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CHAOS OR COMPLEX SYSTEMS? IDENTIFYING FACTORS INFLUENCING THE SUCCESS OF INTERNATIONAL AND NESB GRADUATE RESEARCH STUDENTS IN ENGINEERING AND INFORMATION TECHNOLOGY FIELDS

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Abstract

The paper explores the results an on-going research project to identify factors influencing the success of international and non-English speaking background (NESB) graduate students in the fields of Engineering and IT at three Australian universities: the Queensland University of Technology (QUT), the University of Western Australia (UWA), and Curtin University (CU). While the larger study explores the influence of factors from both sides of the supervision equation (e.g., students and supervisors), this paper focusses primarily on the results of an online survey involving 227 international and/or NESB graduate students in the areas of Engineering and IT at the three universities. The study reveals cross-cultural differences in perceptions of student and supervisor roles, as well as differences in the understanding of the requirements of graduate study within the Australian Higher Education context. We argue that in order to assist international and NESB research students to overcome such culturally embedded challenges, it is important to develop a model which recognizes the complex interactions of factors from both sides of the supervision relationship, in order to understand this cohort's unique pedagogical needs and develop intercultural sensitivity within postgraduate research supervision.

Keywords: English speaking background (NESB), higher degrees research (HDR), research supervision, research culture, communication.

1 INTRODUCTION

Research and innovation are central to the development of Australia's competitiveness in a global economy. The need for well-trained researchers has been recognized through the establishment of the Research Training Scheme [1], which combined with other incentives for research, such as the newly introduced Excellence in Research in Australia (ERA), has motivated universities to improve their research training performance. International comparisons published by the Group of Eight Universities (Go8) and the Australian Technology Network (ATN) of Universities background paper [2] reveal Australia is lagging behind in PhD completions (2.3 per 100 graduates, compared with 3.9 in Canada and 11.2 in Germany). This trend is now amplified by the relatively high rate of overseas students from non-English speaking backgrounds (NESB), who face unique challenges during their postgraduate education. An analysis of the Higher Degrees Research (HDR) data from Queensland University of Technology (QUT), and the University of Western Australia (UWA) as part of the pilot project to the larger project indicated that this is a growing problem in all disciplines, and is especially significant in Engineering and Information Technology disciplines [3]. The underlying causes are still not clear. However, issues such as *research culture; socio-cultural factors; cultural/language issues; non-academic 'life' issues; cultural or religious backgrounds; domestic/personal factors; technology driven factors and/or knowledge or skill in discipline or subject areas* may be contributing to the low rate of HDR completions for international and/or NESB students in these disciplines. Further, since

both students and supervisors contribute to the supervisory relationship, it is important to identify both key student and key supervisor factors which may influence outcomes.

To enable Australian universities to maximize their research potential, the Commonwealth Government's white paper, *Knowledge and Innovation: A policy statement on research and research training* [4] outlined its vision for the future of higher education research in Australia. The paper focuses on a number of themes that include the need to support and reward research excellence and to promote the role of universities in regional economic, social and cultural development through cutting-edge and high quality research. Australia is the preferred destination for many international students for high quality education and research with an annual growth rate of 12.1% in engineering and related technologies and information technology [5].

Australian universities have responded to this continuing growth of international students, universities by putting in place a range of supervisory frameworks to help them settle easily into the alien research culture. While most universities offer some resources for enhancing the quality of supervision, funding limitations and development costs make it expensive for any single institution to resource the supervisory demands of such diverse research student cohorts. Efforts to improve research training performance have emphasised the achievement of timely, quality research degree completions. Examples include the Research Training Scheme (RTS), University of Technology Sydney's FIRST Consortium, QUT's RAPID (Research Advancement Program for International Doctoral Students), and UWA's Facilitating International Research Students Transition Program are all good examples.

