing the performance of students involved in the formative assessment with those who opted out of it. Table 1 compares the average final exam marks making distinctions between the students not taking any formative assessment with those taking at least one, and both, formative assessments. The statistics from the previous academic year are also included, where no formative assessment was employed. Table 2 presents the similar comparison in terms of the coursework marks for the students.

Comparison of the 2008–2009 academic year's exam mark (44.2%) with the 2009-2010 academic year's average mark (46.4%) for the students opting out of the formative assessment shows that, on average, the 2009-2010 class has performed marginally better but this fact should not be used as sole justification for the considerably higher student marks presented in Fig. 1. The effectiveness of the formative assessment is evident from the fact that the average final exam marks for the student group receiving formative feedback is by far higher than their counterparts. In particular, the average exam mark for the students who attempted one formative assessment is 57.6%, which is about 25% higher than those without any formative assessments (46.4%). The average mark of the 16 students participating in both formative assessments is even higher (i.e. 62%), showing the beneficial effect of the formative feedback, which provided early indications of problem areas. By receiving specific feedback relating to improvement of cognitive levels of learning, these students performance has noticeably improved. The correct answers for the test quizzes were not revealed to the students as it was thought that this approach would encourage them to actively seek the information they need rather than just memorising the solutions and correct answers. A similar trend to the exam marks has also been observed in coursework marks, as can be seen in Table 2.

The percentage increases observed in the final exam performance of the students discussed above are higher than similar past studies carried out by Klecker (2007) on psychology students and by Olson et al. (2004) on biomedical students. The only difference was that in the latter studies the test quizzes were taken online by the students whereas in this paper they were carried out in class. Klecker (2007) observed a 6% and Olson et al. a 9% increase in the average exam mark of the students participating in formative assessment as compared to the students who opted out. This study showed a 25% percentage increase in the performance of the students.

3.1.3 Students feedback at the end of the module

The formative assessment exercise was well received by the students. This was evident from their positive comments in response to the questionnaires distributed at the end of the 2009-2010 academic year:

"I liked the practice exam/tests/quizzes in the steel design – very useful; should introduce this to the other sections of the module as well"

"The tests were very-very-very useful provided that they are taken at the right timing"

"More in class tests should be done"

"I would like to see class tests unchanged in the module"

These positive comments, combined with the fact that no negative comments were received, is encouraging and suggests that this assessment and feedback method could be rolled out to all engineering modules.

3.2 Student-led approach

The students were asked to fill in feedback forms at the end of the semester for this level M Bridge Engineering Module. The following sources of information and evidence have been used to gauge success in achieving the desired objectives.

- A detailed feedback for the module at the end of semester.
- A short feedback for two other modules (in the same semester) was obtained to enable comparison of student learning experiences.
- Feedback (overall satisfaction) of the same module from the previous year.

3.2.1 Quality and quantity of feedback

Analysis of students' responses for the module clearly highlighted that they appreciate the importance of feedback and expect to receive this at as early stage as possible, e.g. the analysis of the module feedback before introducing peer assessment revealed that 84% students (out of 44 in total) believed that they would learn more if they received more feedback. Similarly, 83% students supported the fact that feedback helps them to understand things better.

Fig. 3a illustrates the students' satisfaction with the amount of feedback they received in this module. It can be seen that 55% students are satisfied with the quantity of feedback and a very small minority (9%) expected to receive more feedback. A significant number of students (36%) opted to remain 'neutral' (Fig. 3a) suggesting the need for further improvements in the peer assessment process.

On the subject of the quality of received feedback; it was observed that most of the comments given by peers were objective, highlighting either mistakes in the concepts or more effective solutions. Feedback given by the distance learning students through the VLE was more comprehensive, since each task was assessed by two peers. Concluding from this, all students (both the distance learning and class) should be grouped through e-learning and each task be assessed by at least two peers will considerably improve the validity and accuracy of comments.

The students also showed an appreciation of out-of-class contact (through the VLE); 83% of the students (see Fig. 3b) responded by agreeing that '(The VLE) helped them a lot in getting timely feedback'. The feedback survey also revealed that the students took the feedback comments seriously and this helped in improving their understanding about the subject area. Fig. 4 shows the distribution of student

responses on the question that their understanding improved due to the feedback received in the module. It is clear from the figure that 83% students appreciate the quality of feedback received in the module (either agrees or strongly agree) and that they believed this has helped in engaging higher cognitive levels.

