

Engineering Undergraduate Dissertation Supervision: a thesis for change

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Introduction

Postgraduate research and supervision has to date received a great deal of attention (e.g. Lessing (2011), Hussain (2011), Sahoo & Mazid (2009), Brown & Krager (1985), Mudaly (2012)). The vast amount of literature regarding doctoral supervision might suggest that research supervision in general has already been adequately investigated. Although there are undoubtedly many aspects of postgraduate research supervision that are transferable to undergraduate thesis supervision, there exist some very significant differences. Postgraduate research is output focused. Due to lack of student research experience, the undergraduate thesis is necessarily focussed primarily on development of research skills (i.e. it is research process oriented). This implies that undergraduate dissertation supervision focus must be on facilitating the development of research skills rather than on producing research output.

In contrast to the well-studied field of postgraduate supervision, Rowley and Slack (2004) conclude that there is a scarcity of literature on undergraduate dissertation supervision. The recent study by Roberts and Seaman (2018) agrees that “the practice of undergraduate dissertation supervision is an understudied and under-resourced area of higher education” (p. 28). Honours pedagogy in general is described as “relatively invisible and unarticulated” (Kiley, Boud, Cantwell & Manathunga, 2009, p. 4). In a study examining various mechanisms by which supervisory arrangements fail, Ladany (2014) concurs with this position. Ladany (2014) suggests that current undergraduate thesis research supervision is only effective and in about 11% of cases, concluding that “supervisor training in theoretical and practical approaches to supervision is essential” (p. 1102).

One of the six major threats to good supervision of undergraduate dissertations identified by Roberts and Seaman (2018) is staff that are “overworked and pressured to publish” (p. 31). The interviews conducted as part of this study concluded that “it is not surprising that some academics view honours and other undergraduate dissertation students as unpaid research assistants” (Roberts & Seaman, 2018, p. 37). Some supervisors interviewed in this study admitted to taking advantage of students to collect data solely for the purpose of producing research publications, expressing full awareness that this practice resulted in little benefit to students in terms of research skill development (Roberts & Seaman, 2018). In a study examining the implications of student and supervisor perceptions of undergraduate research, Malcolm (2012) also raises the concern that research outcomes are being prioritised over research process, devaluing the learning that is intended to result.

Methodology

The aim of the present study was to examine the alignment of university, supervisor and student expectations regarding each party’s responsibilities in the undergraduate engineering thesis. The undergraduate engineering thesis at the University of Wollongong (UoW) is a traditional final-year annual (i.e. two semester) capstone subject as defined by Cook (1980).

The university’s expectations regarding the undergraduate engineering thesis are defined as those stated in the teaching and learning university policy documents, the thesis subject learning outcomes and accompanying university engineering thesis handbook (UoW Engineering Thesis handbook, 2019). The UoW Faculty of Engineering thesis subject learning outcomes are (UoW Engineering Thesis handbook, 2019, p. 7):

- i. Define clearly the aims and objectives of a given problem.
- ii. Retrieve and analyse previous work on related problems (critical literature review).
- iii. Formulate methods for problem solution.
- iv. Plan, design and construct an experimental or theoretical procedure to solve the problem.
- v. Collect data and evaluate findings.
- vi. Communicate conclusions and solutions verbally and in writing.

These six learning outcomes map almost directly to the six learning objectives described by Cook (1980) as defining the fundamental goals of the undergraduate dissertation in science and engineering.

