Supporting students through the final year engineering project experience to achieve AQF8 outcomes

Fae Martin[a], Roger Hadgraft[a], Alex Stojcevski[b] and Justine Lawson[a]
Central Queensland University[a], Deakin[b]
Corresponding Author's Email: f.martin@cqu.edu.au

Structured Abstract

BACKGROUND

The final year engineering project is widely seen as the capstone experience in engineering programs. For four year engineering programs aspiring to AQF8 accreditation, it is essential that the final year projects provide students the opportunity to demonstrate many of the descriptors for Bachelor Honours degrees. However there is wide variation in both the type of project that students undertake and the level and style of support that they receive from their academic supervisors. This paper presents one set of guidelines to emerge from a national project focused on the assessment and supervision of final year projects. The guidelines are focused on best supervision practice.

PURPOSE

This paper provides academic staff good practice guidelines on how to provide appropriate support to students through the final year project experience. Support provided should give the student an opportunity to demonstrate their ability to 'provide solutions to complex problems with intellectual independence' and to 'design and use research in a project' while maximising the chance of student success. The intention of the guidelines is to enhance academic project advisor capacity to ensure students meet the requirements of AQF8 outcomes.

DESIGN/METHOD

The wider project methodology was largely qualitative, adopting a case study approach. Data was gathered from 16 universities across Australia (from all states and territories) and included university documentation such as subject outlines, rubrics and student guidelines. Additionally, interviews were conducted with 16 coordinators of final year project courses. Within these interviews, participants were asked specifically about supervision practices and challenges. Additional data was gathered from participants during a conference workshop designed to explore understandings of AQF8.The guidelines presented in this paper were developed by analysing these collected data and comparing good practice outcomes with the AQF8 descriptors. Literature regarding the design process, project-based-learning facilitation and the systems engineering approach also informed the framework.

RESULTS

This paper reports on one outcome from an Office for Learning and Teaching (OLT) sponsored project on final year engineering projects. The framework and subsequent guidelines describe the process that the student will navigate and the behaviours that the student and the advisor should exhibit at each stage of the process in order to give the student an optimal chance to successfully complete their project while still demonstrating the level of independence characteristic of the AQF8 graduate.

CONCLUSIONS

Final year engineering projects are a pivotal part of all engineering degrees. There is wide variation in the types of projects and levels of support that academic advisors provide to students throughout this process. The guidelines presented in this paper will assist academic advisors and final year project coordinators to provide quality support to students to meet AQF8 outcomes.

KEYWORDS

Final Year Engineering Projects, Supervision, AQF8

Introduction

Final year engineering projects have long been viewed as a capstone of engineering programs, providing students the opportunity to demonstrate their ability to integrate knowledge and experience gained throughout the program. For engineering programs seeking accreditation at AQF8, it is essential that they are able to demonstrate that graduates have developed the relevant AQF descriptors, including the ability *to plan and execute project work and/or a piece of research and scholarship with some independence* (AQF, 2013, p.16). The final year project is an obvious place that this might be demonstrated; however the type of projects students undertake is extremely varied, as is the format and level of supervision.

The findings presented in this paper are outcomes from an Office for Learning and Teaching (OLT)sponsored project on final year engineering projects. For this project, data about final year engineering projects was gathered from 16 Australian universities. The project research methodology was case study and gathered documentary data in the form of guides, subject outlines and rubrics. Further, semi-structured interviews were conducted with coordinators of final year engineering project courses to determine how the projects were managed at their institution, what challenges they faced and whether they had practices they felt were working well. Data was analysed thematically and revealed three major areas.

1. Assessment
2. Curriculum
3. Supervision

The diagram (Figure 1) shows that FYEPs are shaped by curriculum, assessment and supervision but that these in turn are influenced by local university contexts and broader accreditation requirements. It acknowledges that whilst universities might face common broad imperatives such as EA and AQF compliance, local differences, such as resourcing and governance, will see some differences in the ways FYEPs are run.

