‘SHOULD I STAY OR SHOULD I GO’?: RURAL AND REMOTE STUDENTS IN FIRST YEAR UNIVERSITY STEM COURSES

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ABSTRACT

Research on the achievement of rural and remote students in science and mathematics is located within a context of falling levels of participation in physical science and mathematics courses in Australian schools, and underrepresentation of rural students in higher education. International studies such as the Programme of International Student Assessment (PISA), have reported lower levels of mathematical and scientific literacy in Australian students from rural and remote schools (Thomson et al, 2011). The SiMERR national survey of science, mathematics and ICT education in rural and regional Australia (Lyons et al, 2006) identified factors affecting student achievement in rural and remote schools. Many of the issues faced by rural and remote students in their schools are likely to have implications on their university enrolments in science, technology, engineering and mathematics (STEM) courses. For example, rural and remote students are less likely to attend university in general than their city counterparts and higher university attrition rates have been reported for remote students nationally.

This paper examines the responses of a sample of rural/remote Australian first year STEM students at Australian universities to two questions. These related to their intentions to complete the course; and whether -and if so, why- they had ever considered withdrawing from their course. Results indicated that rural students who were still in their course by the end of first year were no more or less likely to consider withdrawing than were their peers from more populous centres. However, almost 20% of the rural cohort had considered withdrawing at some stage in their course, and their explanations provide insights into the reasoning of those who may not persist with their courses at university.

These results, in the context of the greater attrition rate of remote students from university, point to the need to identify factors that positively impact on rural and remote students’ interest and achievement in science and mathematics. It also highlights a need for future research into the particular issues remote students may face in deciding whether or not to do science at the two key transition points of senior school and university/TAFE studies, and whether or not to persist in their tertiary studies.

This paper is positioned at the intersection of two problems in Australian education. The first is a context of falling levels of participation in physical science and mathematics courses in Australian universities. The second is persistent inequitable access to, and retention in, tertiary education for students from rural and remote areas. Despite considerable research attention to both of these areas over recent years these problems have thus far proved to be intractable.

This paper therefore aims to briefly review the relevant Australian literature pertaining to these issues; that is, declining STEM enrolments, and the underrepresentation and retention of rural/remote students in higher education. Given the related problems in these two overlapping domains, we then explore the views of first year rural students enrolled in

STEM courses, in relation to their intentions of withdrawing (or not) and the associated reasons for their views.

LITERATURE REVIEW

Declines in STEM enrolments in secondary and higher education

Low post-compulsory science and mathematics enrolments are a concern in many countries in the Western world. Dobson (2012) reported that in the period 2002-2010, as overall university enrolments increased in Australia, enrolments in Engineering showed a small relative increase but relative enrolments in Agriculture, Information Technology, and Natural and Physical Sciences declined. This is paralleled by declines in school STEM enrolments, as described in several recent reports (e.g., Goodrum, Druham, & Abbs, 2011, Lyons & Quinn, 2010).

Many interrelated factors have been postulated to explain these declines in STEM in Australia. For example, the 'strategic value' (Eccles, 2009) of many areas of STEM, particularly Life Sciences, may have declined in tandem with structural changes in the Australian economic and policy context, as indicated by relatively poor job prospects and remuneration in the area (Giles, Ski, & Vrdoljak, 2009; Graduate Careers Australia, 2009). The Universities Australia report (2012) examined first year university students' attitudes towards science, technology, engineering and mathematics, and compared the responses of 701 STEM and 851 non-STEM students. They reported that two major issues were the influence of teachers in high school, and the level of awareness of career pathways. The authors highlighted the need for students to engage with these subjects at an early age, and claimed that "a significant issue that impacted on students not choosing STEM courses related to their perceptions of where that would lead them after university" (Universities Australia, 2012, p. 81). Some non-STEM students perceived the career options as uninspiring and were unaware of the different career pathways open to STEM graduates. It was suggested that students needed more awareness of potential STEM career pathways early in their high school studies.