Table 1: Thesis responsibility survey items

Item	Supervisor responsibility	-2	-1	0	1	2	Student responsibility
1	It is the supervisor's responsibility to select a promising topic	←————→					It is the student's responsibility to select a promising topic
2	It is up to the supervisor to decide which theoretical frame of reference is most appropriate						The student has a right to choose a theoretical standpoint even if it conflicts with that of the supervisor
3	The supervisor should direct the student in the development of an appropriate research plan						The student should work out a schedule and research plan appropriate to their needs
4	The supervisor should ensure that the student has access to all necessary facilities						The student must find the necessary facilities to complete their research
5	Supervisor-student relationships are purely professional and personal relationships should not develop						Close personal relationships are essential for successful supervision
6	The supervisor should initiate frequent meetings with the student						The student should initiate meetings
7	The supervisor should check constantly that the student is on track and working consistently						Students are entirely responsible for how they spend their time and should monitor their own progress
8	The supervisor should determine whether to terminate the supervision if they think the student will not succeed						The supervisor should support the student regardless of their opinion of the student's capability
9	The supervisor should ensure that the thesis is finished on time						The student should ensure that the thesis is finished on time
10	The supervisor has direct responsibility for the methodology and content of the thesis						The student has total responsibility for ensuring that the methodology and content are appropriate for the thesis
11	The supervisor should assist in the writing of the thesis if the student has difficulties						The student must take full responsibility for the writing of the thesis
12	The supervisor should insist on seeing drafts of every section of the thesis in order to review them in a timely fashion						It is up to the student to ask for constructive criticism from the supervisor

Expectations of supervising staff and thesis students were examined through the use of survey tools and post-survey interviews. The surveys used in the present study were adapted from the Role Perceptions Rating Scale (RPRS) based on the work by Moses (1985). Each item in the current survey implementation features statements mapped to a numerical response rating scale of -2 through 2 (see Table 1). Negative responses to a survey item indicate that the associated tasks are predominantly the responsibility of the supervisor. Positive responses indicate that the tasks are predominantly the student's responsibility. Survey item 5 varies from this interpretation of the scale by examining the type

of relationship expected by supervisor and students instead. Additional information collected through the student survey was gender and domestic or international student status. Thesis supervisors were also asked to provide their academic level and an indication of their research supervision experience.

A total of 329 thesis students participated in the present study over a two and a half year period (representing a response rate of over 95% of all enrolled thesis students). Of these students, 84.8% were male and 15.2% were female. The international student component was 26.4% (79.3% male and 20.7% female) with the remaining 73.6% being domestic students (86.8% male and 13.2% female).

Twenty eight academic staff members currently supervising undergraduate engineering thesis students completed the survey. This represents an 82% response rate. Semi-structured post survey interviews were held with supervising staff (m=15) (i.e. 53.6% of supervisors participating in the study) to ascertain the motivations related to their supervisory expectations. In particular, three key commonly raised beliefs were examined:

1. The quality of undergraduate student thesis work should be judged by the level at which it is potentially publishable;
2. Undergraduate thesis supervision should result in research output that is publishable;
3. The undergraduate thesis supervisor role is to assist with publication of the student's research.

Results and Discussion

The survey data obtained from all students (n=329) and supervisors (m=28) is presented in Table 2, indicating the gender, international student and professorial level supervisor breakdown of these responses. Only the arithmetic mean and standard deviation (SD) of the responses to each item are presented. These are calculated from the participant responses in the -2 to +2 score range as indicated in Table 1.

Table 2: Thesis student and supervisor survey responses

Item	Students						Supervisors			
	All (n=329)		International (n=87)		Female (n=50)		All (m=28)		Professorial (m=17)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	0.37	1.02	0.47	1.08	0.26	1.27	-1.24	0.93	-1.43	0.94
2	-0.22	0.89	-0.22	0.95	-0.41	0.91	-0.84	1.03	-1.00	1.11
3	-0.23	1.14	-0.40	1.32	-0.22	1.13	-0.64	1.22	-0.50	1.29
4	-0.84	1.08	-0.95	1.06	-1.06	0.68	-1.60	0.71	-1.71	0.61
5	0.05	1.11	0.38	1.11	-0.24	1.15	-1.32	0.90	-1.43	0.65
6	0.42	0.99	0.15	1.13	0.38	1.09	-0.48	1.26	-0.86	1.35
7	0.08	1.13	-0.06	1.33	0.26	1.26	-0.24	1.13	-0.36	1.45
8	0.67	1.09	0.39	1.16	0.56	1.15	0.32	1.11	0.21	1.31
9	1.08	0.97	0.76	1.09	1.16	0.74	0.68	1.41	0.71	1.33
10	0.16	0.96	-0.17	1.03	0.14	0.88	-0.16	1.03	-0.29	1.14
11	0.81	1.21	-0.09	1.36	0.54	1.20	0.60	1.32	0.36	1.39
12	0.06	1.14	-0.20	1.10	0.12	1.33	-0.24	1.39	-0.57	1.50