In addition, research by Bruce [6] identified and examined various supervisory styles and approaches to supervision in the technology disciplines at QUT. They highlighted that

- contexts in which there is rapid (albeit planned) growth of research student numbers place significant strain on both experienced and less experienced supervisors
- supervisors did not draw attention to any externally available resources or development opportunities in discussing helps and barriers to supervision
- some supervisors appear to remain uncertain about the alignment of graduate capabilities with their research directions

Further, it is important to recognize the potential complexity of the factors and interactions in the HDR supervision relationship. For example, there are *at least* four different potential cultural combinations necessary to describe the relationships: Australian-born HDR with Australian-born supervisor(s); Australian-born HDR with international supervisor(s); international HDR with Australian-born supervisor(s); or international HDR with international supervisors(s). Of course, within these combinations, there is also the possibility of students and supervisor(s) sharing a cultural background, or not. In addition, if an HDR student works with a team of supervisors (which is quite common in Engineering and IT), the team composition in any individual situation may add to the complexity, as may the specific institutional and educational context.

Similarly, it is important to note the limitations of terms such as 'international', 'NESB' (non-English speaking background) or CALD (culturally and linguistically diverse). For example, not all international students are non-English speaking (e.g., students from the US, UK, Canada, etc.), nor are all NESB or CALD students from overseas or international students (e.g., immigrants, indigenous or minority language populations, etc.). However, research suggests that even cultural difference (e.g., Canadians studying in Australia) may influence understanding of highly specific institutional and/or educational practices in areas such as higher education. For this reason, in this paper, we have chosen to use the terms 'international and/or NESB'.

Research has shown that cultural, linguistic and/or academic differences between student home cultures and/or institutions and the Australian context may impact students' progress. Culture is a filter through which we perceive and experience the world. Thus, cultural differences may affect communication between students and their supervisors, students and other students, or students in the greater community [7]. Linguistic challenges may include high level, and often highly specific, language skills and/or knowledge. For example, graduate students are expected to be able to write appropriately in a specific genre or discipline, present orally in seminars and at conferences, as well as interact appropriately with colleagues and others. They are expected to know and be able to use discipline specific terminology appropriately, and to read regular academic journal articles. Finally, different countries and different institutions often have distinct academic cultures. Differences may include expectations regarding student and teacher/supervisor roles and responsibilities, discipline-specific skills expectations, or even different understandings of approaches to research (e.g., what it is, how it's done) and requirements for different types of research degrees [8].

English language competency is also an essential component of international students' ability to understand the professional and industrial/business environment in Australia. Birrell et al [9] point that even two years of study at an Australian educational institution cannot guarantee mastery of professional level English. Although a certain level of English skill is required for international students to enrol in Australian universities, further development of language and communication skills enhances students' chances of doing well in their courses and beyond. While most universities have both generic and discipline specific language skill development programs for such students, they are not consistently or adequately implemented and it is often assumed that international students will 'pick it up' as they go.

Finally, international and/or NESB students may find it difficult to adapt to Australian research culture as a result of misunderstanding local social conventions and assumed rules of communication. For example, some international students may struggle to comfortably ask questions, communicate assertively with their supervisors, or have difficulty understanding Australian approaches to time and self-directed learning [10]. These issues can be compounded when an international student is required to interact with a supervisor who is also a non-native speaker of English but from a different culture/linguistic group than the student. Of course, it is equally important to differentiate issues which may be considered 'general HDR' issues (e.g., concerns shared by most HDR students, regardless of background), and those which may be 'NESB/international HDR issues' (e.g., which are more specific to international and/or NESB HDR students).

Therefore, identifying the individual factors (e.g., personality, learner style, motivation, etc.) and more general cultural and/or academic factors (e.g., educational background, role expectations, understanding of research paradigm, etc.) may provide a basis for development of a model which addresses the complex interactions between student(s) and supervisor(s). Such a model could then support development of appropriate support materials and/or interventions for both students and supervisors.