From a different perspective, parents have also been implicated in the relative unpopularity of STEM. In a study involving parents of grades 5 – 7 students, Boon (2012) found that they viewed geography, history, social studies or SOSE (studies of society and environment) over science as better preparation of their children's understanding of socio-scientific issues such as climate change. While most parents recognised the usefulness of science for developing thinking skills (over 85%) and that the scientific method is useful across all domains (over 80%) many parents complained, in the open response section of the survey, that it was insufficiently relevant and contextualised, and too academic or theoretical. Harackiewicz, Rozek, Hulleman and Hyde (2012) reported positive results from an intervention designed to help parents motivate their children towards high-school mathematics and science courses, by giving parents access to information about the utility of mathematics and science, and supporting and encouraging them to share this with their children.

Another explanation for the declines relates to the wide range of subjects available to students, as Australian students are today faced with a wider range of education options at senior high school and university than in the past (Lyons & Quinn, 2010). The implication is that increased curriculum diversity has been drawing students away from science subjects, thereby reducing their market share.

RURAL UNDER-REPRESENTATION IN HIGHER EDUCATION

Rural and isolated Australians are significantly under-represented in higher education. Participation of rural students in higher education was 18.1% in 2007 compared to a population reference value equal to 25%, and participation of rural and remote students in higher education was decreasing (Bradley, Noonan, Nugent & Scales, 2008). The participation of rural Australians in universities and the engagement of universities with rural and isolated Australia continue to be significant policy issues for the nation (James, Krause, & Jennings, 2010, p. 66). This problem reflects international trends in access and equity to higher education; with Baldwin and James (2010) claiming that access and participation issues in higher education are 'significant policy issues in most countries' (p. 334), and that underrepresented groups include people from rural or remote areas. In studies focused on

the number of Australian youth who do not complete year 12, researchers have reported a trend for young people educated in rural communities to be under- represented in post-compulsory education (Lamb, Dwyer & Wyn, 2000; Alston & Kent, 2003).

Reasons postulated for rural underrepresentation in higher education

Studies of Australian higher education consistently point to educational access and equity issues that relate to rurality. James (2000, p. 107) reports that prospective university students' choices are unequal in that: "students' choices are significantly shaped and constrained by their social, economic and geographical circumstances". Heagney (2004, p. 5) claims that "rurality and low socio-economic status combine to produce the greatest educational disadvantage". A range of the interrelated factors related to underrepresentation in HE was discussed by Baldwin and James (2010). As they claim, the interrelationships between these factors are not well understood, as some represent explicit barriers to participation and others the absence of factors in the environment that encourage aspiration to higher education. Baldwin and James (2010) conclude that: "the imbalances in higher education participation often reflect endemic educational disadvantage that begins in the earliest years of schooling" (p. 337). Some of the pertinent interrelated factors are outlined in more detail below. Factors relating to rurality are pertinent to each of Baldwin and James' two categories.

Financial hardship is an important factor inhibiting rural access to higher education. Financial barriers to HE participation include the expense of university fees, the lack of availability of income support while studying, and the loss of potential income while studying (Baldwin & James, 2010 p. 337). In a specifically Australian context, Alston and Kent (2003) argue that the financial cost of education creates a barrier for rural families, and Godden (2008) claims that financial barriers restrict access and deny regional young people their human right to education.

School-related factors that underlie underrepresentation in HE raised by Baldwin and James (2010) include lower school-completion rates and lower achievement levels, which they claim limit opportunities under competitive HE entry systems. This argument certainly has some traction in the Australian context, where rural high school students have lower levels of achievement that may negatively influence subsequent study of senior high school science and hence STEM courses at university. Year 12 completion rates are lower for rural students, and Australian metropolitan students consistently achieve higher scores at Year 12 in areas of mathematics, the sciences and technology (Centre for the Study of Higher Education, 2008). More recently, international studies such as PISA have continued to report lower levels of mathematical and scientific literacy in Australian students from rural and remote schools. The average gaps between metropolitan and remote were more than one year of schooling for both mathematics and science (Thomson, De Bortoli, Nicholas, Hilman, & Buckley, 2011).

