Sailing off in a leaky boat: how some international postgraduate engineering students and their supervisors embark on candidature

Karen Adams
The University of Adelaide, Adelaide, Australia
karen.adams@adelaide.edu.au

Abstract: *This study explores the learning and writing strategies used by two international research Master of Engineering students in the first six months of candidature. Using an interpretive case study approach, data from interviews and samples of the students' research writing were examined and revealed strategies consistent with those identified elsewhere in the literature. Several of these strategies appear to have contributed to the students' difficulties in meeting the academic writing demands of early candidature such as preparing their research proposals. These difficulties related to both the students' fundamental engineering knowledge and their ability to write about engineering research. This study provides insights into these students' responses to the engineering and academic literacy demands of their postgraduate study. It also strengthens the suggestion that some international postgraduate research students require additional time and structured educational approaches to 'stay afloat' in their transition to postgraduate study here.*

Keywords: *international students, postgraduate education, learning strategies*

Introduction

Many postgraduate research students in engineering are required to produce a research proposal in early candidature and this document may form a significant part of the evidence used to assess a student's suitability to continue. This assessment has greater urgency now with pressure placed on university departments for timely completions by these students, a situation sometimes at odds with their need to explore a chosen research field and gain the background knowledge and skills necessary to develop a sound research focus and approach.

There is some evidence that starting the research related writing process early in candidature contributes to the timely completion of a thesis (see for example Latona and Browne, 2001). However, many commencing engineering candidates struggle to understand the theoretical concepts, analytical methods and factual material they will need to conduct their research, and also require enhanced academic literacy to communicate effectively in their research arena. Furthermore, there is a tendency to view writing in engineering and related disciplines as 'being after the fact', that is as description of products or processes that are fully conceptualised before the writing takes place. Winsor (1994) challenges this view by providing evidence that engineering students use writing to generate ideas. A further, persuasive argument for the inter-relatedness of text production and knowledge generation in

postgraduate research in general is put forward by Dysthe (2002) in her study of supervisors' influence on masters students' text production:

> *... the relationship between knowledge and language is a complex one, textual practices are closely intertwined with research process, and writing is both an individual and a social practice (Dysthe, 2002, p 499).*

While Dysthe did not specifically relate this relationship to engineering, it may in part explain the difficulties some international postgraduate students encounter in understanding and engaging in engineering research related discourse practices. The time pressures placed on students who are attempting to meet simultaneously both engineering knowledge and academic literacy demands in a second or subsequent language may create a situation in which it is impossible for a student to succeed in the given time frame.

This situation is important to address because production of research related written text is the single most important way postgraduate students present themselves as participants in their research communities (Mullins and Kiley, 2002; Cadman, 2002). Consequently, an unsatisfactory research proposal may threaten a student's candidature. In this regard, the integration of language and learning specialist programs within engineering postgraduate training provides greater opportunities to foster students' academic research literacy and to recognise and address problems early (see Melles, 2002). The present paper was motivated by the experiences of two struggling international Master of Engineering students in an Australian university, their supervisors and their ESL lecturer.

International students' learning and writing strategies

Studies into the international postgraduate experiences and performance of students provide insight into the strategies used with varying degrees of success by these students as they engage with the discourses of their disciplines through reading (Benson, 1991), writing (Leki, 1995; Chandrasegaran, 2000), and oral communication (Ferris, 1998; Morita 2000). A seminal case study by Leki (1995) reveals the coping strategies of international undergraduate and postgraduate students engaged in discursive writing tasks. These strategies worked to greater or lesser effect for the students involved.

A feature of Leki's study that makes it particularly relevant to the present work is that it investigated students' strategies used to produce authentic discipline writing tasks rather than ESL classroom tasks, which Leki suggested are easier, and that her study included postgraduate writing. However, as in the other few studies that have explored international postgraduate ESL students' writing (Angelova and Riazanseva, 1999), Leki's study was conducted on students in a US university and across disciplines, where the graduate school curriculum is considerably structured. Very little research has looked at international postgraduate research students in an Australian university context, where their assessment relies very heavily on production of a written proposal and thesis with little or no coursework component; negligible attention has been given to the postgraduate writing of international engineering students in Australia.

