Multi Assessment Approach to Major Projects

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ABSTRACT: All engineering students completing the final year of manufacturing and mechanical engineering at Swinburne University of Technology must undertake a comprehensive final year project encompassing many areas of research, design, analysis, or management, often integrating many of these aspects. It is often the assessment of the project, not the pursuit of it by the student that presents difficulties particularly with respect to bias by academic assessors. Hence it is difficult to compare and quantify the final results of a cohort of projects resulting from many different supervisors. In an attempt to make the assessment process free from bias; a multi-valiant set of assessment procedures have been introduced. In all seven steps are involved in the assessment procedure, only one of which is directly dependent on the supervisors, thus reducing their influence on the final grade. The results of this assessment procedure have produced a spread in the series of grades or results, whereas in previous years an obvious bias was seen in relation to the supervisor student relationship. The current assessment procedure has been shown to be bias-free with regards to high or low grades and was a reflection of students’ grades in other subjects. Overall, there seems to be satisfaction by both staff and the student cohort in the overall final marks achieved.

KEYWORDS: assessment, evaluation, project, presentation, learning outcomes

INTRODUCTION

The Institution of Engineers Australia is currently promoting the incorporation of project work into all levels of engineering courses [1]. Program structure and content...engineering design and projects. At the final level of engineering instruction all engineering students completing the degree course manufacturing and mechanical engineering(BE) at Swinburne University of Technology (SUT) must undertake a comprehensive project. The project may encompass many areas of design, analysis, research, development or management. Often the projects integrate many of these aspects. These requirements constitute 25 percent of the overall final semester assessment. The students are encouraged to tackle real problems to which they can contribute solutions. Industrial sponsors or academic supervisors or both define or suggest the theme of the project.

The recognition and incorporation of major projects in the final year of an engineering course have also recently been implemented in many universities around the world, like those at the Universities of Aachen [2] and Uppsala [3], Greenwich [4] and Nanyang, Singapore [5] together with numerous universities in the USA, Asia and Australia [5-9].

It is often the assessment of the project, not the pursuit of it by the student that presents difficulties for the academic staff. In the past, techniques of assessing the project have proved troublesome, particularly where the academic supervisor has control over the execution of the project and has some positive or negative bias towards either the student or his or her project. This bias is often introduced in the final assessment, making it difficult to compare and quantify the final results of a cohort of projects resulting from many different supervisors. The integrity of the academic process requires fair and impartial assessments and honest academic conduct on the part of the staff and the student(s).

In engineering design (similar to the requirements of design in mechanical engineering) it was also perceived to be an assessment task which was difficult. This assessment was entirely based on oral (20 percent) and written presentations...
The importance of project management is highlighted by the integration of this area with the research aspect of the project. The assessment of the project proposal is completed wholly within the management subject by assessors with expertise in engineering management. This section of the assessment comprises 10 percent of the overall mark. The balance (90 percent) is determined at the end of second semester.

The balance of the assessment is determined according to the quality of the written report, by two assessors (according to a prescribed assessment set of criteria [10]). In addition there is a formal oral presentation (with two additional assessments), a poster display (again with two further independent assessments), and a project performance assessment by the students' supervisor - the only direct influence by the supervisor. The contribution of each section of the assessment to the overall score is given in Table 1 where it is seen that the marks are averaged over at least five sets of scores (but includes seven assessments). The overall assessment is calculated as indicated in Table 1, from a range of different assessors and assessment processes.

Table 1. Determination of the overall final assessment mark.

<table>
<thead>
<tr>
<th>OVERALL FINAL MARK</th>
<th>L + E + (C1 + C2)/2 + (P1 + P2)/2 + (T1 + T2)/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>project proposal</td>
</tr>
<tr>
<td>E</td>
<td>student performance</td>
</tr>
<tr>
<td>C1, C2</td>
<td>written report assessment 1 and 2</td>
</tr>
<tr>
<td>P1, P2</td>
<td>poster assessment 1 and 2</td>
</tr>
<tr>
<td>T1, T2</td>
<td>oral presentations assessment 1 and 2</td>
</tr>
</tbody>
</table>

Organisation of Major Project Assessment

The majority of projects are organised for completion by groups of two, three or four students. The involvement of three or four students occur where the project brief is too large for two students to undertake or where there is a shortage of appropriate academic staff. In exceptional circumstances, an individual student undertakes a project. This usually

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occurs when the student is working part-time and it would be difficult to organise additional partners (i.e. another single student). The marking scheme does not take into account the number of students attempting a project, but recognises the situation that one project is being investigated requiring one overall report.

Because one assessment is developed for the overall report, the project partners attempt to achieve excellence in their work - they are dependent on each other to achieve a good assessment, fostering teamwork. They learn to work in groups and interact with each other. They learn both dependence and independence in the completion of their work (written, oral and display). Two copies of each report are collected from each project group. The reports are distributed to the students’ supervisor, and an independent assessor, who may not be familiar with the thesis subject but allocates marks based on strict criteria of report structure and content. What is important is not only the students’ understanding of their work, but also their comprehension of report structure and cohesion in developing a thesis topic.

Assessment

The early project work, during first semester, is assessed outside of the main engineering stream is the project proposal. This is conducted by the management personnel and constitutes 10 percent of the overall assessment. This mark is carried directly into the final assessment. Thus, there is an integration of both the research work and the management aspects of the project.

The only section of the project assessment which is dependent on the supervisor, is the general performance during the conduct of the research project, and this constitutes 10 percent of the overall assessment, thus reducing the supervisor’s influence considerably (both in a positive and negative sense).