Research in the Australian context suggests that some of these school related factors may relate to the lack of experienced science teachers at rural schools. This is a long-standing problem. In 2003 it was found that most Australian States and Territories reported difficulties in filling two types of vacancies; those located in rural and remote areas (and in some locations within metropolitan areas as well) and for certain specialisations – with mathematics, science and ICT vacancies specified as 'hard to fill' (MCEETYA, 2003, p. 20). Recruiting and retaining well-prepared teachers for rural and regional schools remains an ongoing issue faced by all States and Territories (White & Kline, 2012). This is a problematic issue for rural students, given the established link between teacher experience and student achievement gains (e.g., Nye, Konstantopoulos & Hedges, 2004; Clotfelter, Ladd, & Vogdor, 2007). Given this context it is perhaps unsurprising that students from rural areas of Australia and those from Indigenous backgrounds are significantly less likely to report on the benefits of their final secondary schooling (James et al., 2010, p. 29). More than half of the students surveyed felt that school prepared them well for university, but this was not the case for students from rural areas. (James et al., 2010 p. 33)

In addition, the majority of Australian universities have no explicit focus on rural education in their teacher education programs; have random and ad hoc rural practicum opportunities and no obvious link to any of the various financial incentives across Australia to encourage graduates to work in rural areas (White & Kline, 2012, p. iv). A range of other related factors affecting student achievement in

Australian rural and remote schools is discussed by Lyons, Cooksey, Panizzon, Parnell and Pegg (2006).

The final area considered here in relation to rural underrepresentation in higher education concerns attitudes and interest in science. Positive attitudes to and interests in science strongly influence students' STEM choices (Lyons & Quinn, 2010), however, Year 10 students in rural areas had significantly less positive attitudes towards science than those in larger population centres. Students in small rural or remote towns were also less inclined than city students to enjoy science and were less inclined than those in larger centres to prefer science to their other subjects (Lyons & Quinn, 2012). In investigating factors that impact on STEM degree completion, Maltese and Tai (2011) found that interest during high school is an important factor, reporting that "students who in eighth grade indicated that they held an interest in a STEM career were significantly more likely to complete a STEM degree" (p. 898). They also found that, for year 10 students, perception of its usefulness, and interest in a career were important factors. Research by Hulleman and Harackiewicz, (2009), showed that one reason that students demonstrated low levels of engagement in STEM courses in high school was that links were not made between their lives and what they were learning. When students were encouraged to make links to real-life relevance, their interest increased.

RETENTION OF RURAL STUDENTS IN HIGHER EDUCATION IN AUSTRALIA

The problems of underrepresentation of rural students in higher education are in part reflected in retention statistics. Student retention is of concern to universities worldwide, in part because it is a performance indicator of quality assurance (Crosling, Heagney & Thomas, 2009). The most recent available data for Australian university students (Department of Education Employment and Workplace Relations 2011) suggests that while the situation is not too bad for regional students, inequities have persisted for the designated 'remote' equity group. For these students, access and participation rates were lower than the entire cohort and have declined between 2006 and 2010; retention and success rates, while more or less steady over this time were also low relative to the entire student cohort and the regional group.

These data are consistent with the findings of James et al., (2010, p. 23) that those expressing a desire to defer or leave university are more likely to be from rural backgrounds (26 per cent compared with 23 per cent of urban first year students). They reported that over the previous five years, increases were evident in the proportion of rural students attaching importance to family commitments and financial reasons that contribute to thoughts of deferring or departing. In addition, rural first year students were significantly less likely to feel part of a group of students committed to learning, were significantly less likely to say they enjoy being a university student and were less likely to enjoy being on their university campus (James et al., 2010). Radloff and Coates (2009, p. xi) also reported that provincial and rural students were more likely to consider departing before completing their degree. Low SES remote students and Indigenous students in particular do not do as well as other students at university (CSHE, 2008, p. 4).

