Experiments in the use of quizzes to facilitate team work

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Abstract: The programs in the School of Civil, Environmental and Chemical Engineering at RMIT utilise Project Based Learning as the main teaching paradigm. Workshops/tutorials where students work in teams play an important role in this process. All RMIT courses are surveyed using the Course Experience Survey (CES) - similar to the Australian national survey of graduates (the Course Experience Questionnaire, CEQ). The project based courses tend to score lower in terms of feedback in these surveys – characterised by the GTS (Good Teaching Scale). Provision of additional written feedback has had limited influence on this response – in fact much of the feedback goes uncollected/accessed. This study examines the influence of introducing quizzes (short tests) to offer the facility of providing timely and meaningful feedback. Online individual quizzes and workshop quizzes for individuals and teams have been trialled and appraised by means of CES returns and focus groups. The findings demonstrate that both approaches can be effective however it identifies pitfalls to be avoided in utilising online quizzes.

Introduction

General

Encouraged by Engineers Australia, the teaching professions and industry, the School has adopted Project Based Learning (PBL) as the main teaching paradigm to deliver the graduate capabilities required by industry, eg teamwork and communication, problem solving, autonomous learning, as well as technical skills. Consequently, team-based work forms a major component in the programs. Throughout the range of courses taught in this way it is observed that the QA survey used at RMIT evaluates students' perception of the quality of the feedback they receive as inadequate and overall less adequate than that received in other (traditionally structured) courses. Attempts to improve this by providing more written feedback is often frustrated by students' unwillingness to either access online feedback or collect hardcopies - as reported by Jollands et al (2009) and McCallum et al (2008). Their studies identified (through focus groups and literature review) four main characteristics of effective feedback – quality, quantity, timeliness and equity. The quality aspect refers to the feedback being useful and relevant (positive and constructive) – ie it can have an impact (on their future work - particularly marks). Quantity is self evident – too much and it is not processed and too little not effective. Timeliness explains how and why feedback on summative assessments are the most likely to be left uncollected at the end of semester – if it is not timely it cannot be effective (at improving future marks) and hence why bother. The equity aspect is interpreted by the students as fairness and openness.

Several researchers have reported that online tests have to be managed carefully. Banky (2008) studied students response to online simulation exercises through focus groups and surveys. He found that peer help was perceived as more effective for self learning and that students indicated a clear preference for tutorial problems over the online exercises. Buskes et al. ((2009) examined the introduction of active workshops and the feedback from students suggests that attending workshops

was the highest contributor to their understanding - considerably higher than online quizzes. Falkner (2009) when looking at engagement in first year classes introduced collaborative learning exercises finding that students' perceptions on their ability and engagement altered significantly as a result. She observed that students were more quickly able to develop peer groups and improve their ability to problem solve. Goldfinch et al. (2009) reported on a literature survey on improving learning in mechanics courses. They observe that whilst active learning approaches (as adopted here with TBL etc) often receive positive feedback from students, this is not always reflected in improvements in grades/marks. It is too early to tell whether the initiatives adopted below will result in improved marks – students' responses suggest that they believe it will.

The initiatives described here have intended to improve students perception of the feedback and assistance they receive and improve engagement and learning, by providing feedback directly following group and individual quizzes (interpreted here as short tests). Recognising the variety of teaching approaches, subject matter and extent of student development, interventions across several years and subjects are examined.

First Year Course

Engineering Practice II is a first year (second semester) course in which students tackle the Engineers Without Borders (EWB) challenge project. The course consists of tutorials (workshops) and lectures on topics such as presentation skills, report writing skills, project management, and relevant topics by visiting speakers. Assessment for the course consists of a combination of quizzes, report writing and presentations. The project logistics involves teamwork in 7 tutorials with 240 students and requires a mechanism for facilitating strong communication between staff and students and within and between student groups for efficient sharing and optimisation of knowledge gained through the project. In the second semester 2009 individual quizzes and team based exercises were introduced with a view to improving engagement within the teams and to improve the students' perception of the feedback they receive. The belief was that even though within this teaching structure there is significant informal (workshop) staff-student interaction, this was not being perceived as providing adequate feedback.