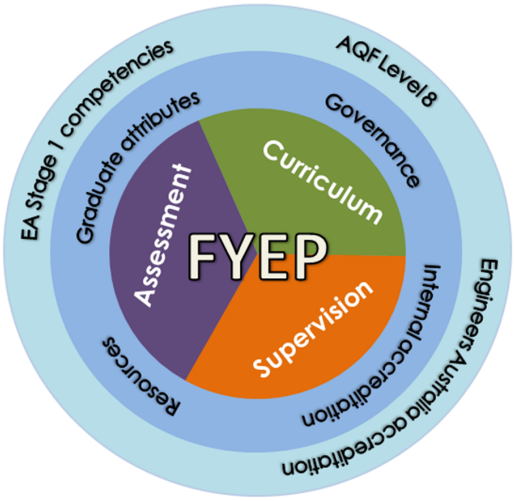

Figure 1. Locating Final Year Engineering Projects in local and national contexts

Jarman et al (2014) and Howard et al (2014) discuss findings and recommendations from the assessment and curriculum themes respectively. Further, Lawson et al (2014a, 2014b) detail the project methodology and findings more broadly and explore the place of research in an engineering context.

This paper presents initial findings on the supervision theme and proposes guidelines for student advisors based on interview and documentation collected. At the time of writing, the project was in the process of testing these draft guidelines in workshops across Australia. A reviewed version will accommodate feedback and build on what is presented here.

Supervising student projects and student teams

Supervision of student projects and student teams does not only happen in final year engineering projects. As project work and team work become more pervasive across many disciplines and programs, it becomes more important than ever that the attributes and behaviours of good supervisors are considered.

Fraile et al (2010) suggest that a supervision process for final year projects should include group meetings as one element, even though the projects are often individual. They propose three (3) meetings, one at the beginning to 'launch' the projects, the second after submission of the project plans and the last being the final presentation of the projects by the students. Although students also meet regularly with supervisors individually, the intention of these 3 meetings is to promote discussion between students. By having students discuss their projects in a group situation, an environment is created where good questions are asked (by other students as well as by the facilitator) and supervisors may refrain from simply giving answers, instead encouraging meaningful discussion about alternative solutions.

A further benefit of meeting with students in groups is the provision of opportunity for peer assessment. Students can be invited to provide feedback and comments on peers' plans and implementation which in turn assists with ability to improve their own projects. This has particular benefit for students in early learning development stages (Li, 2011).

In order to manage large student numbers, at many institutions, students complete their final year projects in teams. This brings many additional complexities to the process as there may be conflicts within the teams which supervisors then need to manage. Guo (2004) looks at a number of case studies for students completing a team project in the final year of their computer science or related degree. His approach is to give teams members advice about potential solutions to the conflict but to allow the team to decide on the ultimate action to be taken. This approach gives students the opportunity to take responsibility for managing their team.

Many final year projects are design-based. In their paper discussing teachers' actions in supervising design-based learning activities, Gómez Puente et al (2013) indicate that the role of the teacher in design-based projects is in formulating prompting questions, providing formative feedback and supporting students as they work through iterations of analysis and problem-solving. Teachers should stimulate discussions that encourage students to articulate and reflect upon their design experience. Questions should aim to scaffold student learning by guiding students to define the problem and encouraging them to explore alternative solutions. This is a useful way of viewing supervision for all projects because it highlights the role of the supervisor as advisor – posing questions and providing formative feedback, situating themselves as the guide as students assume increasing responsibility for their project and learnings as the term progresses.

How is supervision of FYEP currently managed?

There is enormous variation in the way in which final year engineering projects are managed and how supervision is implemented at Australian institutions. Of our sample, 14 engineering disciplines within institutions required students to complete projects individually, 6 stipulated group projects and 4 allowed either an individual or group project. It is accepted that at universities with large cohorts of students, and indeed in other disciplines within our sample, there may be greater numbers of group projects. The project types vary from research (experimentally) focused, to industry projects, usually design focussed. Where industry projects are used, students typically have an industry and an academic supervisor. Similarly,

in some institutions, students have a technical supervisor in addition to their academic supervisor.

Supervision styles and methods are also extremely varied. One of the recurring themes in the interview data is that supervisors at many institutions receive little or no training beyond the provision of a written supervisor guide or access to materials online. In some cases, these are targeted at what the project outcomes should be rather than the behaviours that the supervisors should be exhibiting. At one institution, support for supervisors occurs at moderation meetings during the project. At some institutions, regular meetings are scheduled by the supervisor but in other cases, students are expected to arrange the meeting times.

Some institutions have developed supervisor guides but these are often targeted at what the project outcomes should be rather than the behaviours that the supervisors should be exhibiting. For example, some guides provide details on the assessment inclusions and tend to guide supervisors in terms of what to expect in submitted work, rather than the specifics on how to facilitate the production of high quality work. There was one exception to this where a guide did specify the types of things supervisors can do (ask questions, review student plans, provide feedback) and we have made this available as an exemplar with our guidelines (see Rasul, et al, n.d.).

