International Student Learning in an Engineering Management Coursework Masters Thesis Context

Rodney A. Stewart
Lecturer, School of Engineering, Griffith University

Linda Conrad
Deputy Director, Griffith Institute of Higher Education, Griffith University

Abstract

International students attending Australian Universities frequently encounter problems in adjusting to their new social environment. To address this issue, numerous researchers have examined the generic difficulties faced by international students when adjusting to typically 'western' higher education institutions. However, few researchers have examined the difficulties faced by international Masters' students undertaking engineering management coursework thesis projects. In addition to 'adjustment' problems facing these international students, they must also embrace a deeper level of learning and thought that is usually far removed from their undergraduate experience. In particular, many international students struggle to adjust to a learning environment where they are encouraged to design a research topic, research approach etc. in mediated consultation with their supervisor. Traversing this 'learning culture' abyss can take some students up to six months before they are ready to tackle the challenges of their projects. In an attempt to understand newly enrolled international Masters students' perception of engineering management practice and research, this paper reports on five (5) in-depth interviews. These interviews were conducted in the first few weeks of the students' program commencement and they were requested to comment on their previous study and industry experience, perceptions of engineering management, and perceptions of engineering management research. The outcome of this first stage of the larger study was the categorization of students' baseline level of understanding of engineering management practice and research utilizing a SOLO taxonomy. Future research will build upon this taxonomy, by including further interviews with the same students at the completion of their thesis project, with the view to develop a framework which attempts to encapsulate the learning constructivism for international students over the lifecycle of their engineering management coursework masters program.

Keywords: international students, SOLO taxonomy, thesis projects, engineering management

Introduction

In recent years, the proportion of international students participating in the Australian higher education sector has increased exponentially. Moreover, this same trend is being experienced in the US, in Europe and in other developed nations, resulting in an opening awareness of the international dimension in higher education [1]. However, in many cases, international students studying in Australia typically link socially with similar others, hardly interacting with local students [2]. Since the English language has come to play a prominent role in internationalizing curriculum and linking the academic profession, it has become essential for

international students to have a high level of English proficiency prior to commencing dissertation writing. A number of studies from English-speaking host countries suggested that international students' overall ability in English is closely related to their academic success and overall adaptation [3-4]. This is particularly true for thesis writing, where a student may undertake a high quality research project but does not receive a commensurable grade because they failed to articulate their literature review and findings in a professionally structured academic writing style.

Although, the mastering of academic writing and verbal presentations in English is one of the fundamental difficulties facing many international students, they also must adapt to different teaching and learning styles to successfully complete their thesis project. In particular, research undertaken by Tompson and Tompson [5] cite behavioral characteristics such as limited classroom participation, not asking for clarification, and studying only with international students as behaviors that undermine international students' academic performance. Moreover, before international students can become confident self-learners they must make a significant behavioral adjustment by shifting from an instructional method of learning to a free learning environment in which they have to solve problems rather than memorizing facts [6]. In particular, students needed to be more independent in their approach instead of relying on thesis supervisors. Through understanding students' perceptions of research at the commencement of their thesis projects, improved learning strategies can be developed and implemented.

The primary objective of this study is to develop a framework which attempts to encapsulate the learning constructivism process for international students over the lifecycle of their engineering management coursework masters program. This will be achieved through a longitudinal study where in-depth interviews will be conducted with newly enrolled internationally students at the commencement, middle and end of their engineering management program. This paper presents the results of the first interview (program commencement) with five (5) students who commenced the Master of Engineering in Engineering Management program. These interviews requested that the students provide their perceptions on engineering management practice and research. The outcome of this first stage of the larger study was the categorization of students' baseline level of understanding of engineering management practice and research utilizing a SOLO taxonomy.

Research Method

The research method for this project consists of three sets of interviews with students over the life of their engineering management program (see Figure 1). In total five (5) newly enrolled international students in the Master of Engineering in Engineering Management Program were requested to participate in this research study. It should be noted here that this paper only presents the outcomes of the first stage (interview 1: start of program) of the research project. The objective of these interviews was to ascertain the students' perceptions of engineering management practice and research. The five interviewed students were all male and originated from three nations in total (India: 3, Taiwan: 1, and Bahrain: 1). All of the students have completed an undergraduate degree in a discipline area of engineering and had limited experience in industry (2 with no experience, 3 with 0-3 years of experience). Interestingly, none of the students had undertaken a thesis project during their undergraduate studies. In Australia, most undergraduate engineering programs require that students complete a minor thesis project in their final year of study.

