Getting it right: Assessment tasks and marking for capstone project courses

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Capstone projects represent the culmination of an undergraduate engineering degree and are typically the last gatekeeping measure before students graduate and enter the engineering profession. In Australia there is a longstanding interest in and commitment to developing quality capstone experiences. A national study into the supervision and assessment of capstone projects has determined that whilst there is relative consistency in terms of what project tasks are set and assessed, there is not comparable consistency in how these tasks or assignments are marked. Two interconnected areas of assessing process and the role of the supervisor in marking are identified as contentious. This paper presents some findings of a national case study and concludes that whilst further investigation is warranted, assessing process as well as project products is valuable as is the need for greater acceptance of project supervisors as capable of making informed, professional judgments when marking significant project work.

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Background

Getting assessment right in capstone project courses in engineering education programs is critical not only in terms of ensuring students have met course outcomes, but because the projects themselves are often indicators of wider requirements. In Australian universities current wider requirements include meeting AQF (Australian Qualifications Framework) research capabilities and satisfying Threshold Learning Outcomes to be used by TEQSA (Tertiary Education Quality Standards Agency) – as well as Stage 1 Competencies for Engineers Australia - the national professional body for registered engineers. In addition, many universities in Australia take project courses as evidence of achievement of graduate attributes and/or generic skills. Assessment of project or capstone courses is typically the last gatekeeping measure before students graduate and enter the engineering profession. It is important to get both the tasks and assessment processes right.

As has been noted elsewhere, the Final Year Engineering Project (FYEP) or capstone project is a unique undertaking as students work largely in self-directed ways and are expected to embark on significant assessment tasks without structured support. [1] The student is not entirely unsupported; however, it is likely that they have not yet encountered a course with assessment requirements such as those associated with the final year or capstone project previously in their programs. Students are typically assigned an academic supervisor who mentors them through their project and assessment submissions. The supervision relationship often spans a year, through planning, implementation and presentation phases. This relationship holds particular implications for assessment and is seen to manifest at the point of marking and moderating project work.

The literature shows that there is a variety of ways in which students are assessed in their final year projects and indeed variation on how marking takes place. Assessment of projects can involve the full range of tools from peer to self-assessment, assessment of process and product, and formative and summative assessment.[2] Since the project course is usually extended and typically culminates in a final submission, there is often an emphasis on the place and value of formative assessment.[3] Similarly, portfolios and e-portfolios as means for recording and reflecting on project learning are advocated as effective assessment tools.[4] The complexity around the tasks set for students in these courses points to the need for consistency of practices and an assurance that project courses meet accreditation requirements. Making tasks and their marking criteria explicit to students is often seen as one way to address rigor and marking rubrics have been widely adopted in this process.

There is some debate around the use of rubrics for marking however. On the one hand, there is perhaps a rightly argued provision of “clearly articulated levels of

proficiency" in assessment criteria.[5] However, Sadler identifies that pre-set criteria is problematic and indeterminate and he suggests holistic marking be explored as a possible alternative.[6] Similarly, in acknowledging the problematic nature of rubric grading, Littlefair and Gossman suggest a combination of both analytic and holistic marking.[7] Interestingly, both Sadler and Littlefair and Gossman suggest some of the contention in such marking stems from the subjectivity to be found in the supervisor student relationship. This is at the heart of the marking debate. This paper presents issues of assessing the final year project as the significant task in capstone courses. Development of guidelines for assessing and marking FYEPs are emphasized outcomes of a research project funded by the Australian Government.

Assessment of FYEPs: An Australian Context

A large research project with seven partner universities is currently underway and is investigating best practice for capstone or FYEPs. The project, entitled Assessing Final Year Engineering Projects (FYEPs): Ensuring Learning and Teaching Standards and Australian Qualification Framework (AQF8) Outcomes, is funded by the Australian government's Office for Learning and Teaching. The research comprises two phases: a mapping and review of existing assessment and supervision practices followed by the development and promotion of guidelines to assist engineering disciplines to improve FYEP assessment. It addresses the need that although Australia has a strong history of developing FYEPs as capstone courses in engineering education, there is no national approach to assessment or supervision[8].