2 METHODOLOGY

Data was collected using an online survey which was administered to 227 international and NESB HDR students in the areas of Engineering, and Information Technology at Queensland University of Technology (QUT), the University of Western Australia (UWA), and Curtin University (CU). Online survey data was analysed using descriptive statistics, while comments were analysed using qualitative methods which identified themes and categories.

The survey was divided into seven sections. The first section collected demographic information, including age, gender, country of birth, length of residence in Australia, course information, previous experience at an Australian university, level of previous education, and mode of current enrolment (e.g., part-time or full-time). The second part of the survey included a series of items related to supervisory satisfaction using a Likert scale of 1 (poor) to 5 (very good). For example, items related to supervisor's expertise in the area, interest shown in the student(s), availability and guidance in the early stages of the postgraduate's candidature, etc. In addition, there were items related to the level of independence and support that was given to the students in planning their research work. The third section of the survey included a series of items about the perceptions of international graduate students in terms of their research environment(s). The items were related to the role that supervisors played in helping the international and NESB students recognize and understand the local research environment, the research culture, and the socio-economic and national implications of their research.

The fourth section of the survey explored the level of social interaction that students had with their supervisors, as well as their perceptions of their supervisors' willingness to discuss non-academic (e.g. personal) issues. The fifth part of the survey involved a series of items about the help that supervisors provided in assisting NESB graduate students to develop their communication and social networking skills. Using a 5-point Likert scale (1 - Never, 2 - Sometimes, 3 - Most times, 4 - Frequently, 5 - Always), participants were asked to rate their supervisors' support in developing students' English speaking capability, directing them to useful resources, encouraging them to improve their communication skills, etc.

The sixth and seventh sections of the survey used a 5-point Likert scale to ask a series of questions on what international and NESB students perceived as their obligations/ responsibilities and those of their supervisors. There was also an open-ended, optional question which allowed participants to comment on "any other aspects of your HDR supervision you want to highlight as part of this survey?"

3 RESULTS

The survey was completed by 227 international and/or NESB graduate students studying in the areas of Engineering Systems and Information Technology at three Australian universities: the Queensland University of Technology, the University of Western Australia and Curtin University.

3.1 Students' linguistic, academic and cultural backgrounds

The students came from 33 different countries. The largest numbers of students came from China (25%), Malaysia (10%), Iran (9%), Sri Lanka (8%), India (8%), and Indonesia (8%). 67.4% were male respondents and 32.6% were female respondents. The age range was 23-47 years old, with the majority of participants (53%) between the ages of 20-29; and 38% between the ages of 30-39. Only 9% were over 40 years old.

Only 25% of the respondents had previously studied in an Australian university, while over 75% were studying in the Australian higher education system for the first time. In terms of length of residence in Australia at the time they completed the survey, 11% had been in Australia for one year or less, 44% between 1 to 2 years, 26% between 3 to 5 years, 6% for 6 to 10 years, and only 3% for more than 10 years.

The majority of students were PhD students, with 82% enrolled in full time PhD studies and 13.7% enrolled in Masters by Research. The remaining students were enrolled part time in either PhDs or Master of Science by Research. In terms of the highest level of qualification participants currently held, the majority (67%) had a Masters degree, with 31% with a Bachelors degree. Only four students had cited other qualifications: one had a PhD, and three had graduate diplomas.

The majority of participants (71%) were studying in the broad area of Engineering, including Chemical (3%), Civil (14%), Design (2%), Electrical (6%), Mechanical (14%), and Other or Unspecified (32%). Other areas included IT (19%), Life Sciences (4%) and Other (7%).

Most (over 70%) respondents were supervised by a team of supervisors while the rest were supervised by a single supervisor. In terms of IELTS entry scores, 74% had scores 7 or higher on Reading, and 70% had scores higher than 7 on Listening. By contrast, only 51% had scores higher than 7 or writing, and only 56% had scores higher than 7 on Speaking.