The initiative involved two stages – an individual quiz sent by email immediately after the lecture, and a group quiz in the following workshop (comprising short responses to questions similar to the individual quiz). The individual quiz, involving material that was covered in the lecture plus a small element of additional research, was handed-in at the start of the workshop following the lecture (on entry into the room). Each team on entry into the workshop was then given a group quiz – based on the same material – the groups' responses were then collected and the questions discussed in that workshop. The marks for both quizzes were returned the following week. Both exercises (individual and team) were assessed with a few marks. Only those group members present gained the group mark and individual quiz sheets were only accepted at the start of the workshop.

Second year courses

Pollution Control is a second year semester 1 course for environmental engineering students. The course involves lectures, field trips, laboratories, tutorials and workshops – the students produce presentations, reports and undergo an end of semester examination. Students find the subject technically challenging with a high degree of conceptual understanding required to be able to tackle the problems and produce a meaningful design. Students work in groups in the workshops and tutorials on their group design and problem solving. This year they have been introduced to two initiatives - online quizzes (with feedback) and a style of team based interaction referred to as Team Based Learning (TBL), (Michaelsen & Sweet, 2008). On arrival at the workshop the students are given an individual multi choice quiz for the first 15 minutes in which they fill-in bullets (circles) on the form to indicate their answer. These questions are based on the lecture topic. These forms are then collected and immediately processed through an automatic marking machine. Whilst this is occurring the groups are working on a team-based quiz covering the same material. These group questions are presented in the form of multiple choice questions with a scratch-off zone (block) for each possible answer. The team agree on which of the multiple choice answers is correct then scratch off that block – to reveal either a star (correct) or a blank (incorrect). A second or third box may be scratched off – with marks reducing depending on how many blocks are scratched off.

Second year civil engineering students take Water Engineering in their first semester and just as for the Pollution Control course above, students find this subject conceptually challenging. Historically this course has been challenging to teach with large classes (over 200) and strong criticism of the feedback – as assessed by the CES (internal QA evaluation). In previous years online quizzes were adopted but these had no effect on the students' perception of feedback – even though the questions gave feedback/responses following incorrect answers. Last year (2009) small class size tutorials were trialled to offer more staff student interaction time, but again there was little improvement in student perception. This year worked examples were combined with team quizzes that were returned the following week. The course comprised a lecture followed by a tutorial. The students on arrival at the tutorial undertook a brief individual quiz based on the previous week's tutorial followed by a team based quiz (for 30-40 minutes) comprising technical questions on the subject matter of the previous lecture. The team quiz was open-book and there was assistance available in the form of help/guidance/hints from the tutor. The tutor then finished the session with a worked example (on the week's lecture material). The team quizzes were returned at the start of the following week and discussed where necessary. 20% of the overall marks for the course were attributed to this exercise.

Third year courses

Third year environmental engineering students undertake a course titled 'Wastewater Treatment and Recycling' (in the first semester) in which they engage in lectures, laboratories, tutorials, field trips and group discussions. The students are assessed by presentations, reports, and an examination. The students work in groups in the tutorials. Using the same approach as for the second years taking Pollution Control (above) these students were introduced to online quizzes and Team Based Learning.

Evaluation

Quality Assurance surveys are conducted for all courses at RMIT – the questions used are the same as for the national CEQ (Course Evaluation Questionnaire) and involve assertions assessed by a five point scale representing a range between 'strongly agree' and 'strongly disagree'. The six questions relating to feedback and assistance are amalgamated during post-processing to produce a 'Good Teaching Scale' (GTS). The value represents the percentage of students in the cohort who 'agreed' or 'strongly agreed' (selected 4 or 5). The surveys are conducted by independent staff members (not associated with the course).

The second year students taking Water Engineering were also surveyed with a more targeted questionnaire at week 5 and week 11 of the 12-week semester.

Focus groups conducted by an outside facilitator were used to assess the online quizzes and Team Based Learning as used in the second year Pollution Control and third year Waste Water Treatment course.

Results

Surveys

Table 1 below gives results for the various CES surveys.