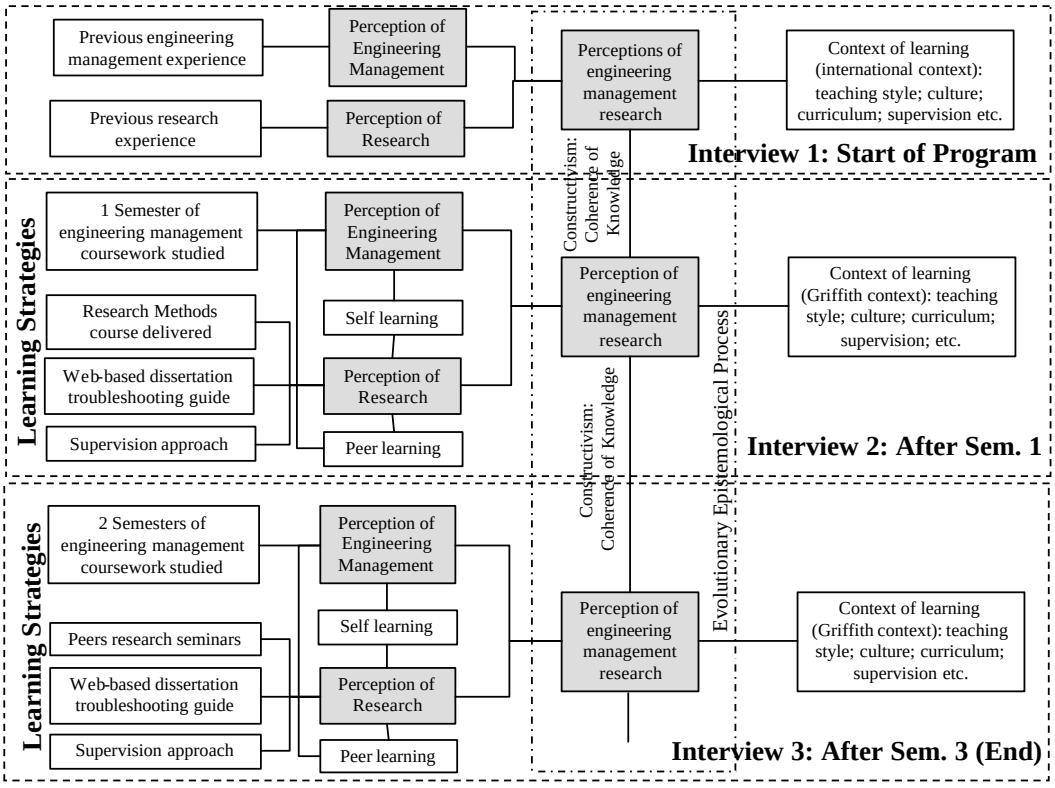

Figure 1. Research method

Interview Questions

The students were requested to respond to a number of questions (see below) across three areas, namely: (a) perspectives of engineering management practice; (b) perspectives of engineering management research; and (c) perspectives on an engineering management scenario. The objective of these questions was to gauge each student's perceptions of engineering management practice and research and attempt to classify their 'baseline' understanding using an appropriate taxonomy. Further interviews will be undertaken with the same students, using a series of similar questions, to ascertain any growth in knowledge and/or interpretative skills in the engineering management practice and research areas.

Part A: Perspectives on engineering management

- Why did you undertake the engineering management degree?
- Explain your industrial experience to date?
- What does an engineering manager do in the context of your industry?
- What do you think are the major problems or issues that an engineering manager has to face in the industry?
- What information, knowledge or subject matter would you consider important in studies on engineering management?

- What engineering management skills do you hope you will gain from your study towards the engineering management degree?
- What type of position would you like to take up at the completion of this degree?

Part B: Perspectives on engineering management research

- What do you think constitutes research in the area of engineering management? Give an example if that helps?
- What do you think is the purpose of engineering management research?
- What are some of the pressing engineering management issues requiring research attention in the industry you work (or were educated) in?
- What would you like to research in the engineering management discipline?
- What knowledge/skills do you have that would help you successfully undertake a research project in engineering management? Give an example if that helps.
- How do you think you might go about your research project? I realize that you haven't started the program yet, but I'd be interested in learning your ideas at this stage.
- What do you think that a thesis or dissertation is intended to do?
- What outcomes do you hope to obtain from your research project?
- What do you believe to be the role of a research supervisor in helping you successfully undertake a research project in engineering management? Give an example if that helps.

Part C: Perspectives on an engineering management scenario

The interviewees were presented with an engineering management scenario where some research outcomes were required. They were requested to answer the following questions related to the scenario.