3.2 Supervisors' direct involvement in research

Overall, 80-90% of the respondents rated the supervisors' direct involvement in research as either "good" or "very good". This was in response to the supervisors' expertise in the area of research, commitment, availability, timely feedback and general research guidance. For example, 85% of respondents felt their supervisor(s)' expertise in their research field was 'good' or 'very good', and 90% of respondents were happy with the level of interest shown by their supervisor(s) in their work.

3.3 Supervisors and research environment

This set of items related to the participants' perceptions of their supervisors' role in helping them to understand the Australian Engineering and IT higher education research environment. For example, 78% agreed their supervisors helped them to understand the impact of their research at the national and international level (e.g., good or very good), and approx. 82% felt their supervisors educated them on standards of good research practice at the discipline and university level.

3.4 Supervisors and social interaction

In terms of perceptions of social interaction between supervisor(s) and students, the majority of students (83%) felt their supervisors were considerate of their cultural and religious backgrounds, and social needs 'most times' to 'always'. However, more diversity was seen in terms of supervisor support in the areas of life in the university, where 30% indicated their supervisors had sometimes or never provided support. Similar results were found with respect to consideration of student economic needs (31% never or sometimes), and helping students achieve work-life balance (30% never or sometimes).

3.5 Supervisors and linguistic and academic skill development

A series of items examined student perceptions of their supervisors' involvement in their linguistic and/or academic communication skills development. While the majority of students (85%) agreed that their supervisors were considerate of their non-English speaking background 'most times' to 'always',

they indicated less involvement in terms of directing students to useful resources to help develop language skills (33% never or sometimes), recommending readings to help improve English skills (43% never or sometimes), or promoting interaction with other English speaking HDR students (33% never or sometimes).

3.6 Research student obligations

Students were asked a set of 10 items using a 5-point Likert scale about what they perceived as their obligations as an HDR student. The items related to aspects such as attending induction programs, reading information pertaining to HDR students' responsibilities, initiatives in driving their research, work place health and safety issues and compliance to Office of Research regulations while developing their final theses. The majority of students (70-90%) agreed or strongly agreed that it was their responsibility (e.g., the responsibility of the HDR student) to attend orientations, comply with University reporting, plan their research and be aware of deadlines, etc.

3.7 Supervisor obligations as perceived by the HDR students

The final part of the survey related to a set of 12 items on the perceptions of students about their supervisor(s) obligations in guiding their research programs to successful completion. These items closely paralleled those described in Section 3.6 (above). The majority of students (70-90%) also agreed or strongly agreed that it was their supervisors' responsibility to ensure the students were aware of key processes and procedures such as attending orientations, complying with University reporting, planning their research and being aware of deadlines, etc.

3.8 HDR issues versus international NESB HDR issues

There were 65 responses to the open-ended question "are there any other aspects of your HDR supervision you want to highlight as part of this survey?". These responses were broadly categorized as relating to general HDR issues (e.g., issues common to most HDR students), and international or NESB HDR issues (e.g., relating to issues specific to international and/or NESB HDR students).

One participant clearly underlines this distinction, noting

"The lack in supervision/mentorship, I felt during my PhD, had nothing to do with potential cultural or language barriers [our emphasis]. My supervisors practised a laissez-faire [sic] approach in their supervision which certainly made me an independent researcher but did not help at all in finishing within the given time frame of 3 years. It became clear to me that juggling the supervision of HDR students together with teaching liabilities represents a challenge not every supervisor is able to cope with and I am not sure if the university is undertaking enough to address this issue."

This quote clearly illustrates that some issues in supervision may be considered 'general HDR issues', and may be common to many HDR students. For example, one student suggests the need for supervisors to give specific feedback, saying *"Supervisors should provide very constructive feedback and give very specific advices [sic]"*. While another notes their need to fill gaps in their own knowledge in the new context, stating *"I think I am satisfied with the supervision of my work. But sometimes there are gaps of knowledge which takes [sic] considerable time to fill."*

Finally, a third identifies the impact of inexperience in supervision, complaining *"I have bad experience with unexperience [sic] supervisor that let me of thinking to giveup [sic] my study"*.