One of the issues around which there is quite a lot of disagreement is whether supervisors should only supervise students in their discipline area. In many cases, supervisors suggest topics and therefore by default, only supervise in their area of expertise. However some coordinators suggest that supervising outside the discipline area means that supervisors are less likely to specifically direct students, instead providing suggestions that guide the student while allowing space for the student to make decisions and find required resources. This is in line with the AQF8 requirement of "*plan and execute project work and/or a piece of research and scholarship with some independence*". It was suggested that students in this situation are more likely to come up with their own ideas and are also more likely to consult a broader spectrum of stakeholders since the supervisor does not have all the answers.

One coordinator made the point that students not only need to manage the project, to a certain extent, they need to manage their supervisor as most supervisors have many project students and they may not necessarily follow up with students to ensure they are progressing.Many of the coordinators who were interviewed suggested students thought good supervisors were those who *ask the right questions at the right time*. Students don't necessarily want a supervisor who gives them the answers to the questions. Good supervisors allow students to take ownership of their project.

Coordinators also reported that students thought one of the attributes of a good supervisor was that they respond promptly when the student asks for guidance; they are *available* to students. There is a combination of interpersonal and technical expertise required of supervisors as seen in what coordinators said. The following guidelines reflect the coming together of these characteristics.

Guidelines for student advisors

In most institutions, the academic staff member supporting the student is described as the 'supervisor'. The team investigating this theme considered that 'facilitator' or 'student advisor' was a more appropriate title. The intention is to reinforce the idea that the project belongs to the student, not the supervisor, and that some *independence* is required. The Guidelines have therefore been written using this terminology.

The final year engineering project process is shown in Figure 2.