Immediately evident from this data is that there are some distinct differences in expectations of thesis responsibilities between the male, female and international student sub-groups. Overall, the biggest disagreement between student responses appears to centre on the nature of the supervisory relationship itself. International students indicating a preference for a more personal relationship as opposed to domestic student (in particular the female cohort) who believe the interactions should remain purely professional. Discrepancies between

student perceptions are also evident in the areas of responsibility for the thesis content and production (i.e. survey items 10 and 11) and the requesting and providing of feedback on thesis drafts (i.e. survey item 12). Significant differences are also observed in the responses of junior and senior (i.e. professorial) academics.

Table 3 provides a direct comparison of the student and supervisor thesis responsibility expectations with accompanying statistical testing for significance of the observed differences. Supervisors indicated a pronounced expectation that they were to take responsibility for most thesis tasks. This general trend observed was amplified at higher academic level, where the difference between student and supervisor responses was greatest.

Table 3: Difference in means of student and supervisor survey responses; * statistically significant difference in means at $\alpha=0.05$, ** statistically significant difference in means at $\alpha=0.1$

Item	Theme	All students (n=329) - All supervisors (m=28)	International students (n=87) - All supervisors (m=28)	Female students (n=50) - All supervisors (m=28)	All students (n=329) - Professorial supervisors (m=14)
1	Topic selection	1.61*	1.71*	1.50*	1.80*
2	Choice of theoretical frame of reference	0.62*	0.62**	0.43	0.78*
3	Research plan development	0.41	0.24	0.42	0.27
4	Ensuring access to necessary facilities	0.76*	0.65*	0.54*	0.88*
5	Professional vs personal relationship	1.37*	1.70*	1.08*	1.47*
6	Initiation of meetings	0.90*	0.63	0.86*	1.27*
7	Checking on progress	0.32	0.18	0.50	0.44
8	Termination of thesis	0.35	0.07	0.24	0.46
9	Finishing the thesis on time	0.40	0.08	0.48	0.36
10	Methodology and content of the thesis	0.32	-0.01	0.30	0.44
11	Thesis writing	0.21	-0.69	-0.06	0.45
12	Requesting drafts/feedback on the thesis	0.30	0.04	0.36	0.63
Overall		0.63*	0.43	0.55*	0.77*

The first thesis responsibility of students as stated in the UoW engineering thesis handbook is “developing a thesis proposal and plan for completing the project within the timeframe stipulated” (UoW Engineering Thesis handbook, 2019, p. 8). The associated supervisor responsibilities are “supporting students in developing a proposal for their thesis within the required time frame” and “assisting students to develop a plan for completing their thesis within the stipulated time frame” (UoW Engineering Thesis handbook, 2019, p. 8). The words ‘supporting’ and ‘assisting’ imply a secondary role and as such it is reasonable to interpret the thesis handbook rules to assert that the student has primary responsibility. Items 2 and 3 of the survey, pertaining to the choice of theoretical framework and planning of the research approach, clearly fall within this domain.

In selecting thesis topics, the options are of course largely limited by the set offered by supervising staff. The impetus to arrange a topic and consequently the final decision to accept a topic however, clearly place the responsibility for this task (i.e. survey item 1) principally with the students. Pedagogically, it is best practice to not be too prescriptive in defining the thesis topics for students. Investment in the thesis and subsequent improved academic performance has been observed to correlate well with a strong sense of ownership gained through student driven topic selection (Roberts & Seaman, 2018).

Since the resources required to complete theses are predominantly under the control of academic staff and the educational institution, it is reasonable to state that ensuring access to necessary facilities (i.e. survey item 4) is the principal responsibility of the supervisor. This

does not in any way however, diminish the related student responsibilities such as following through with inductions, appointments to use the facilities etc, but it does imply that primary responsibility logically lies with supervising staff.

The development of a close personal relationship with the student (i.e. survey item 5) is discouraged by university policy (UoW Close Personal Relationships Guidelines, 2017, p. 8). A close personal relationship constitutes a conflict of interest in terms of the supervisor's independence as an adjudicator of the quality of the student's work. There are also several prior thesis supervision studies (e.g. Ladany, 2014) that suggest that close personal relationships are extremely detrimental to successful thesis completion. In light of these factors, a professional student-supervisor relationship is prudent.