3.2.2 Assessment results

The key objective of introducing peer assessment tasks into the curriculum was to engage the students with higher cognitive thinking by increasing their active engagement in the module. It was expected that this increased engagement would be reflected through their assessment results. The results for the two years (before and after introducing the peer assessments in the module) are summarised in Fig. 5.

Fig. 5 demonstrates that the assessment results have improved. The mean coursework marks jumped from 57% (before peer assessment was introduced) to 61.7% when peer assessment was introduced to the module. Similarly, a jump from 51.5% to 58.9% can be seen for the final exam for the two cases. It is acknowledged that the comparison cannot be seen in absolute terms as the students were not same for the both years but a clear trend of increased number of students gaining better marks can be seen from the distribution of students in various mark bands, as seen in Fig. 6. The mean value for the module improved from 52.8 to 58.9.

Similar to the lecturer led approach, the weaker students have benefitted from the timely feedback and the failures have considerably reduced, with more students achieving a higher mark. This is also evident from the reduction in the standard deviations due to the inclusion of peer assessment in the module.

The peer assessments have helped in improving distance learning students' understanding and provided early indications of potential problem areas. The peer assessment tasks induced an element of active engagement, which generally triggers higher cognitive levels of learning (Biggs 2003). Hence, the students not only enjoyed the tasks but also achieved better understanding and gained more marks in both formative and summative assessments.

3.2.3 Students' Overall Satisfaction

In order to analyse the effects of peer assessment tasks on the students' overall satisfaction, a summary of students' evaluation for the two academic years with and without peer assessment are plotted in Fig. 7. Overall patterns of student satisfaction from this module are the same in both cases, i.e. most of the students appear satisfied with the module. However, the percentage of students having 'strong agreement' or at least 'agreement' to the overall satisfaction has increased from around 70% to 80% due to the inclusion of peer assessment in the curriculum.

In order to counter the argument that the above results may be biased since the two cohorts are different, the students' overall satisfaction for three different modules in the same academic year (i.e. using the same cohort) is compared. Figure 8 summarises the students' satisfaction with the feedback received in the module with peer assessment and two other modules (without peer assessment) respectively. The mode of delivery and the method of assessments in the three modules were similar. It can be seen from the Figure that the percentage of students not satisfied with the received feedback is considerably less in the former, where peer assessment was provided,

whereas a high percentage of students expect more feedback in the other modules. Fig. 8 also illustrates a high percentage of students opting for 'neutral' option, which is an indicator that further improvements are needed in the peer assessment process to satisfy these students.

4. Summary and conclusions

This paper has presented two cases studies aimed towards providing timely feedback to the students aimed to promote deep learning approaches, leading to the improvement of exam performance. The first of the studies employed formative assessment and a lecturer-led approach. Two in-class quizzes were given to a cohort of second year undergraduate students within the semester and the lecturer provided individual feedback to all students about their level of understanding, strengths, weaknesses and suggestions about their future course of action. The second study was performed on postgraduate students by employing peer assessment and a student-led approach where the assessment and feedback process was driven by the students themselves. Three peer assessment tasks were distributed uniformly throughout the semester for this purpose.

Both case studies have demonstrated that the use of formative assessment and feedback is beneficial not only to engineering students but to the lecturers as well. These assessments, if planned ahead of time and applied in a timely manner within the semester, have been shown to offer active engagement of the students with the course content. The feedback provided by the lecturer and by the students themselves has been shown to be a catalyst towards improvement of their overall performance. Comparison of the two practices leads to the conclusion that both methods are equally effective, but peer assessment needs less time commitment from the lecturer. It is thought that a lecturer-led approach would be more appropriate for first and second year undergraduate students whereas a student-led assessment practice would fit better with postgraduate teaching and especially distance learning students. In the case of upper level students (postgraduate and final year undergraduates), a combination of the two may offer the sought reliability in terms of the lecturer's involvement and the time savings achieved by the involvement of the students.