- What do you think would be the objectives of this research study?
- How would you go about meeting these objectives i.e. what steps would you undertake?
- How would you gain the necessary information to achieve your objectives?
- What do you think would be the outcomes of this study and how would this benefit your company?

Sample Responses

The above-mentioned questions were asked to each of the five interviewed international students commencing the Master of Engineering in Engineering Management program. The following sections provide sample responses to some of these questions.

What engineering management skills do you hope to obtain in this degree?

- Interviewee 1: Like how to manage the process. What should be the production line?
- Interviewee 2: I think how to plan it. Manage the business risk and how to schedule resources. How to define the factory's units per day. Actually that's all.
- Interviewee 3: Time management, planning, evaluating the risk, make the plan.
- Interviewee 4: Technical skills. Like what are the problems we face while designing something? Maybe how to organise the things from the start and how to look after them.

- Interviewee 5: Managing skills. I will not be able to give you an appropriate answer. I guess you need a lot of skills. Managing the entire set-up. Human relations skills are important. Finance skills. Risk. I am just guessing these things.

What do you think research is?

- Interviewee 1: I think that research is just like learning. You have to learn more things that you don't know.
- Interviewee 2: Research is, I think, going into some field and trying to take profit of that. We don't have a lot of money to do research on waste things; we do research to have some profit on it.
- Interviewee 3: Learning. Learning and innovation. Research is something that you can innovate with it; you can bring out new stuff, but at all times you are learning, whichever way you look at it.
- Interviewee 4: Learning something new.
- Interviewee 5: Learning something. Finding out ways to get a maximum output.

What do you think engineering management research is?

- Interviewee 1: I think it maybe about saving time or money. Maybe about gaining info on other countries. Maybe the design of your project or something.
- Interviewee 2: I have no idea yet. I have not gone for research methods yet so learning how to get maximum output. You have to study and then apply it.
- Interviewee 3: I don't know. I would like to learn how to manage a construction project in an effective way.
- Interviewee 4: Product improvement. You have a product and a specification; you want to improve on it. Process innovation also. Understanding a product. Engineering management is a broad field; you can do lots of stuff.
- Interviewee 5: I don't know exactly. But maybe how to manage resources. Maybe how to design a completely new industry.

What do you believe to be the role of the research supervisor?

- Interviewee 1: On how to start the dissertation. The topic of the dissertation. So, if the start is on the wrong direction after going a long time, oh I would have started that way. The supervisor should guide the right way.
- Interviewee 2: Just I think he should give the idea and the dissertation and the direction. Evaluate your job.
- Interviewee 3: Whenever one needs some guidance he will be able to tell you what you need to do. The option is yours. You can't go running for every detail but he can guide you to get out of your problem.
- Interviewee 4: He should be the right person with the right knowledge. If I have some misconceptions they should be cleared. The research will be done by the person but you need a lot of guidance for it. Like 60/40 per cent (i.e. 60% researcher; 40% researcher).
- Interviewee 5: I think, because I never done research, maybe just help me, maybe, I didn't know something, he can correct me. Help me in many things. I don't know.

From the students' responses it appears that some students have a better aptitude for research Generally, most students know what engineering management research could be but are not sure how to proceed at this stage. As expected, the students are biased towards technology/technical research (engineering blinkers on) and lack an understanding of the

broader range of issues that an engineering manager must face on a day-to-day basis (e.g. safety, human resources etc.). From the interviews, it becomes evident that the students have experienced a very different teaching and learning style than their Australian counterparts. Some of the students may initially find it difficult to work in an environment where independent enquiry is a valued learning mechanism.

Baseline Level of Understanding

Due to the size constraints of this paper, the level of understanding of only one student (Interviewee 4) has been presented (see Table 1). The SOLO taxonomy [7] was considered to be the most appropriate framework to map the baseline level of understanding of the students in two areas: (1) engineering management practice (EMP); and (2) engineering management research (EMR). Firstly, a summary of the responses for interviewer 1 for EMP is detailed below:

- *Role of an engineering manager*: purchase of raw materials; inventory management; and markets.
- *Problems faced by an engineering manager*: mechanical failure in production; maintenance; meeting production targets; and maximizing profits.
- *Important subject matter in EMP*: resource planning; consumer marketing; and project management.
- *Engineering skills you hope to gain from program*: unsure.