By contrast, what we will refer to as NESB or international HDR-related comments specifically identify linguistic and/or cultural factors as underlying the issue. For example, one student identifies the need for NESB students to interact with English speaking, both for language development and social reasons, commenting *"I think non English speaking students [our emphasis] need to interact with native speaking colleagues or attend some lectures. Research is very lonely job and easily make people isolated."* Another student reminds supervisors of the need to consider students social and personal needs, suggesting they *"consider about the issues from living overseas, like homesick [sic]"*.

The dilemma of the project-based PhD, which is typical of many Engineering programs, for international students and their supervisors for both cultural and pragmatic reasons is outlined by another student who says *"the need of supervisors to finish their research project, and the need of an international students [our emphasis] to study a certain topic which is useful for their country are*

often unfit [sic]. Out of these confusions and misunderstandings, supervisors and the students are both experiencing hard times."

Based on these results, it appears a distinction between 'general HDR' and 'NESB-HDR' issues may be critical to the identification of relevant factors which may influence the supervisory relationship.

4 Discussion

The survey provides a picture of a complex culturally and linguistically diverse group of students in the areas of Engineering and IT at three Australian universities. As a group, the majority of students surveyed were male, relatively young, studying full-time for a PhD in Engineering, and had never studied in Australian institutions prior to beginning their current graduate studies. Most arrived with a Masters degree by coursework or research. The majority came from China, India, Iran, Indonesia, Malaysia and Sri Lanka, or broadly 'Asian' countries. Typically, the students were being supervised in teams, rather than by a single supervisor.

This broad demographic description is not unexpected for the fields of IT or Engineering, which typically attract more men than women, and tend to supervise using teams (often built around specific projects). The fact that the majority of participants were studying full-time may reflect the conditions of their visa status. Given Australia's location, and the current mining and resource boom, the cultural mix of students predominately from Asian countries, India and the Middle East is also not surprising. However, given the relative distance between some of these cultures and the predominately Anglo-Australian orientation of many Australian universities, the probable need for specific orientation concerning possible cultural and academic/administrative differences becomes clear.

4.1 Perceptions of student and supervisor roles

Overall, the students appear satisfied with the core supervisory issues related to their research programs, including their supervisors' level of expertise their fields, and the amount of interest shown in the students' work. They also felt their supervisors helped them to understand the research and/or academic context, including standards of good research practice. In other words, they felt their supervisors provided good support related to academic issues in their programs.

However, confusion appears to exist regarding student and supervisor responsibility, as well as in terms of cross-cultural differences in the definition of student and supervisor roles. For example, students both agreed that it was the student's responsibility AND that it was the supervisor's responsibility to keep the student informed on program and administrative issues in the two sections of the survey comparing allocation of responsibility. While some of these results may relate to participants' (mis)interpretation of survey items, there also is evidence the results may reflect cross-cultural differences in the perception of student and supervisor roles. For example, in many countries, the role of supervisor (or teacher) is more encompassing of non-academic and/or personal issues (e.g., a more parental role), than in the traditional Anglo-Australian role expectations, which emphasize a high level of student 'independence' and 'self-sufficiency', which in practical terms is often interpreted by supervisors as expecting students not to rely or expect the supervisor to organize either academic or personal matters, but rather to do this themselves. Similarly, within this cultural paradigm many supervisors see their role as primarily focussed on academic matters, not personal or life issues [10].