Adopting a case study methodology, the project has drawn on three sources of qualitative data: National and international literature, documentation such as course profiles, assessment rubrics and marking schedules and; semi-structured interviews with course coordinators. The data has been gathered from 15 universities across Australia. The interview data in particular offered rich insights into the practices accompanying the described assessment and enabled coordinators to articulate strengths and challenges. To date the findings have highlighted that university coordinators are reflective and committed to improved practice with many course coordinators commenting on changes and improvements made to capstone courses over time. Four main, interrelated areas themes have emerged from the data – intended outcomes, curriculum, supervision and assessment and within these a number of related topics and issues (see figure 1).

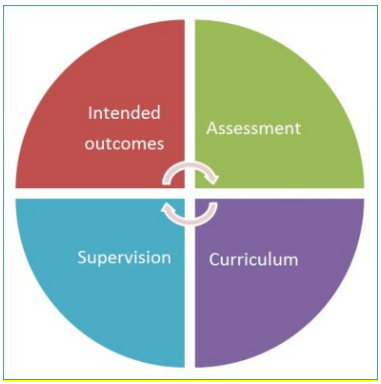

Figure 1 Interrelated Themes

This paper will focus on the area of assessment and what the findings to date illuminate, in particular, about the place of assessing process and the role of the supervisor in marking.

Methodology: Interviews with FYEP coordinators

Semi-structured interviews were conducted with sixteen individual coordinators of capstone project courses across a range of Australian universities. The interviews allowed participants to explain their documentation and their practices, and in particular to articulate the strengths and challenges of assessment and supervision. Interviewees were prompted with questions such as:

Tell me about some of the challenges you face with your final year project course.

What do you see as some of the strengths of the way you do things?

How are supervisors involved in the assessment and why do you do things this way?

The interview data supplemented and explicated the extensive documentary data mentioned earlier.

Process and assessment and the role of the supervisor

How students are assessed varies across (and sometimes within) institutions. Such variation might be expected given that the nature of the projects varies considerably – from design and implement to more research focused projects and from industry sponsored projects to internal university projects – as do the outcomes and standards, against which they are assessed, with some universities assessing against Engineers Australia Stage 1 Competencies, others graduate attributes and course-specific outcomes.

There are a number of commonalities across institutions with many requiring students to submit a report or thesis at the end of their final semester and this is inclusive of literature review, methodology and findings sections. In most cases the report or thesis is

the most heavily weighted assessment component, comprising between 35 and 100% of the final grade. Having the thesis as a final product and with a heavy weighting demonstrates that there is a preference for viewing a written product as the strongest indicator of meeting course outcomes. Indeed rather than the project itself being the object of assessment, the process undertaken as captured in the final report is seen as important.

Many rubrics for the thesis or final report included criteria for technical content knowledge as well as academic writing skills. However, the documentation from universities shows that in some instances, students are also assessed on project execution, overall competency, performance and/or professional conduct. Sometimes these things are marked implicitly, as aspects of the supervision relationship. The interview data revealed that in practice, some supervisors allow their knowledge of the students' effort and progress to influence the overall grade. This suggests that regardless of whether analytic or holistic marking is used, holistic summation is taking place.

In some instances, it could be argued that effort and progress are assessed in the early stages of student projects where progress or planning pieces are submitted as assessment items. These include progress pieces such as their reports and seminars as well as proposals and risk assessments. Such progress pieces are consistent with the literature that shows the importance of formative assessment in fostering student learning.[9] What remains unresolved however is the extent to which this early assessment and feedback shapes the supervisor's marking of the final report or thesis.