The purpose of this paper is to provide insight into the language and learning experiences of these international postgraduate engineering students in the early stages of candidature. The specific aim of this study was to identify the strategies used by these students to select and use engineering content information for their research related writing tasks. The location of

this study exclusively within the engineering postgraduate learning context may render its findings particularly useful for international engineering postgraduates and their supervisors.

Method

The two Masters of Engineering students who are the focus of this study attended a semester long bridging program that is compulsory for all commencing international postgraduate research students at The University of Adelaide (McGowan et al, 1996; Cargill, 1996). The program curriculum moves students through a series of developmental writing tasks, specifically a critical review and literature review, culminating in the production of a draft departmental research proposal. This document, or a refinement of it, is used to meet the University's requirement to submit a research proposal within six months of commencement of candidature. Both students had attended the classes and both had been identified by the ESL lecturer and their supervisors as having significant difficulties in completing a research proposal. Neither student had successfully completed his research proposal by the end of the program or in time to meet the University's six month deadline.

Sources of data included student interviews, oral and written communication with supervisors, observations of students in the bridging program class, student consultations, documents produced for the bridging program, and supervisor feedback on those documents. Each student was interviewed once; each interview lasted approximately 1.5 hours. The interviews were unstructured, and were focussed around the following three questions:

- How did these students' prior academic experiences prepare them for the writing demands of their candidature?
- What problems did these students encounter in meeting these demands during the first six months of their candidature?
- What strategies did these students use to overcome these problems?

Data analysis

The study used an interpretive case study framework where data are interpreted in terms of an existing theory or construct (Merriam, 1998). Data interpretation was informed by coping strategies that emerged in Leki (1995).

Findings from interviews

Louis, aged 25 and Tariq, aged 23 obtained undergraduate engineering degrees outside Australia. Both were ESL students, although Tariq attended an English medium university for his undergraduate study. They gave remarkably similar accounts of their past and current experiences, described their undergraduate performance as 'average', obtained IELTS scores of 6.0 in their home countries, had prior educational experience of lectures and labs only, and their undergraduate courses demanded a great deal of homework but almost no discursive writing. Homework involved calculation and lab reports written in a prescribed manner, which in Louis' case included using prescribed wording. Both came to Australia because they wanted the experience of living and studying in another country.

The interviews revealed that the students used seven of the fifteen strategies identified by Leki (1995). These related to managing information and language, and controlling demands on themselves. Data from their writing indicated that the students used three additional strategies in response to supervisors' and lecturer's written feedback.

Managing information: clarifying and focusing

Both students attempted to clarify their research writing by seeking guidance from their supervisors. Tariq explicitly stated that this did not help. 'At first my supervisors gave a lot of suggestions about readings but they were too hard. I asked them what I should read and what to avoid. They made suggestions. Still even suggestions were too hard – especially I could not determine how the readings related to my project. I tried to see how they related but couldn't'. Tariq also eventually decided to discuss his work with other students to get 'different ideas', which is another way students exhibited clarifying strategies in Leki's study.

Louis used what he called a 'clarifying' strategy, developed in his undergraduate years 'to extend my knowledge'. It involved standing in the library stacks looking for helpful books: 'I select interesting titles that might be helpful'. He looked for 'the big words' in the title and then at subtitles, pictures and diagrams; if a picture was related to what he wanted to know he read paragraphs around it. Louis also pointed out that he solved most of his problems by himself and only occasionally asked his supervisor or other students for advice.