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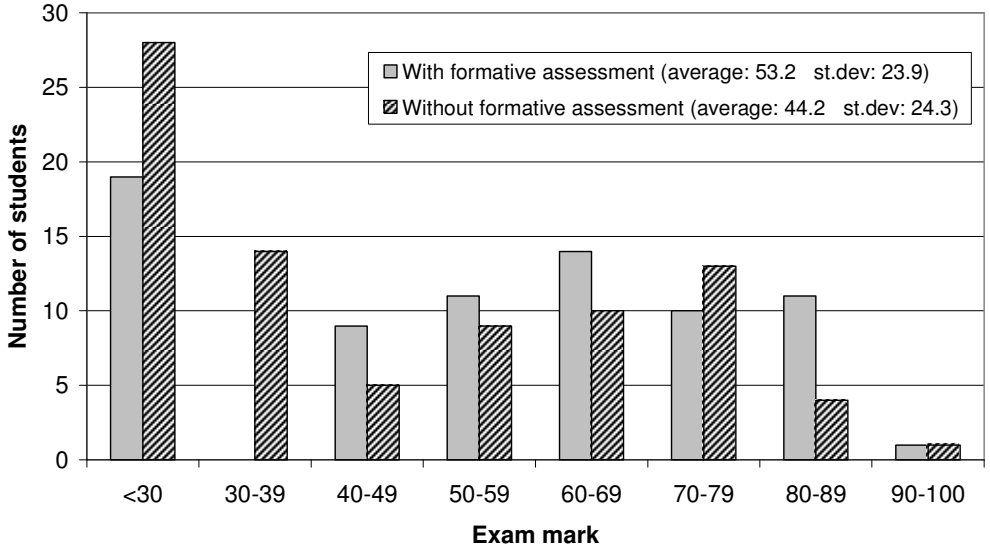

Fig. 1. Exam mark distributions for the entire class comparing two academic year results with and without formative assessment.

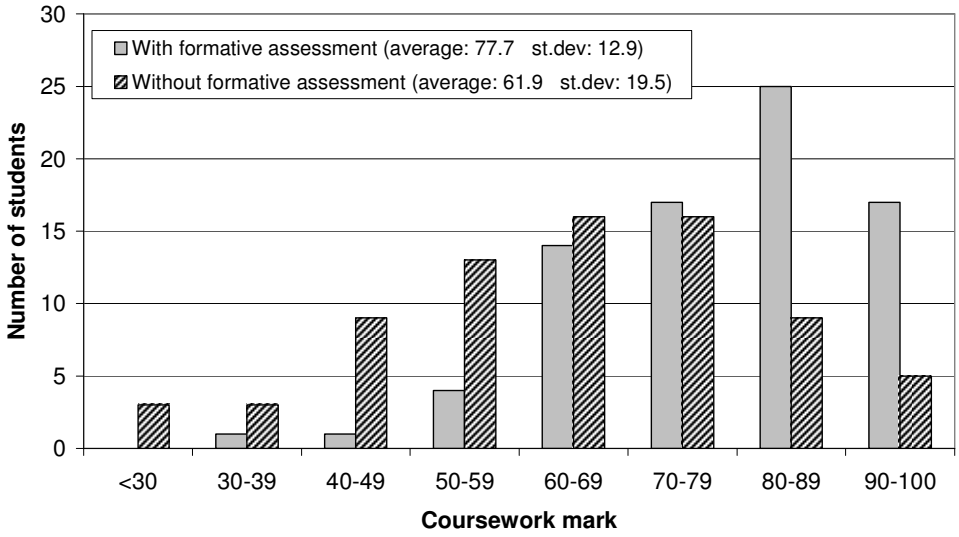

Fig. 2. Coursework mark distributions comparing two academic year results with and without formative assessment.