Table 1: Results of student CES surveys

Question	Week	Very useful	Quite useful	Useful	Not very useful
How useful are you finding the tutorials in this course in helping you to learn?	5/6	73%	27%	0%	<1%
	11	67%	30%	2%	<1%
How useful are you finding the group quizzes in helping for better understanding and feedback?	11	90%	9%	<1%	<1%
How would you rate the connection of your assignment on 'north-south pipeline project' with real life problem to learn in this course?	11	62%	31%	6%	<1%

Table 2 gives the key results for the additional surveys conducted on Water Engineering – the table shows results for week 5/6 and week 11. These surveys were conducted using an anonymous Likert response scale questionnaire.

Table 2: Water Engineering – Week 5/6 and Week 11 surveys – key questions

COURSE	Class size	Survey size	GTS result for previous year	GTS results following initiative
Year 1 – Engineering Practice II	213	103	52%	68%
Year 2 – Pollution Control	54	48	46%	60%
Year 2 – Water Engineering	229	149	34%	60%
Year 3 – Waste Water Treatment	29	29	45%	79%

The questionnaires in week 5/6 included open-ended examples aimed at gaining general feedback of the form: 'What is the best thing about the tutorials you have attended in this course'; 'What would you like to see changed in the way the tutorials are run?' The responses were used to judge the effectiveness of the general delivery of the tutorials and to guide fine tuning of these. As it turned out, a large number of students commented that the tutorials were far more helpful in aiding understanding than the lectures, during which the theories were derived and equations developed.

Focus Groups – Pollution Control and Waste Water Treatments (Year 2 and 3)

The purpose of the focus groups was to explore students' uses of and responses to the two teaching innovations used in these courses. These innovations comprised a set of online practice quizzes to develop capabilities and enhance skills in areas where students' performance indicated weaknesses, and Team Based Learning (TBL). The TBL is a process whereby students arriving at tutorials are asked several brief questions and marked on their answers. They then join together in groups to discuss the same questions and arrive at a group consensus on the correct answer. No marks are awarded for the online quizzes but the TBL carried marks.

Students report that they find the online quizzes helpful and would not want them discontinued but they have issues with the organisation of the tool and in dealing with making the connection between lecture and textbook content and the processes of problem-solving that the quizzes require. In terms of the organisation they did not see the point of having a limited time that the quizzes were active. The reason for this had been that the lecturer is naturally focused on the progression of the course from topic to topic and lecture to tutorial and has timed the delivery of the quizzes to fit in with this progression; students however juggle the work associated with several courses and need to fit the quizzes in when it suits them, not necessarily when it suits the course. The lecturer's aim had been to provide feedback on the online quizzes in the following tutorial and allow a few days for students to retry the quiz. In addition they were frustrated by the ability to retake the quizzes but each retake involved answering all the questions – including the questions they had answered successfully (with randomisation of question detail such as numerical values). This was later improved by placing the questions in subsets of subject area and skill level (e.g. fundamentals, medium level and advanced level) – the students appreciated this. Several students considered that they should have credit for the number of attempts as well as whether they succeeded in obtaining the right answer – i.e. a reward for effort. Students thought that this ability to repeat but with different numbers created problems for them in figuring out where they went wrong. It seems that when they submitted an incorrect answer they would try to work out where their mistake was, but in the absence of a correct answer they couldn't be sure that they had really spotted the mistake. Randomisation of question parameters in the next attempt meant that even if they succeeded at the next attempt they were still left unsure about having the correct working. Students reported that a major stumbling block for them with the quizzes was in knowing what process to use to solve the problems – and there was no help offered at the time.

Students were enthusiastic in their support for TBL, finding the group work motivational and reporting

benefits from hearing how other people approach the problems. For both groups, they valued TBL over online quizzes although they said if they were forced to choose they would like more TBL (may be not all of it assessed) through the semester and online quizzes used for exam revision. The third years seemed generally more comfortable with the process, with second years reporting that it took them some time to get used to the process. Students in both years reported that they would like more time to prepare for their TBL, even though they don't get the questions until they arrive in class. With regard to the teamwork all students thought that this was the strength of the approach - typified by these quotations: "*You gain the most because you do it with your group. You work through it in the second part and they explain it to you and that's sometimes better and you then can see how to get the right answer so you know exactly how to tackle that question*" (3rd year student); "*If you're working by yourself if you get stuck you get stuck but when you're in the group you see other reasons*" (3rd year student). Feedback was mentioned on many occasions – typically: "*We get instant feedback and you get to hear what everyone thinks* (3rd year student)*; I like hearing how other people interpret the questions*" (2nd year student)*.* The students thought that the TBL group discussion helped them get over the problem they found with online quizzes - of not being sure how to attack the problem. There are some issues around the students knowing how to link the problem tackled during the TBL to the rest of the course material (the bigger picture), and more examples in lectures was cited as the change most likely to help with this.