These differences in role perceptions as key factors appear to be supported by survey results show that while students felt that their supervisors were generally considerate of their linguistic and cultural backgrounds, they felt their supervisors' were less involved in helping students to access language skill development resources or providing support for non-academic and/or personal issues. For example, while the majority of students agreed that their supervisor(s) were considerate of their non-English speaking background, they indicated less involvement in terms of directing students to useful resources to help develop language skills, recommending readings to help improve English skills, or promoting interaction with other English speaking HDR students. Similarly, while the majority of students felt their supervisors were considerate of their cultural and religious backgrounds, and social needs, they indicated less satisfaction with the level of consideration of their economic needs, and/or achieving work-life balance.

This student preference for their relationship with their supervisor(s) not to be restricted to just academic issue is clearly illustrated by a student who notes, *I'm satisfied with HDR supervision in UWA, if the Uni can organise more activities for supervisor and Phd student to enjoy together other than working together, it will be much better."*

4.2 The impact of linguistic and cultural factors

It is interesting that while many institutions nominate 'language issues' as a key issue with NESB students, the majority of students had IELTS scores in the 6 and 7 range. Although these scores may be expected based on entrance requirements in most Australian universities, it seems significant that the majority of student had higher scores (e.g., 7 or higher) in the receptive skills (e.g., reading and listening), than in the productive skills (e.g., 6 for writing and speaking). While these results may reflect the dominant cultural and linguistic groups who participated in this survey, given the importance of productive skills in academic and social interactions in the Australian context, this difference in score areas may be an important factor in integration and success.

For example, the ability to speak and write clearly in English would theoretically benefit both academic productivity and ease of surviving in a foreign country such as Australia. Within the academic setting, students need to understand both the Australian academic context, as well as the specific institutional expectations of their host university, and the expectations of the various members of their supervisor(s). Difficulty communicating in English may make this more difficult, as noted by one of the participants, who states *"My supervisor sometimes thinks that he knows everything about my research. He does not give me a chance to express my ideas and I feel this is due to my English not being so good. And also I am quite shy."*

The complexity of the cross-cultural permutations of the supervisor(s)-student relationship such as that of a non-Australian-born HDR student and a non-Australian born supervisor is clearly illustrated by a student who notes *"one of my supervisors is not native English speaker so the difficulty of communication between us is much larger than communication with the other."*

The analysis of the student survey has revealed that the research supervision of international and non-English speaking background HDR students involves a complex range of unique factors that existing supervisory frameworks struggle to fully address. In addition to the cross-cultural and linguistic factors discussed above, Bruce [6] notes that supervisors from the technology discipline typically follow a rigid supervisory style modelled around creating groups (drawing key players together), developing a structure (project planning) and generating outputs. In addition, as is the case with other disciplines, supervisors in these disciplines seek many learning outcomes from candidates which have strong alignment with the university's graduate capabilities. The inflexibility of such protocols may place the international HDR cohort at a distinct disadvantage in the current context where there is rapid growth of their numbers and placing undue strain on both experienced and inexperienced supervisors.

5 CONCLUSIONS

The results of the survey provide support for Cahill's [10] observations that there are a number of issues that need to be considered to assist students in settling into a professionally organised and a friendly supervisory relationship, including:

- formal assessment of relevant previous knowledge in the discipline
- relevance of previous professional experience
- students educational and occupational expectations, aspirations and learning styles
- English language competency and associated needs

It is clear from the survey that in addition to the need for support strategies and resources for international and NESB students, culture and discipline-specific approaches may be needed to ensure that research cultures are welcoming, helpful and sensitive of this cohort's unique needs. Identification of key student and supervisor factors in the complex supervisory relationship equation is a critical step in that direction. Further research within this project will be examining the supervisor side of the supervisory equation.

This research also underscores the need to extend the existing supervisory frameworks to include not only linguistic and cultural diversity, but also the unique discipline requirements of the fields of Engineering and IT, which should lead to students effective sociocultural integration and result in high quality research output. Arguably, a model which includes development of generalizable cultural awareness strategies and skills would benefit both HDRs and supervisors within a general international mobility context (e.g., both those returning home and those living and working in international contexts).

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