Clearly these retention issues are related to the broader educational and school experiences outlined above. Researchers (e.g., Adelman, 2006) report that influences on degree completion can be traced back to high school, not just experiences during the degree itself.

RESEARCH QUESTIONS

Given that current data on retention, access, participation and success rates all highlight the relative disadvantage of students in small rural and remote areas; the experiences of such students in university STEM courses were an important focus of the IRIS study. The following two research questions are explored in this paper:

1. What are the responses of a sample of rural/remote Australian first year STEM students at Australian universities to the question: "I will probably decide to leave this course before I finish", and how do these compare to the other location categories?
2. What reasons are given by rural/remote students for considering withdrawing from their STEM university course?

METHODOLOGY

The IRIS Questionnaire

This paper comprises a small component of a broader research project; the Interests and Recruitment in Science (IRIS) project. This is a large-scale international study of student recruitment, retention and gender equity in university science, technology, engineering and mathematics (STEM) courses. The study was developed by a consortium of European universities, and the initial project was extended to countries across the world. The IRIS project addresses the widely held concern that too few young people choose STEM courses or careers, and aims to contribute to understanding and improving recruitment, retention and gender equity in STEM higher education.

The National Centre of Science, ICT and Mathematics Education for Rural and Regional Australia (SiMERR) collected the Australian IRIS data. During second semester, 2011, the Australian IRIS team collected data from 3496 first year University students enrolled in science, technology, engineering and mathematics (STEM) courses in 30 Australian universities. This study investigated the factors which had impacted on first year university students' decisions for choosing science, technology, engineering and mathematics (STEM) courses, and their first year experiences, including the extent to which their expectations were met by their courses, and their intentions to complete their chosen course.

IRIS Australia used a questionnaire developed by the consortium partners and administered to around 7200 European first year STEM university students. The data collection instrument is a survey with fixed response Likert-type questions and some open response questions. The focus of the survey is on motivations for and influences on students' course choices, and on their perceptions of their experiences during their first year of studying a STEM related course at university.

The online survey was open to students for ten weeks from the beginning of September to mid-November, 2011. Hence it captures the views of students still in their courses towards the end of first year, who have had a reasonable length of time to experience university life.

Two specific items from the survey form the focus of this paper. These are:

1. "I will probably decide to leave this course before I finish" (5-point Likert scale from 1: 'I disagree' to 5: 'I agree')
2. "If you have seriously considered withdrawing from your course, could you please say why?"

Responses to item 1 were analysed with a ci-square contingency table test of the frequency data. Item 2 was an open-text response, coded according to the themes emerging from responses over multiple readings and illustrative quotations reported verbatim except for minor corrections to capitalisation and spelling.

The sample

Table 1 reports the percentages of the 2999 Australian students completing the survey who attended high school in the different location categories. These four categories were used rather than the more technical MCEETYA Schools Geographic Location Categories (Jones, 2001) or the Accessibility and Remoteness Index of Australia (ARIA) since respondents are more readily able to identify appropriate categories based on approximate populations rather than complicated remoteness indices. Nevertheless, the proportions of respondents in these categories were comparable.

High school characteristics	*% of sample*
In a capital city	52.4
In a large, non-capital city (population greater than 25000)	19.9
In a rural city or large town (population between 10000 and 25000)	18.6
In a small rural or remote town (population less than 10000).	9.1

Table 1: Percentage breakdown of Australian respondents by school characteristics during all or most of their high school years

RESULTS

The 274 students in the small rural/remote category provided 266 responses to the item "I will probably decide to leave this course before I finish". Of these, the vast majority (224) disagreed (or strongly disagreed) with this proposition, 17 were neutral, and 25 agreed (or strongly agreed). These results are summarised in relation to the responses of the other location categories to this question in Figure 1 below.