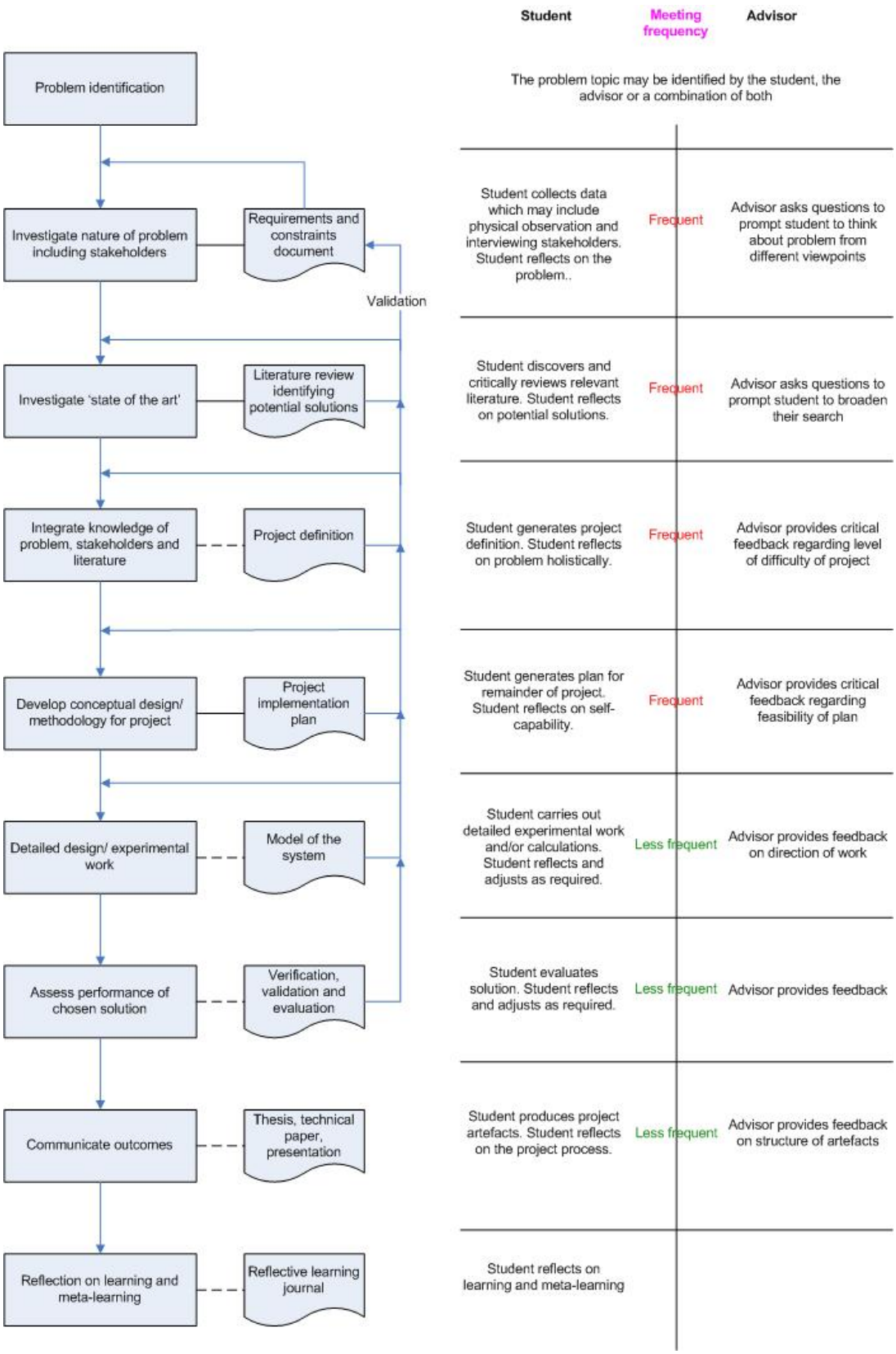

Figure 2. Final year engineering project process

The guidelines for student advisors are listed below.

1. **The student advisor should ask good questions.** This behaviour is particularly critical in the early stages of the project when the student is developing the project definition and investigating the problem. The type of question will vary depending on the phase of the project:
    a. **Investigate the nature of the problem including stakeholders.** The advisor should ask the student to explain what it is they believe the problem to be about and who the stakeholders are. By asking questions about the nature of the project, the advisor not only gains a better understanding of the project, they also help the student to structure their thoughts about the project. This may include questions about the proposed output from the project. It is important that the student understands that the project should give them an opportunity to demonstrate critical analysis skills so there must be some element of evaluation/ decision making in the project.
    b. **Investigate 'state of the art'.** By asking questions that tease out the nature of the problem, the advisor can guide the student to think about similar problems in related domains that may be relevant to the project and hence be a starting point for research.
2. **The student advisor should provide critical feedback.** This behaviour is particularly critical in the middle phases of the project (integration and conceptual design/ methodology development) when the student begins writing up the Project Definition and Investigation. The advisor needs to ensure that the student has done a thorough investigation and there are no significant gaps in their understanding of the problem. The 'level of difficulty' of the project needs to be sufficiently complex to allow the student the opportunity to demonstrate higher order critical analysis but the project scope should not be so large that it is unachievable within the time constraints.
3. **The student advisor should provide feedback on direction of the work.** As the project enters the later phases, the advisor can reduce the intensity of interaction with the student, allowing the student more autonomy. At this stage, the advisor needs to merely ensure that the student is remaining on track.
4. **The student advisor should consider having all project students meet with them concurrently if possible.** If all project students meet with their advisor concurrently, there is an opportunity for students to share their progress and challenges with the group. This can have the effect of alerting students if they are falling behind and also giving ideas regarding ways in which they might progress. This may be more difficult if students are not on campus but could be done by videoconference after hours if required.
5. **The student advisor should be available and motivated.** These are indicators of good supervisors (advisors) as seen by coordinators.
6. **The student advisor needs to allow the student to take control of the project and do the work themselves.** Some supervisors (advisors) feel that they must take responsibility for the project outcomes and that a poor outcome will reflect badly on them. Whilst the advisor has a very important role to play in terms of asking questions, providing feedback etc**,** in order for the student to demonstrate the AQF8 requirements, they must be given the opportunity to take responsibility for the project.

The student is expected to take responsibility for **'own learning and practice'** and **'executing a project with some independence'.**

Conclusion

Final year project coordinators from 16 institutions across Australia were interviewed to gather their experience and views on final year engineering projects. AQF8 descriptors were investigated to determine where current practice in final year projects needed to be strengthened or improved in order to ensure that theAQF8 outcomes were achieved. Analysis of the coordinator interview data revealed that the main themes were around assessment, curriculum and supervision. The guidelines presented in this paper have been developed by considering the coordinator interview data as well as established research around effective supervision of student projects.

In summary, student advisors wishing to emulate best practice and ensure AQF8 outcomes for their project students are encouraged to:

- Ask good questions at all stages of the project, with particular emphasis in the beginning project definition phases.
- Provide critical feedback at all stages of the project with particular emphasis on the middle integration phases.
- Be available and motivated throughout the project.
- Allow the student to take control of the project and do the work themselves.

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