"The responsibility for successful Project Management lies with each student" (UoW Engineering Thesis handbook, 2019, p. 9) dictates that responsibility for elements related to project management, such as setting and keeping regular meetings (i.e. survey item 6), monitoring progress (i.e. item 7) and timely thesis completion (i.e. item 9) rest principally with the student.

Although it is the responsibility of the supervisor to "advise students of inadequate progress or work below the standard generally required and suggesting appropriate remedial action" (UoW Engineering Thesis handbook, 2019, p. 8), it is ultimately the student's decision to continue or terminate their enrolment in the thesis subject. If the student remains enrolled then the supervisor duty to provide effective thesis guidance also remains. The associated survey item (i.e. item 8) is therefore clearly the student's responsibility. It is alarming that almost 65% of senior academic staff members do not rate this as a student responsibility.

Please note that these interpretations of university policy and the thesis handbook are not to be taken to diminish the guiding responsibility of supervising staff. The UoW thesis handbook clearly states that "The overriding responsibility of supervisors is to provide continuing support to students throughout their research to enable them to produce a thesis reflective of their academic ability" (UoW Engineering Thesis handbook, 2019, p. 8). Rather, the university expectations discussed ensure that thesis students can be properly assessed. If the bulk of the responsibility for each of the thesis tasks is assumed by the supervisor this then presents enormous difficulties in determining whether the related learning outcomes have been achieved by the student. If the thesis research plan for example is so rigidly specified by the supervisor as to have no chance of being unsuccessful, then the student cannot fail to meet the associated learning outcome. If the student cannot fail to meet a learning outcome due to overly prescriptive supervision, then the student cannot be properly assessed as having met the conditions for a pass level performance in the thesis subject. Primary responsibility for any task that can be linked directly to any of the subject learning outcomes must necessarily remain the primary responsibility of the student.

From Figure 1 it is clear that this requirement is often incongruent with the expectations of students and academic staff. Several particularly noteworthy areas where university and pedagogical expectations are at odds with student and/or supervisor responses are indicated. It is especially alarming that student expectations regarding thesis responsibility are better aligned with the university requirements than those expressed by the supervising staff. The student position can be somewhat excused as they find themselves torn between the responsibilities stated in the thesis handbook and those dictated by the supervising staff. The survey results indicate that academic staff supervising undergraduate theses appear to be driven by agendas that do not align well with the sound pedagogy stipulated by the educational institution.

Only 13.3% of post-survey interviews with staff indicated disagreement with the statement that "the quality of undergraduate student thesis work should be judged by the level at which it is potentially publishable". Similarly, for the statements that "undergraduate thesis supervision should result in research output that is publishable" and "the undergraduate thesis supervisor role is to assist with publication of the student's research" supervisors

indicated only 20.0% and 6.7% disagreement respectively. This lack of opposition to undergraduate supervision with a publication agenda is more pronounced for professorial supervisors who showed no disagreement with these statements at all.