To address the writing demands of a research proposal, the students identified elements of their project work in which they could develop greater depth of knowledge. Tariq changed the information gathering strategy he used at the beginning of his candidature because he felt he was looking at 'a too big picture and not focusing specifically on the project.' He took his original approach because he joined an existing project where several important stages of the research had been completed. 'In the beginning I told myself that if I do not study the whole things I will not be able to find my way because my project is related with so many stuff – even the physics so I am study physics to see the parts that are related'.

Louis chose to focus on subject content by extending his knowledge of vibration, which he believed 'will result in a better research proposal'. Louis concentrated on learning difficult information, but his strategy may explain a problem he had misappropriating others' words in his academic texts: 'Sometimes a paragraph is beyond my knowledge so I just write it. Over time I will absorb this unfamiliar type of information. For example, if I'm reading some research and don't understand why an experiment was conducted in a particular way.' Louis' focusing strategy appears similar to Leki's 'using current or past ESL strategies', but it was initially aimed at focusing on needed engineering information. Only after Louis thought he might have found the information did it become a language development strategy. He also looked for similarities between the way an author 'did things' and his own project. 'Sometimes, for example a computer program is the same but article uses it for different subject, so I think it's related.'

Managing language: looking for models and using past or current ESL strategies

Louis used these strategies to develop his written language skills, even before he came to Australia. When looking up texts, he picked out what appeared to be related paragraphs by the terminology used. 'Sometimes I appreciate word combinations in articles and write them in my notes. Sometimes this will mean I can then write something better. Sometimes word is out of my knowledge and I learn it for the first time.' He decided that information was relevant to his research by identifying key words. He also pushed himself to read the original English and not a Chinese translation, despite his friends' suggestions, because he wanted 'to get used to the English'.

Louis took notes verbatim while he read text. 'When I see something I like, first I write out in my notebook, then I make some changes… By the end of the week I put everything together and then change the writing to make it smooth by connections. I don't know if it's OK when it's finished.'

Controlling demands: managing workload and life, and regulating cognitive load

Tariq identified a 'danger' in postgraduate study; without specific assignments that have to be done, he found himself wanting to say 'I'll do it later' … 'it's easy to just exit my study'. Louis worked very hard and then felt justified in taking a rest: 'Sometimes it takes too much energy to do English language writing. I work long, maybe a whole day, then I take a rest.'

One of Tariq's strategies for moving forward was to work out, by himself, the relation between mathematical methods and computer programming. 'No one else will do this for me; I will have to work out the relationships myself. They're not going to do this for me.' This approach meant that he was consciously deferring his attention to this singular task until he was satisfied he could make these appropriate relationships.

Louis found his first three months in Australia very difficult for personal reasons and was aware that this interfered with his ability to get on with his work. Eventually he was able to focus on his studies but suspected it was then too late to finish his research proposal on time.

Other findings from interview data

Interestingly, both students found writing easy in their undergraduate study back home, but very difficult here. Both identified the transition from undergraduate to postgraduate study as the main contributor to this difficulty. According to Tariq, nothing he experienced in his studies back home prepared him for the way he would have to work here.

Both students expressed confidence in their current strategies. Louis' believed he was using the best strategies: 'These are the only way, in my kind of view, you can get best result'. As for meeting the writing requirements of their postgraduate candidature, Tariq felt he could not have produced a research proposal in six months. Jumping into a running research project meant he had a lot of catching up to do. 'The [bridging] program helped you to understand what you had to write about and how to write it. But I could not make links between all the parts of my project. Some parts had very complex mathematical solutions and I could not get them.'

Findings from other sources

Supervisor communication with the ESL lecturer early in the semester clearly demonstrated the confusion that can result when students present an array of difficulties:

> [His review] seems very jumbled and I'm unsure whether this is due to his language skills or lack of understanding.. Some of the questions [he] asks me also lead me to believe that there is some obstacle that prevents him grasping the simple concept of what I am asking him to do. Again, I cannot determine whether this is a language matter or lack of technical familiarity.