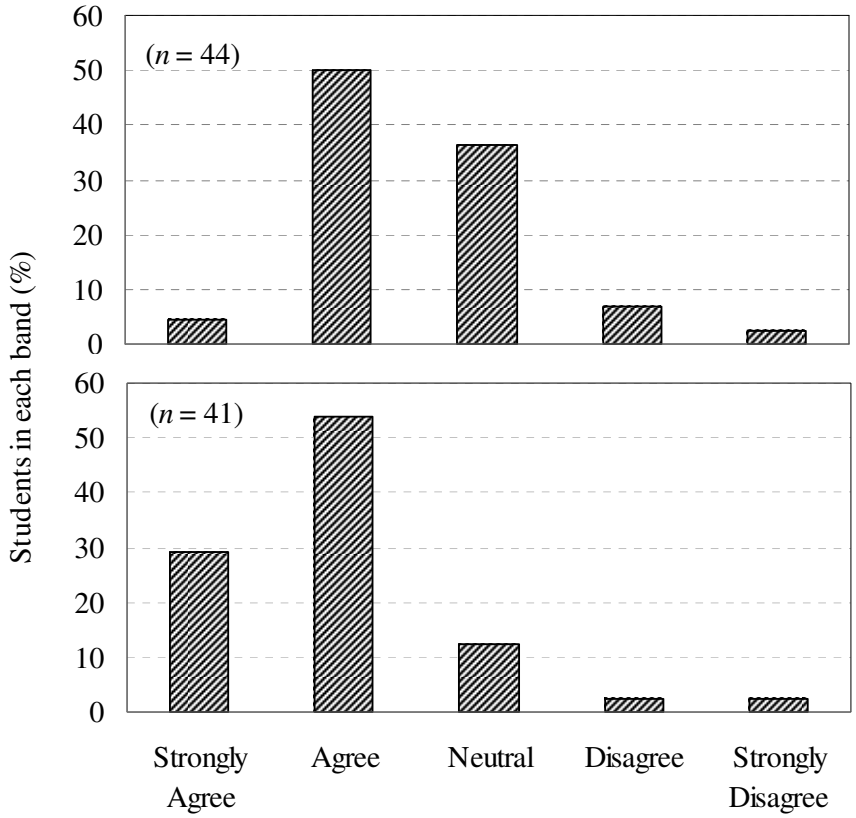

Fig. 3. Distribution of students' satisfaction with (a) amount of feedback received, and (b) use of ULearn for timely feedback (*n* is the number of student replies).

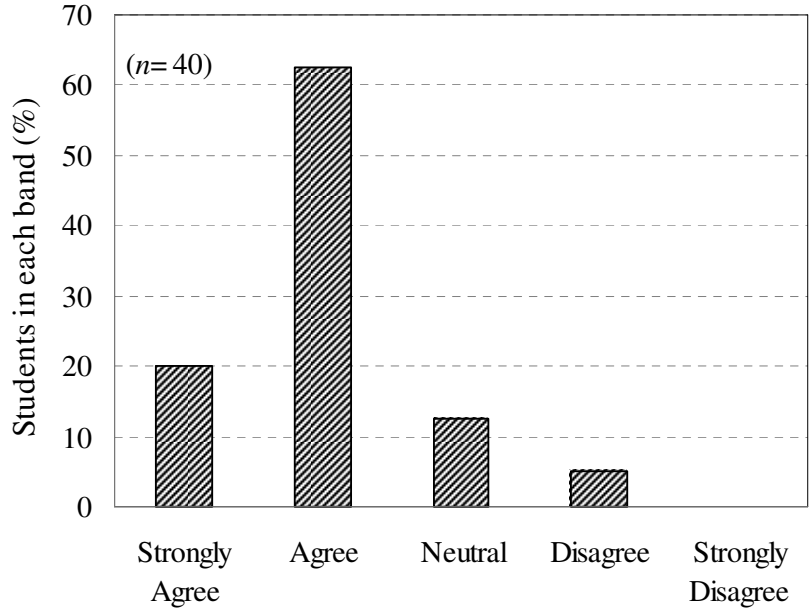

Fig. 4. Understanding improved with feedback (*n* is number of student replies).

