Trialling an Assignment Structure that Develops Generic Competencies and Enriches Subject Understanding

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Abstract: *This paper reports on a new assignment structure that aims to address the rapid changes in content, and improve student engagement by assigning individual topics to students. It has been trialled in a third year introductory course for computer systems and communication networks. Two thirds of the students in this course are located off campus. As part of the assignment, students have to research an individual topic that extends the course content. Students disseminate the results of their research in presentations to the class along with a written report. The presentations are scheduled throughout the semester to coincide with study module content and are available online. Both, presentations and reports are assessed by peers. All presentations are recorded so they can be viewed and assessed by all students. This paper introduces details of the assignment and the mechanics that are employed to facilitate this structure. Post-course survey results are analysed to show the student's perception of this new structure.*

Introduction

The pedagogy of many engineering courses has to adapt to rapid changes in science and technology and there is a trend in Engineering Education towards a stronger focus on generic competencies such as life long learning, written communication and presentation skills, but this is not at the expense of discipline technical knowledge. Generic competencies are also referred to as soft skills or transferable skills. The focus on transferable skills is in direct response to professional bodies such as Engineers Australia, and employer demands (ABET, 2007; Engineers Australia, 2004; IEEE, 2002). This university has a large and diverse external student cohort, which makes it difficult to teach and assess generic attributes whilst catering to individual student learning. External students have limited opportunities to engage with lecturers and other students.

In S1 2009 a new assessment structure was devised to increase student engagement with the assessment process as well as dealing with the rapid change in technical content. The assessment strategy was run as a pilot trial in a course of 59 students. The assessment included students selecting their own project topic (from a given list), researching the current technical literature, writing a report and developing a presentation to explain the technology to the rest of the student body. These reports and presentations where electronically published and other students where required to critique and assess their peers using given marking rubrics.

Rubrics are systematic scoring methods that use pre-determined criteria to measure student learning for grading assessment. This leads to a more objective and consistent assessment of student work (Brodie & Gibbings 2009). They also help to clarify grading criteria, demystify the marking process and encourage student self-judgement. Tierney & Simon (2004) offered some suggestions, examples, guidelines and principles of how to design effective rubrics. This work has been used as the basis for developing marking rubrics within the faculty and in particular for use in Engineering Problem Solving 1 (Brodie & Gibbings 2009).

The benefits of self and peer assessment have been widely acknowledged in the literature (Brown et al. 1994, Bostock 2000). Potential benefits include improved motivation and ownership, critiquing, evaluation skills and life long learning. If graduates are expected to develop as lifelong learners, then

they must also become adept at objectively assessing their own learning (Williams, 2008). Rather than disempowering learners with strict summative assessments, greater emphasis should be placed on technology-supported tools and techniques to assess context based learning (Brodie & Gibbings, 2009).

Cassidy (2006) suggests the peer assessment also improved 'soft skills' which are increasingly important graduate attributes. Bostock (2000) proposes that student assessment of other students' work has potential learning benefits to both students by encouraging student autonomy and higher order thinking skills. In addition such a system can be easily enabled and assisted by technology.

This paper reports on a trial of an innovative assignment structure that combines a marking rubric and peer assessment to encourage student engagement. The remainder is organised as follows: Section 2 discusses the context of this course and the motivation for the changes. Section 3 introduces the assignment structure and discusses the assessment components in detail. Results of an initial student survey are presented in Section 4. Anecdotal observations and insights are raised in Section 5 and future work is discussed in Section 6.

Context and Motivation

The trial of this new assignment structure was motivated by three aspects. Firstly, the subject in question covers a wide range of computer systems and networking topics. Content in this area is emerging fast and changing rapidly. For example, microprocessor enhancements are introduced on an annual basis. A review of the course content, using concept mapping (Phythian, 2008), identified a number of topic areas that were not covered. However these topics were required for a logical flow of content and the completeness of the subject discussion.

Secondly, there is a strong demand for the inclusion of generic skills. It has been widely acknowledged that many students will work in jobs in the future that are not known yet. Content is losing importance in such a changing environment. It is expected that employees are able to acquire knowledge as it is warranted. Generic and transferable skills on the other hand are gaining importance.

The last aspect is the nature of the student body. About 2/3 of students are located off-campus. Therefore any new assessment scheme has to account for the student body. It also limits the activities that can be included as part of assessments.

These aspects lead to a number of key learning objectives for this assignment: Researching a topic in computer systems or networking, get an understanding of developments in the area, evaluate other work and place students' own abilities in the context of others; and improve generic skills such as communicating concepts to others, presentation skills and report writing skills. From a teaching perspective, the following objectives can be added: Fill gaps in the curriculum, address rapid changes in content and engage external students.

Assignment Structure

The assignment structure in this course consists of two components. The first component consists of six online quizzes, worth 2% each of the final marks, to provide students with an opportunity to evaluate their discipline technical knowledge throughout the semester. The second part is a semester project that accounts for 28% of the overall marks. The remaining 60 % of marks are allocated to the end of semester exam. The emphasis of this investigation is on the semester project.