For allocating marks, the report is marked as a whole, as is the project proposal and the poster. So each group member receives the same mark for those sections of the assessment. However, individuality is accounted for with the marks for oral presentations and performance.

The assessment of the report is based upon a comprehensive set of criteria relating to the format, structure and contents of the thesis [4]. A detailed analysis of the report assessment is given in that reference. As this section of the assessment comprises 50 percent of the overall mark, the average of two assessors’ reports is utilized in the overall mark.

The presentation of the students’ work is organised in the format of a conference. Two staff members are present as chair and co-chair. These two staff members also have the role of assessors for the presentations that are delivered during a particular session. Neither of the assessors is the project supervisor. An abstract booklet is produced to highlight the individual projects. All presentations are allocated twenty minutes and all participants of the project must take part in the presentation – their assessment mark is dependent on their involvement. There are nominally four presentations in one session. In general there are four sessions per day, giving a total of 16 presentations, this results in parallel presentations with a large cohort of students. All students are required to be present for at least the half day in which their project is scheduled. Supervisors are present as well as invited members of the academic community together with industrial visitors who may have sponsored the projects.

The oral presentations are assessed in a different manner from the written presentations. There are no prescriptions for marks, there is an overall mark required (averaged over the two independent assessors); however, they are required to take a number of factors into account including content, presentation style, use of audio-visual facilities, clarity of language and handling of questions from the audience.

Poster presentations are also assessed in a different manner to the written or oral presentations. All the poster presentations are displayed together in one central area. The assessment is based upon a comparative judgment. Up to four faculty members
determine which are the best projects, and which are the worst - allocated full marks and half marks respectively, according to their relative merits - again a subjective assessment. The remainder of the posters are classified within those two upper and lower limits. It has been found from experience that a comparative assessment was a very acceptable way to allocate marks. Moreover, the assessors are required to take a number of factors into account, including readability, clarity, and succinct description of the project, overall appearance and engineering impact on the audience.

All the students are required to be present for the whole conference day, albeit in various sections, e.g. oral presentations, poster displays and in the general meeting areas. Refreshments are available and various members of staff, students and industrial guests are able to discuss the work performed by the students.

Assessment Results

The distribution of assessment results is discussed below according to the different marking variables shown in Table 1. In addition, a correlation analysis was undertaken between various marking parameters and the final overall mark, in an attempt to predict this final outcome. This prediction may present itself as an indicator to assist both students and their supervisors in the achievement of satisfactory results.

The distribution of marks for the project proposal is shown in Figure 1. The data is best fitted by a logistic distribution similar to a skewed normal distribution. The data has been normalised and a curve fitted to this data. The left tail data is an indicator of non-performance by some students resulting in counselling before the commencement of the overall project. Some students decided to withdraw at this stage and continue the project in the following year.

Assessment of the oral presentations by two independent assessors produced the histogram and fitted distribution of marks as shown in Figure 2a where a right skewed bell-type curve of data is obtained. The range of marks was between 55percent and 95percent. A similar distribution was obtained for the poster assessment, Figure 2b. These presentation skills by students are seen as important for job interviews and their working environment [1] and are an indication of their ability to communicate well.
A correlation of the marks by the assessors between the presentations and the posters resulted in a correlation coefficient of between 0.78 and 1.

Depicted in Figure 3a are the results of the project report analysis which indicate a large scatter of results, again demonstrating considerable scatter in allocating marks by the assessors. This may be interpreted as an indication of the different values various assessors place upon the relative importance of assessment criteria. This is a matter requiring further investigation.

The results indicated in Figure 3b show that there is a definite bias to awarding high (or decidedly low) marks by the supervisors for their individual students' reports, as well as awarding high (or decidedly low) marks for the students' performance within the project. This may be interpreted as a form of bias on the part of the assessors.
The results of this assessment procedure have produced a right skewed curve series of grades or results, commensurate with those in previous years which also showed a skew towards one end [4] of the curve. This may indicate an inherent bias by assessors who are also supervisors. There are also a few outliers, indicating non-performance by a small cohort of students.

An interesting outcome is that from a series of correlation processes to determine which assessment procedure would be able to predict the overall final mark, the first assessment of the project proposal, was the best predictor. Shown in Table 2 are the values of linear correlation coefficients for all the assessment variations as a function of the overall final mark. The correlation data is not weighted according to the relative input from the various marking parameters.

Table 2. Various correlation coefficients of assessment components versus overall mark.

<table>
<thead>
<tr>
<th>Item</th>
<th>Correlation Coefficient</th>
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<tbody>
<tr>
<td>Project proposal versus final mark</td>
<td>0.78</td>
</tr>
<tr>
<td>Oral presentation versus final mark</td>
<td>0.05</td>
</tr>
<tr>
<td>Poster presentation versus final mark</td>
<td>0.06</td>
</tr>
<tr>
<td>Individual student project</td>
<td>0.67</td>
</tr>
</tbody>
</table>

As an early predictor of the overall final mark, the first semester mark for the project proposal shows a high correlation, as shown in Table 2. All other assessment components do not indicate a high correlation with the overall final mark, except for the final written report. At this stage the students have completed their work and it is the weighting attached to the final report (50 percent) which greatly influences the positive correlation.

CONCLUSIONS

This assessment process has shown to be bias-free with regards to high or low grades and was a reflection of students’ grades in other subjects. It has been found that there is a strong correlation between students who perform well in the initial project proposal and their final overall mark. In particular there is a strong positive correlation between the marks for the written report and the final overall mark. However, there is little or no correlation between the oral presentation and the overall final mark, and the poster mark and the overall final mark. As an indicator of final results, the initial project proposal is sufficient to indicate the students’ overall project performance.

ACKNOWLEDGEMENTS

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REFERENCES

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