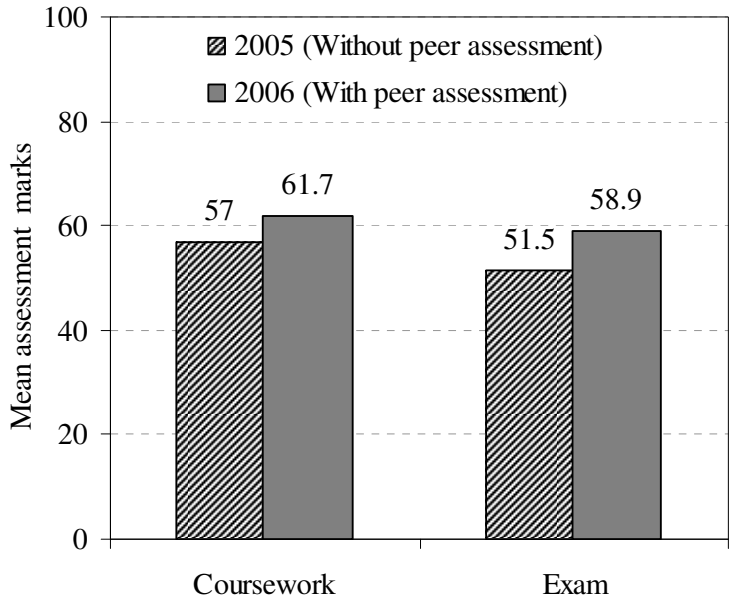

Fig. 5. Average assessment marks with and without peer assessment in the module.

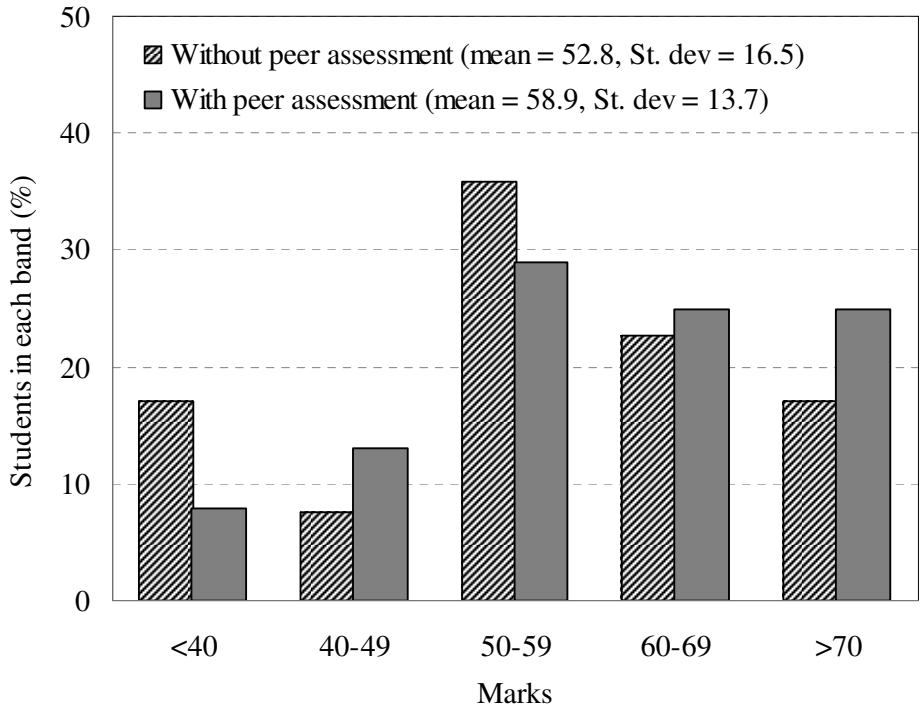

Fig. 6. Distribution of student marks with and without incorporating peer assessment in the module.