Discussion

All indicators suggest that the interventions were successful in improving the quality of feedback that the students' perceived that they received.

Three courses incorporated Team Based Learning in so much as there were individual exercises followed by a team challenge based on the same subject matter. This has two effects – one to create an atmosphere/feeling of responsibility – if a team member does not turn up the team is at a disadvantage. It produces a realisation that the team produces better results as a result of cooperation. In several cases teams with low individual marks produced the top team marks. In addition the marks awarded for the individual component and the share of marks received from the group mark acted as a great encouragement to attend the workshops. Tutors reported a noisy active atmosphere while students were engaged in the team exercises. The students' enthusiasm for the TBL was clearly demonstrated through the focus groups. Two of the courses used automated marking and scratch-off pads to return marks (feedback) during the (same) workshop. During the first year (Engineering Practice) course the submissions were marked and then returned the following week. In the EWB course the activities changed significantly from week to week and it was felt that this resulted in the feedback arriving too late to be useful and hence some of the advantages of the system were lost.

The second year Water Engineering course, although apparently exhibiting differences in approach to the TBL – there are critical similarities. The students worked in teams on exercises (although with tutor and open book help) that were based on the current lecture topic. The students arrived at the tutorial having been prepared for the initial questions by the lecture and then worked on examples from the last tutorial. So the exercises are timely and relevant to the current topic. In the TBL approach marks are received during the same tutorial – in this case they were returned a week later. However this had little effect as the course had a natural progression from topic to topic and the feedback was received before tackling similar questions at the start of the following tutorial (hence the feedback had an immediate beneficial effect in the next tutorial).

In summary and with reference to the ideal characteristics of good feedback of quality, quantity, timeliness and equity (Jollands et al., 2009 and McCallum et al., 2008) the TBL and allied approaches adopted here provide many of these features. Good quality is achieved by virtue of the exercises being relevant to the current topic and the help being freely available in the workshops – from peers and tutors. Feedback is timely - received personally during the tutorials and when the marked exercises are returned. The returned assessments are in good time to assist the student in understanding the next tutorial (as the topic is still relevant). Students clearly believe that the feedback is of sufficient quantity and there have been no suggestions of unfairness –due to the assessment process being open.

The online quizzes, whilst resulting in some positive feedback, were more problematic. The

management of these quizzes appears to be critical. The previous trials in the Water Engineering course were found to be ineffective in providing students with their desired level of feedback and the approach was abandoned and replaced by the considerably more successful tutorial team-based group quizzes reported above. The online quiz trials reported here have resulted in some positive response from the students however there are key aspects to note. They are difficult to time to coincide with the relevant topic being covered in the lectures as students prefer to work to their own timetable. They are not perceived to be good at improving understanding – even when multiple attempts are allowed. The students have no (timely) mechanism to get help when they cannot obtain the correct solution. In terms of the above criteria for good feedback the quality is not as good as the TBL approach because it is not helpful. The 'canned text' associated with an incorrect answer does not always offer enough help. Likewise the quantity of feedback is not perceived as sufficient – there is not enough explanation. With regard to timeliness there are issues regarding the controlling of the delivery of quizzes to match the progression of topics. The students suggest that they should be used as revision for the exam and that TBL creates a better learning experience.

Conclusions

The use of the Team Based Learning exercises and similar approaches adopted here result in significant improvements in the quality of feedback that the students perceive they receive.

The timeliness of the TBL exercises (in terms of the progression of topics), the positive influence in terms of individual attendance, team responsibility/engagement and the prompt feedback are major contributors to its success.

Online tests/quizzes are not a substitute for tutorial based problem solving.

Online quizzes have a place in the learning environment but have to be managed and organised carefully. Issues of feedback, timeliness and availability of assistance should be addressed when implementing these techniques.

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