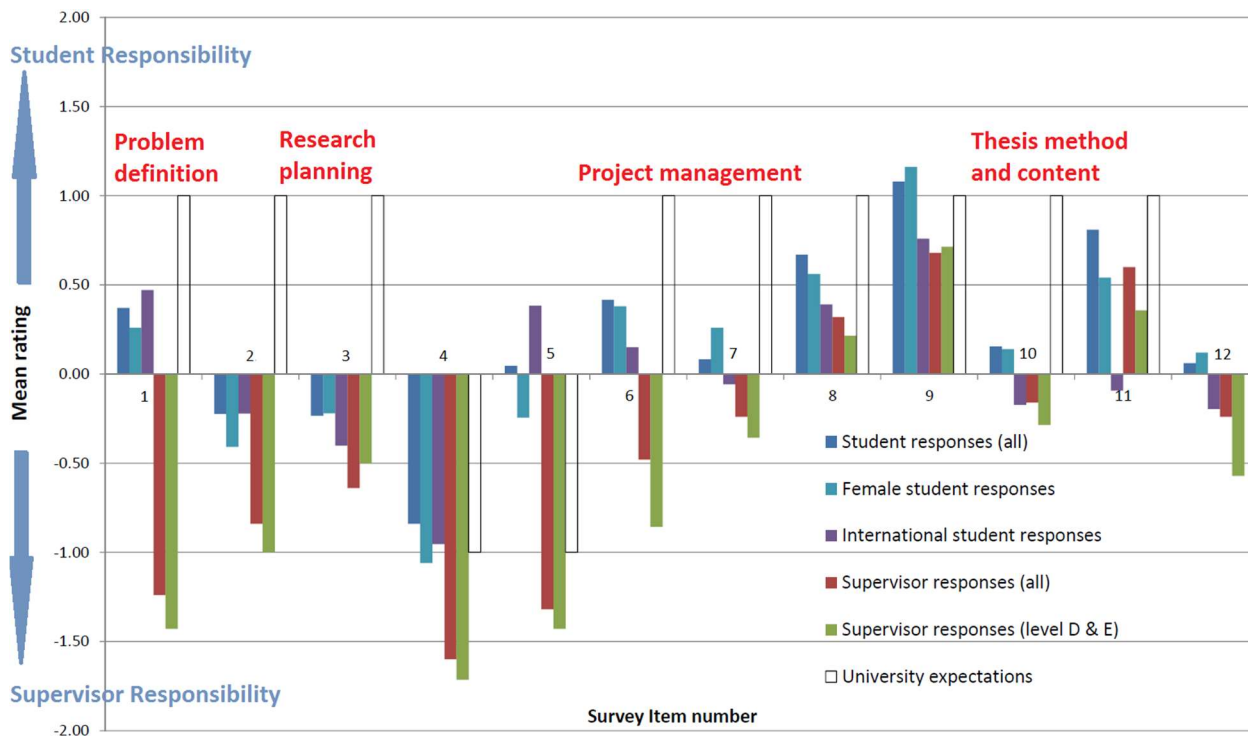


Figure 1 - Student, supervisor and university thesis responsibility expectations; note that the university rating provided indicates the directionality of expected responsibility only.

A key expectation evident from the post-survey interviews with supervising staff was that useful research data that complemented existing research projects would result from each undergraduate thesis supervised. Many staff expressed what they thought to be the widely held belief that publications were expected from all research student work, including undergraduate thesis research. These views are consistent with the observed survey results. When supervisors operate under such beliefs, they necessarily take primary responsibility for topic selection, research planning and implementation to ensure research output is produced at the required standard. The staff involved in the post-survey interviews invariably pointed to the pressure to publish as a key driver for this behaviour.

Conclusions

Alignment between student and university expectations regarding undergraduate thesis responsibilities in the present study was generally poor. It is evident that international students in particular commence their undergraduate theses with strong expectations that their supervisor will assume primary responsibility for many aspects of the thesis. Many of these thesis elements are necessarily the student's responsibility. Relinquishing these puts many international students at risk of not adequately demonstrating the attainment of the thesis subject learning outcomes.

There exists even stronger disagreement between supervisor and university expectations than the university-student expectation discrepancy noted. The most alarming result of the present study is that academic staff thesis supervisors appear to be taking too much responsibility for the research being conducted by undergraduate thesis students. This diminishes the ability for an accurate assessment of adequate academic performance by making it difficult to determine whether learning outcomes are actually met by the student. This trend appears to be primarily driven by supervisor expectations that undergraduate thesis research would contribute to or result in publications.

Undergraduate research is concerned with research method and should not be overly concerned with research output. "Honours projects primarily represent a teaching and learning exercise, established for the benefit of students and not for the gratification of staff" (Stefani, Tariq, Heylings & Butcher, 1997, p. 284). What is desperately required is a renewed effort to focus the role of the supervisor toward, as Cook (1980) described well as providing "educational guidance, rather than instruction" (p. 182). Supervision requires more than just academic and research skills from undergraduate thesis supervisors.

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Acknowledgements

The authors gratefully acknowledge the students and staff who participated in the present study. Particular thanks go to the academic staff who candidly expressed their views on undergraduate thesis supervision during the post-survey interviews. Support for conference attendance was provided by The Wollongong Academy for Tertiary Teaching & Learning Excellence (WATTLE).

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