Semester Project

The semester project has three parts: A presentation, a written report and peer assessments of other student's submissions. Students have the choice to undertake it as a group assignment with up to three members or, as an individual assignment. Depending on their choice, the deliverables are slightly different.

Topics

This assignment covered topics that have been selected from the areas of computer systems and communication protocols. A number of topics are scheduled through out the semester to coincide with

other learning content in the course. This implies that assignment deadlines are not the same for all students, they are topic specific. A comprehensive list of topics and their presentation timeslots were published on StudyDesk, the University Leaning Management System (LMS). Each student/group selects a different topic. The selection process opens in the second week of the semester and closes in the third week. Topics are allocated in first-come, first-served basis. Presentations start in Week 5 of the semester.

Due Dates

The presentations and the written report are due on the allocated time slots. The peer assessment of the presentations and the report are due 2 weeks later. For a proper flow of the presentations, the assignment is relying on students to submit both, report and presentation, in the allocated time slots. This has several advantages: The presentations relate and extend the content covered in the lectures; there is sufficient time for the peer review process, the workload does not accumulate at the end of the semester, students have great flexibility as to when to do the assignment and the lectures are more diverse and interesting. Students are strongly encouraged to comply with the timeslots or notify the examiner in advance so the presentation can be rescheduled.

Marks for the presentation and the report are calculated as an average of all peer assessments that have been received. The report and the presentation account for 10% each of the final subject mark, the peer assessment of reports and presentations accounts for 4% each. Therefore this project accounts for 28% of the overall assessment.

Presentation

The presentations are delivered by all group members taken equal parts on the date specified in the topic table. Depending on the number of group members the presentations are timed to 10 minutes for a single presenter, 20 minutes for two presenters and 30 minutes for three presenters. Additional 5 minutes per presentation are allocated for questions. The presentations are scheduled as part of the normal lecture time. The requirements for off-campus students are the same as they are for on-campus students. However, presentations are pre-recorded and are played on campus in the appropriate timeslots. Detailed instructions on presentation recording are provided. It is expected that presentation software such as power point is used.

Written Report

The report is a formal, concise document that addresses the chosen topic in appropriate detail. It should be divided into sections and include suitably annotated and referenced diagrams. The report has to include a title, an abstract, a body, conclusions/summary and a bibliography.

The report is prepared using the IEEE template for transaction papers. Depending on the number of group members the length requirement of the report varies: 2 pages for a single student, 3 pages for two students and 4 pages for three students. Group members are required to have equal input into the report. The contributions of individual team members are assessed by team member rating forms. Marking rubrics are used to assess the report by peers.

Peer Assessment

One key component of this assignment is the peer assessment. From a student perspective the peer assessment directly integrates with the LMS. Students access a web page and get a random sample of topics that have to be assessed by them. On this page students follow two links to access the marking rubrics for reports or presentations. The marking rubric appears as another web page where students can select the appropriate phrases and provide additional feedback. Figure 1 depicts an example rubric for one category. After the reviews are completed, they are submitted online. Results are not made available until the end of the semester. Then students can access a summary page that shows average scores for the entire items that have been assessed. Minimum and maximum ratings are also included. Finally their own average assessments of other students' work is placed into context.

Comprehensive

○ Excellent coverage of all the major aspects within the given time frame.

○ Most of aspects have been addressed in great detail.

○ Most of aspects have been addressed.

○ An appropriate number of aspects have been addressed.

○ Minor aspects have not been addressed.

○ Major aspects have not been addressed

Figure 1 Example Rubric for one category used to assess presentations

This process resulted in almost 2000 peer assessments for this trial. The large number of peer assessments from a relatively small cohort of students indicates that most of the peer assessment process, including collection and analysis has to be automated. A custom built system has been developed to facilitate the assignment delivery. It consists of a set of PHP scripted web pages and a MySQL database that holds the information. Currently this is a separate system that is only visually integrated with the LMS. It is envisaged that the system to be fully integrated in the future.

Initial Survey Results

To assess the student's perception of this assignment structure, a 20 item online survey was constructed. The survey wars run at the end of the semester. Students responded to each item on a five-point scale from strongly agree to strongly disagree. Out of 59 students in this course, 40 completed the survey. 65 % of the responses were from external students, 35% from on campus students. This is close to the ratio of students that participate in the course: 61% external and 39% on-campus.

An overwhelming number of student responded positively to the possibility of choosing their own topic, 65% strongly agreed and 30% agreed. A similar response could be seen for the free choice of a timeslot for the assignment, 60% strongly agreed and 27.5% agreed.

A large number of students believe that they learned practical skills that will help in their workplace, 50% agree and 32.5% strongly agree. This is particularly encouraging as 60% of the respondents are working fulltime and 27.5% of the respondents are working part time. Many students will have a considerable amount of work experience as the average age of the respondents was 30 years, the youngest being 18, the oldest 46 years.

Most students believe that as a result of the assignment, they are better equipped to write reports (56% agree, 32.5% strongly agree) and presentations (60% agree and 27% strongly agree) in the future.