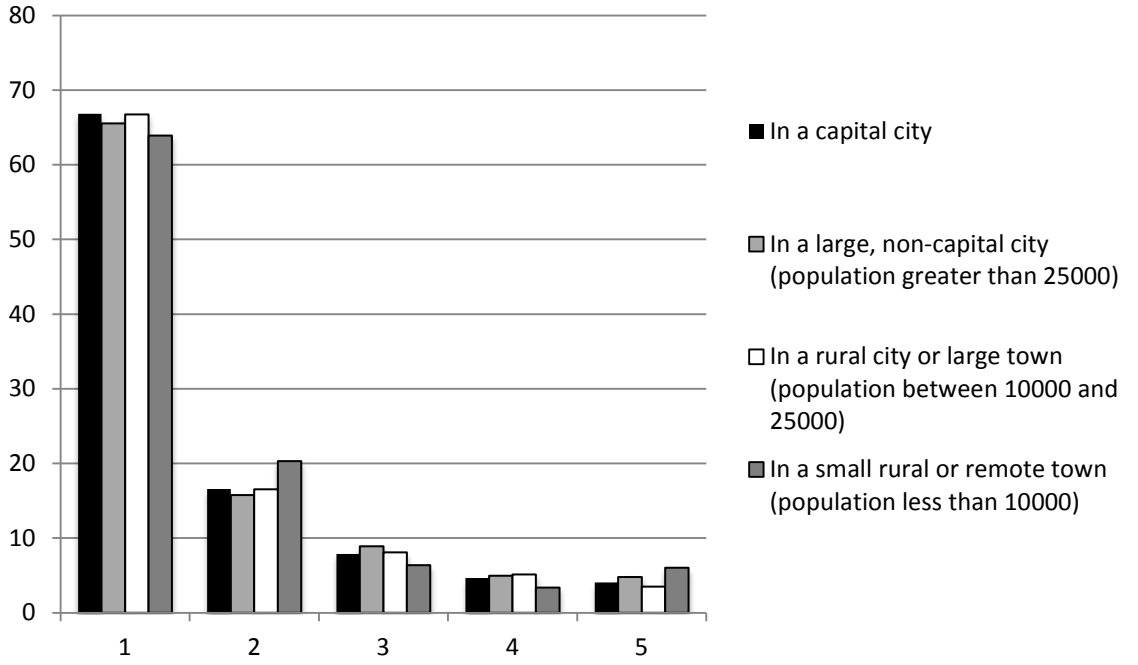

***Figure 1*:** Percentage responses of students from different locations categories to the item "I will probably decide to leave this course before I finish". 1 = I disagree, 5 = I agree.

As shown in Figure 1, the pattern of responses among the small rural/remote students was similar to those from other locations, with no evidence that at this stage in their studies they were more or less likely to consider withdrawing than were their peers from more populous centres ($\chi 2$ (12) = 12.3; p= 0.42).

In relation to the question of whether students had considered withdrawing from their course during their first year, 53 rural students (almost 20% of the cohort) suggested that they had. Their explanations for considering withdrawing are shown in Figure 2.