Results and discussion: Findings from interviews

There is not agreement amongst supervisors about what is actually assessed or should be, or even by whom. Some universities allow supervisors to mark all assessment pieces, including the thesis. Others give heavier weighting to a second marker who is not the supervisor and two universities in our study have moved away from the supervisor marking the thesis altogether and show examination practices more consistent with higher degree programs. This is contentious however, as one coordinator commented:

It's interesting that we seem to making a point about supervisors assessing the project themselves as an owner and yet they are quite capable of assessing everything else up that point. Why is this final year project so wonderful that they can't make a good, you know, decision on that sort of thing and so I think, I personally think that the supervisor should be involved in it…You're OK all the way up to the report but then you can't do it anymore...(Coordinator A)

The following quote from one interview participant encapsulates further the complexities around fairness in marking but also shows the emphasis of his institution on process over product. The interviewee is commenting on whether the supervisor of the project should be on the assessment panel for the oral presentation. In addition the comment shows the importance of reflection in this process – a skill not usually associated with engineering programs.[10]

Some semesters we say 'no, no. The supervisor shouldn't be part of the panel because he's biased' but then we say 'no, no. The supervisor knows very well what's going on so he should be in the panel.' …I think the more people get involved in the assessment the better…So my feeling is yes the supervisor should be part of the assessing because I make a huge emphasis to students what we assess is the process. We don't care what you are doing really. I mean I am very cynical and I tell them, tell it like this to make an impact: "'We don't care what you are doing, what we care is how you do it…How you make your decisions, how you make your assumptions, how you select components, what do you see as constraints, how do you plan, how do you follow your plan, how do you reflect on your plan, how you can say 'oh, I underestimated this activity' or 'I thought I had to do this.'" You know things like that. So that process, I think only the supervisor can really speak about, because in a 15 minute oral presentation it is very difficult to really convey all that process. So definitely, I think it is crucial that the supervisor is involved in that first assessment of the project. (Coordinator B)

Conversely, at another institution, the importance of the final product is emphasized, with the argument that only the 'product' in the form of the thesis is available to accrediting authorities so that the process –or insider supervisor knowledge – is not considered important, though the participant acknowledges that this does conflict the team. In other instances, this insider supervisor knowledge is referred to as supervisor bias.

Actually, coming back to the challenges, probably that's one of the challenges that we've faced, the fact that sometimes...particularly with the implementation part we see the thesis as the lasting artefact. So when Engineers Australia comes to accredit us, that's what they see. That's what we show them and that's what they

see. So they can't see the other bits. So we are always a little bit conflicted, I think, about the difference between the fact that thesis is the artefact and it's the lasting artefact of the student's work and yet sometimes there are other things that may impact on the grade you want to give the student and that can be a little bit of a tension sometimes I think. (Coordinator C)

Both of these coordinators acknowledge that the supervisor has knowledge about the student's work which may not be reflected in the 'products' submitted (an oral presentation or a thesis) and each sees this as a potential dilemma. In the first two instances the supervisor knowledge is viewed as valuable and should contribute to the marking process. The third is a bit more ambivalent, suggesting that what outsiders see should be completely defensible and therefore more tightly focused on product. Other interviews revealed that supervisor knowledge was thought to bias marking and so academics other than the student's supervisor were assigned to marking major assessment pieces. Such uncertainty about the role of the supervisor in the marking process points to the lack of consistency about what is marked: is it the project? The artefacts of the projects? The process? The implementation?

If there is broad acceptance for the insider knowledge a supervisor has about a student's engagement with the project – and in other areas of education, particularly teacher education acceptance of teacher's professional judgment of learners is longstanding[11] - then the tasks that can be assessed within a final year or capstone project can be broadened to include things that only the supervisor and student know – such as commitment and time management, creative problem solving, effort and implementation. Perhaps rather than trying to mitigate subjectivity, it should be seen as a valuable and meaningful way to assess the whole project rather than parts of it.

Conclusion

Students undertaking final year or capstone projects are expected to conduct sustained projects in largely self-directed ways and complete a number of assessment tasks with a supervisor mentoring them over an extended period. This supervision relationship can be seen to influence student grades in a couple of ways and there is some variation in marking practices within and across universities in Australia. Much of the contention hinges on the place assessment of process matters and the difference in perception about the role of the supervisor and the degree to which the knowledge they have of the student influences marking. There is a case to rethink and perhaps systematize how supervisors are used in the assessment process together with how to effectively assess and value process as well as product. This study has revealed that there are still areas to address in terms of best practice for assessment of FYEP or capstone project courses.

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