The peer review exercise was seen as a valuable experience by most respondents; 57.5% agree and 20% strongly agree that peer reviewing broadened their understanding of the topic areas. 60% agree and 32.5% strongly agree that looking at other students' assignments made them aware of their own mistakes. Students were also able to gain a better understanding of their own abilities in relation to their peers, 62.5 % agree and 25% strongly agree.

The feedback process is seen as valuable from both perspectives as an assessor but also as an assessee. Students believe that their feedback will help their peers to improve their work, 57.5 % agree and 22.5% strongly agree. They also believe that the feedback of their peers was constructive and useful, 65% agree and 25% strongly agree. 67.5% agree and 25% strongly agree, that they will take the feedback on board for future assignments

32.5% of the respondents stated that they had difficulties researching the information that was required for the assignment and 25% found it difficult to summarise concepts in formal English writing. 40% reported that they don't like public speaking and that they found the presentation challenging. Nevertheless, almost all respondents found that researching their own topic was a rewarding learning experience, 42.5% strongly agree and 52.5% agree.

In regard to the original objectives to implement this structure of addressing rapid changes in content and to fill gaps in the curriculum, responses have been positive. Students are aware of other topics that are related to this course, 67.5 % agree and 25% strongly agree; and the assignment broadened the student's knowledge of the subject matter, 52.5 % agree and 37.5 % strongly agree.

Finally, 90 % of respondents indicate that they enjoyed these activities and 80% would like to see similar activities in other courses. These results show that students have a positive attitude towards the assignment and the way it was implemented

Observations

In course specifications, deadlines are generally fixed and assignment specific, in this new structure, deadlines are individual for all topics. This means that each student (group) has an individual deadline. University processes and documentation do not account for this. To work around these limitation students were strongly encouraged to submit their work in time and most students were supportive. Only a few students did not work to the deadlines. For future offerings, the official deadline for the assignment will be set early in the semester, individual deadlines are then extensions of the single fixed deadline and penalties can be imposed for late submissions.

In this trial students had a choice to do the project as an individual or group assignment. Surprisingly, 75 % selected the individual option. As a result the number of topics and presentation time slots had to be increased. Presentations throughout the semester and the final results suggest that mostly weak students selected the team option. Unfortunately, this was generally not to their benefit as requirements for groups were higher, i.e. longer presentations and more detailed reports. It is expected that the same student body would have been able to achieve higher marks for individual assignments. In the next offering of the course, the group option will no longer be included as a consequence.

Anecdotal evidence suggests that the new assignment structure was of greater benefit to external students. In previous years the rate of HD in the external student body, 13.6%, was consistent with the number of HD in the on-campus cohort, 9.5%. In the current year with the changed assignment structure this rate improved considerably for external students to 28.6%, for on campus students it remained at a similar level of 8.7%. As the assignments cover only 40% of the course marks, it suggests that the activities help external students to engage more with the subject and allow for better learning outcomes. External as well as on-campus students had also access to video recordings of the on-campus lectures available.

Initially a concern was that students would mark assignments of their friends up. However, students have to assess a random sample of 20 out of 59 topics. Therefore each assignment was scored by an average value. A few biased assessments in the pool don't have a major impact on the final result. Three extreme cases, where average assignments were graded with close to 100% of the marks were recorded. These instances were removed and the students were notified. It is envisaged that in the future more elaborate methods are used to detect biased assessments.

Most assessors had similar expectations. However, there were a number of students whose assessments were consistently lower or higher then the average. There was no action taken as a result of this observation. However, there is the possibility to weight student assessments by their ranking in regard to other assessors in the future. This would mean that somebody who is very strict in their assessments would be marked at a higher standard.

Future Work

The administration interface of the current system is rudimentary: to be able to use this on a larger scale, additional development work is required. There is also great potential to facilitate the use of

these techniques in other courses where 450-500 students are being assessed. Potential time savings for staff in the order of 350 hours could be redirect to more rewarding teaching activities.

The aim of this project is to develop an online rubric module and peer assessment system. This will include scoping the project by identifying potential users, identify their needs, and incorporate these requirements in the system. It is envisaged that the system will be trialled, evaluated and integrated into a Moodle online learning environment.

To date on the pilot study, anecdotal evidence indicates that this approach improves external student engagement and the learning outcomes of students have greatly improved. It is envisaged that a rigorous investigation of this anecdotal evidence using appropriate education research methodologies will be undertaken.

Conclusions

This paper has introduced an assignment structure that consists of online quizzes and a research project where students disseminate the results of their investigations to peers. A pilot trial with a cohort of 59 students was run in S1 2009. Student feedback from this pilot trial, gathered from the survey and unprompted correspondence has been very positive. It is encouraging that the results of external students have improved considerably above the normal yearly fluctuations. This is particularly remarkable as the assignments accounts only for 40% of the overall masks. During seminars and in individual discussions, academic colleagues indicated interest in the project and further development of online marking rubrics which can be designed to suit a variety of assessment criteria and learning objectives. It is concluded that the initiative challenges students, as it diverts from the norm, and, at the same time, helps to develop new skills and interests.

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