This students' perception of engineering management practice was still largely focused on the technical role of an engineer. They understood that an engineering manager may be involved in some project management and marketing issues but were unsure of the skills that an engineering manager may require and how these skills could be applied to overcome problems that they may face in such a role. Overall, the student demonstrated a uni-structural level of understanding of EMP but displayed some multi-structural understanding of the 'hard' EMP areas (see Table 1). Secondly, the student provided their perception of EMR, which is detailed below:

- *What is EMR*: learning something; optimizing; and learning how to get maximum output.
- *Purpose of EMR*: make maximum output; quality improvement; and invent something new.
- *Pressing issues in EMR*: automation; technical improvement of products; opening up markets; and process improvement.
- *EMR Research approach*: sort out what the specific problem is, why we are getting this problem and how can it be minimized.
- *Outcomes of EMR*: get a maximum thing.
- *Role of supervisor*: they must have the right knowledge; clarify questions and get me onto the right direction; a lot of guidance should be what is required.

The student had some definite perceptions as to what they believed EMR involved. They perceived that EMR was focused on obtaining maximum output from engineering processes (i.e. process improvement). They also had some idea as to how to approach their research and how they would interact with their supervisor. However, they had a relatively narrow view of EMR and overly simplified the EMR issues that needed addressing in the industry. In summary, the student has a uni-structural understanding of EMR.

Table 1. SOLO Taxonomy of EMP and EMR understanding for Interviewee 4

Levels of Understanding SOLO Taxonomy [7]	Engineering Management Practice (EMP)	Engineering Management Research (EMR)
Extended Abstract: student conceptualizes at a level extending beyond what has been dealt with in the actual teaching. Can generalize to a new area. *Relational*: Indicate orchestration between facts and theory, action and purpose. Understanding of several components which are integrated conceptually. Can apply the concept to familiar problems or work situations *Multi-structural*: Indicates understanding of boundaries but not of systems. Understanding of several components but the understanding of each is discreet. Disorganized collection of ideas or concepts around an issue. Has not been able to relate the items in the list. *Uni-structural*: Concrete, minimalist understanding of an area. Focuses on one conceptual issue in a complex case. *Pre-structural*: No understanding demonstrated.	* Interviewee four (4) baseline level at program commencement	* Interviewee four (4) baseline level at program commencement

Summary

International students undertaking the Master of Engineering in Engineering Management program at Griffith University typically have limited research and industry experience. In particular, many of the international students completed a highly technical undergraduate degree that did not include any management-focused courses. Additionally, these students fight an uphill battle when delivering oral presentations and trying to master academic writing in English. This research attempts to understand how an international student perceives engineering management practice and research at the commencement, middle and completion of their program with the view to evaluate their learning outcomes over the duration of their program. This paper discusses some of the students' responses to the first interview, which will be used to establish the students' baseline perception of engineering management practice and research. These baseline perceptions of engineering management practice and research have been mapped utilizing a SOLO taxonomy. Future research will build upon this taxonomy, by including further interviews with the same students at the middle and completion of their thesis project. Ultimately, a framework will be developed which attempts to encapsulate the learning constructivism for international students over the lifecycle of their engineering management coursework masters program.

References

[1] Callan, H. (2000). The International vision in practice: a decade of evolution. *Higher Education in Europe*, 25(1), 15-23.

[2] Knight, J. (1997). Internationalization of higher education: a conceptual framework. In J. Knight and H. de Wit (Eds.), *Internationalization of Higher Education in Asia-Pacific Countries*, European Association for International Education.

[3] Barrett, M. F. & Huba, M.E. (1994). Factors related to International undergraduate student adjustment in an American community. *College Student Journal*, 28, 422-436.
[4] Lewthwaite, M. (1996). A study of International students' perceptions of cross-cultural adaptions. *International Journal for the Advancement of Counselling*, 19, 167-185.
[5] Tompson, H.B. & Tompson, G.H. (1996). Confronting diversity issues in the classroom with strategies to improve satisfaction and retention of International students. *Journal of Education for Business*, 72(1), 53-57.
[6] Ladd, P.D. & Ruby, R. (1999). Learning style and adjustment issues for International students. *Journal of Education for Business*, 74(6), 363-367.
[7] Biggs, J. (1999). *Teaching for Quality Learning at University*. The Society for Research into Higher Education, Buckingham.

Biographical Information

RODNEY A. STEWART is a Lecturer in the School of Engineering at Griffith University, Gold Coast, Australia. He holds a Bachelor of Civil Engineering and a PhD in Engineering Management. He is currently undertaking a Masters in Higher Education examining international student learning in an engineering management coursework Masters context.

LINDA CONRAD is a Senior Lecturer and Deputy Director at the Griffith Institute for Higher Education (GIHE) in Brisbane, Australia. She holds a Bachelor of Arts and a PhD in Higher Education. She actively undertakes research in the area of postgraduate education and has authored a number of articles, book chapters, and conference papers on the topic.