Examination of the other sources of information related to the students' first semester of candidature reveals instances where students appeared to be acting on the strategies described in the previous section, and additionally on Leki's strategies of accommodating and resisting teachers' demands. Louis' supervisor asked him to write an FEA report with very specific instruction for the report structure: 'The report should contain an abstract, an introduction, a method, results, discussion and conclusion.' Louis' unusual disengagement of words from their meanings and context, as evidenced in his 'focusing' strategy use, led him to produce a report with the required subheadings but with inappropriate text, as illustrated in Table 1.

Student's text	**Supervisor feedback**	**Student's strategy**
Abstract The simple rectangular fixed plate experiment for natural frequencies, the ANSYS program simulates the testing procedure and obtains the precise results.	Titles OK but content is in error Not an abstract: should be very short, concise overview.	Accommodating teachers' demands Also Louis' 'focusing' strategy resulting in meaningless use of word 'Abstract'.

Table 1: Illustration of Louis' focusing strategy use

The problem presented in Table 1, was partly addressed after Louis worked with his ESL lecturer to meet feedback expectations on a subsequent draft (Table 2). However, Louis' final research proposal reverted to copying others' language and showed inadequate grasp of research related engineering concepts.

Student's text	**Supervisor feedback**	**Student's strategy**
Abstract Modal analysis is used to obtain the natural frequencies of vibration of a structure, and it is very important to study the vibration modes. The discipline of modal analysis is divided into two areas, analysis and experiment…However, in the use of finite element techniques it can supply more accurate natural frequencies and verify the experiment results, furthermore, finite element methods can analysis more complicated structures that cannot be predicted by classical mathematical models	Louis, this is much <u>better</u>.	Using current experience or feedback to adjust strategies

Table 2: Initial response to supervisor feedback

Louis also received many hours of instruction concerning the appropriate use of source materials in his bridging program. He resisted these demands and continued to rely on his focusing and past ESL strategies, which resulted in copying from sources. Louis had no explanation for this resistance except that he found writing very hard.

Another example of resistance to supervisor's demands was found in Tariq's drafting of his literature review and subsequent research proposal (Table 3).

Student's text	Supervisor's feedback	Student's strategy
The first stage (Preliminary) of study one was conducted to develop a numerical model to optimise the design of the entire device…This stage compared the numerically predicted results with those experimentally measured…The next stage, study one was concerned with optimisation of the various parameter…The second stage of study two of this project applied to analysis tools developed in stage 1 to more…	Each of the project stages should not be considered separately. The literature review should flow from one to the other via a logical progression, highlighting the advances or different approaches taken at each stage.	Resisting teachers' demands

Table 3: Resistance to supervisor's demands

Supervisor further stated the following on a page of written feedback:

> …At the end of each stage of work [in large project] a report is required and hence the reports are titled Stage 1, Stage 2 etc so that the work in the reports can be compared with the aims and deliverables for each stage of work. When reporting on the work, or including it in a literature review it is necessary to consider which physical system or analysis methodologies have been examined. These are of much more relevance to a reader not familiar with the work. Titles such as Stage 1, Stage 2 etc do not convey any information.

This message was reinforced by the ESL lecturer, who pointed out that his literature review was very confusing to read with its references to these stages. Tariq resisted this advice and continued to refer to these stages of the larger project and prior reports throughout his subsequent research proposal drafts, resulting in the following feedback (Table 4).

Student's text	Supervisor feedback	Student's strategy
Stage one (Preliminary) was conducted to develop a numerical model to optimise the design of the entire device…This stage developed a numerical model for predicting results…Stage one (Final) was concerned with …Stage two of this project was applied the analysis tools developed in stage 1…	Supervisor feedback does not appear to have been incorporated in the final version of documents (written on end-of-semester report)	Resisting teachers' demands

Table 4: Resistance to supervisor's demands

Communication between the ESL lecturer and supervisors indicated early concerns about the students' writing, particularly their copying from other sources and difficulties in grasping the purpose of research related documents despite their having received clear guidance. Several months elapsed before their difficulties with engineering concepts became clear to the students, lecturer and supervisors. Table 5 shows Tariq's ultimate attempt to express his knowledge in his own words in his research proposal. His supervisor's comments clearly pointed to his need for improved engineering content knowledge.