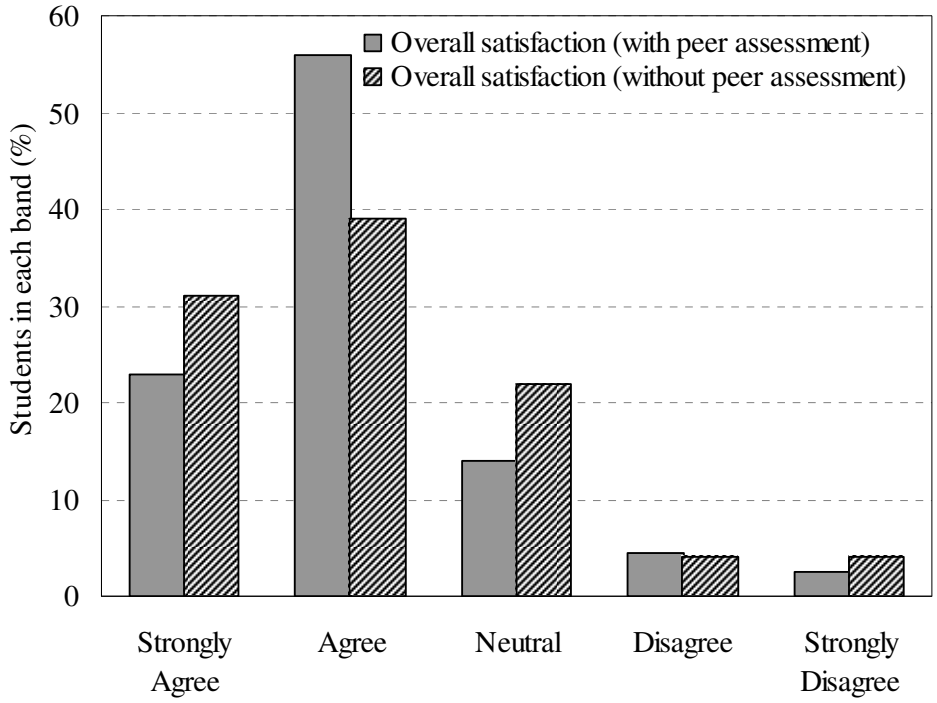

Fig. 7. Overall student satisfaction for the module before and after peer assessment was introduced.

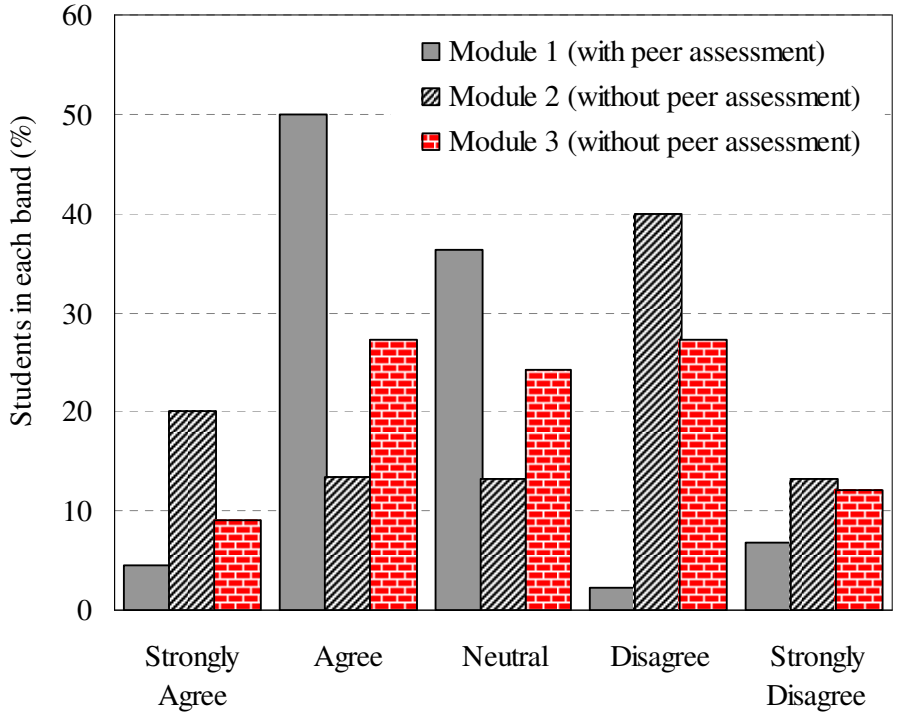

Fig. 8. Student feedback satisfaction with and without peer assessment for three different modules.

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Table 1. Effect of formative assessment on final exam mark statistics.

	Number of students	Average	Standard deviation
Academic year 2008-2009	84	44.2	24.3
Academic year 2009-2010 (no formative assessment)	40	46.4	24.8
Academic year 2009-2010 (1 formative assessment)	37	57.6	24.8
Academic year 2009–2010 (2 formative assessments)	16	62	23.6

Table 2. Effect of formative assessment on coursework mark statistics.

	Number of students	Average	Standard deviation
Academic year 2008-2009	75	61.9	19.3
Academic year 2009-2010 (no formative assessment)	40	75.2	12.6
Academic year 2009-2010 (1 formative assessment)	39	80.2	12.9
Academic year 2009-2010 (2 formative assessments)	17	82.6	13