Student's text	Supervisor's feedback	Student's strategy
Different methodologies such as Modal Coupling Analysis, Finite element Analysis (FEA) and Boundary Element Analysis were considered as a modelling approach.	This is not a different approach to FEA. It is used with FEA. .	Using current experience or feedback to adjust strategies
A Modal Coupling Approach gives modal descriptions of the system components…	Not a good description. You must take notes during our discussion.	
The Modal Coupling Methodology can specify the acoustic impedence at the liner face.	Misinterpretation of what modal coupling theory does. Not clear how this is relevant.	

Table 5: Attempt to convey engineering knowledge in writing

Tariq decided to apply for an extension to his candidature on the basis of inadequate time available to finish a Masters degree. He used the time to strengthen his engineering knowledge relevant to his research area, while continuing to develop academic literacy for research writing. At the time of writing, Louis was indecisive about whether to apply for an extension, intermit or abandon postgraduate research study in Australia.

Discussion

Both students used a variety of strategies to deal with the writing demands of their postgraduate study, but they became increasingly aware that they were ill-prepared for the academic literacy and engineering demands of early candidature and had great difficulty writing enough that was meaningful. At the time of interview, Tariq had made a shift in his thinking about strategies, but Louis had not.

In the present study, there was a clear indication that the ESL lecturer and supervisors gradually became aware of content knowledge problems as the semester progressed. Many gentle suggestions were given to these students to provide them with opportunities to show capability. Finally, feedback showed explicit comments on the students' apparent lack of understanding of key engineering concepts related to their research projects.

The strategies Louis and Tariq used have been identified elsewhere in the literature. Angelova and Riazantseva (1999) found similar strategy use, such as resisting instructor's suggestions and problem-solving alone. Louis's strategy of copying promising text from elsewhere appears to reflect the tensions, described by Pennycook (1996), that are faced by ESL students who are told to use their own words and 'are at the same time required to acquire a fixed canon of knowledge and a fixed canon of terminology to go with it" (p. 213). Also, the views of Chinese students whom Pennycook interviewed were similar to those Louis held about using other people's words. Johns (1991) description of an ESL science student's English competency exam preparation shows strategies used included memorisation of TV conversations, dictionary entries and biology text. Like Louis, this student also described his approach as looking for models.

Interestingly, Louis and Tariq were not able to make use of the highly effective bridging program in which they were enrolled, when other Master of Engineering students in the

program over the same semester performed very well. Tariq's comments that he simply could not use the writing information he received because his understanding of engineering concepts was so limited is an indication that there was a strong need for him to spend more time honing his engineering knowledge.

Its small number of participants limits the present study. However, it provides a depth of insight that cannot be gained by larger, quantitative studies. Louis and Tariq used many of the strategies Leki identified in her study, and this suggests the use of these strategies may be common to many international postgraduate students. If so, awareness of this could be useful in informing supervisors and ESL lecturers who work with students in the personal educational environment of postgraduate research.

Conclusion

Louis' and Tariq's approaches to addressing the writing demands of their postgraduate study presented a frustrating interplay of linguistic, learning, subject knowledge, and intercultural issues. These students are not unusual. The transition to postgraduate study in engineering, with its high demand for learning independence, for writers to operate within the discipline-specific research genre, and for students to complete their research proposals, research studies and theses within a restricted time frame, may prove too difficult for international students struggling with language and inadequate engineering knowledge in their research area. These students may be better served by, for example, Diploma or Coursework Masters programs that prepare students for subsequent research candidature or allow the opportunity to go home with a completed non-research qualification. This would ensure that international postgraduate students and their supervisors have a better chance to 'fix the leaks' before sailing into candidature.

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