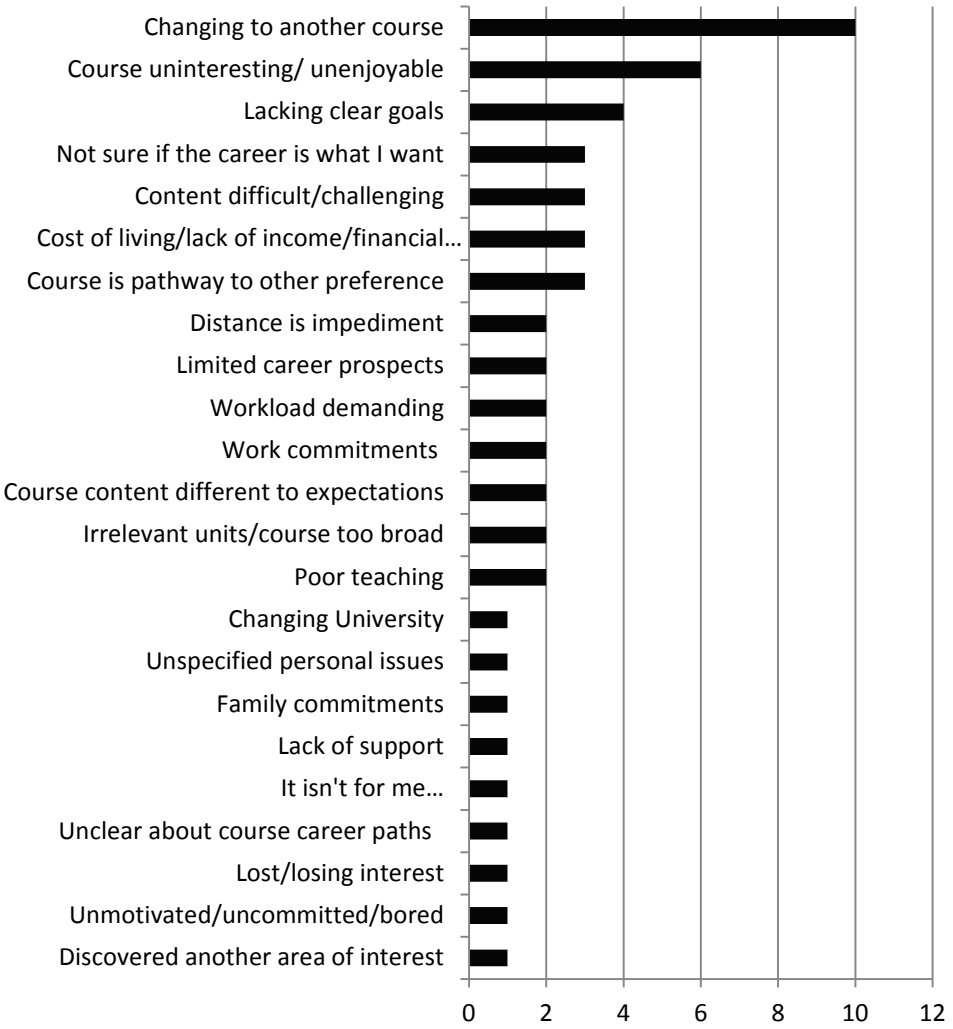

Figure 2: Reasons given by rural/remote students for considering withdrawing from their course, ranked by frequency of response.

As shown in Figure 2, the reasons provided by students spanned a wide range of domains, from wanting to change to another course (the most frequent category with 10 responses), to not enjoying the course, lacking clear goals and being unsure about career aspirations.

Students commented most frequently on reasons that were to do with their course. These included:

- changing to another course ("not saying that I will drop out but if I do it would be because I don't know if this is the course that I want to take");
- lack of interest/enjoyment ("I don't find it interesting enough to commit 3 years of my life to it, it is also difficult to full-time study with limited income") and
- the challenge of the workload ("have not felt smart enough to finish the course", "study load can be overwhelming", "not enough individual support from uni. Almost like moving to another country and not speaking their language").

Some students were still unsure of their career aspirations ("I still don't know what I want to do in the future, so thought about transferring courses, but didn't know what to change to, so I'm just picking the subjects I like and continuing with this one"). Other issues for these rural and remote students included distance from home ("trouble moving away from home in 1st Semester", "cannot commute 4hrs per day to attend a class").

The relatively small sample size for this element of the study meant that comparison with other location categories would not be very meaningful, but it is pertinent that the two most frequently represented categories are the same as for the cohort as a whole (Lyons et al., 2012).

DISCUSSION

The figure of 9% of the rural/remote students considering leaving their STEM courses can be interpreted a few different ways. From a positive perspective, it is little different to the proportions of students from other location categories considering this option. Given the retention and attrition issues in rural and remote education identified in the literature; and in particular, the research reporting that young people educated in rural communities are under- represented in post-compulsory and higher education (Lamb et al., 2000; Alston & Kent, 2003; Bradley et al., 2008; James et al., 2010), it would been reasonable to speculate that intentions to withdraw may have been greater among this group. In particular, it was positive to see that only three students from this category mentioned financial issues as a reason for withdrawing – again a similar proportion to the cohort more generally.

It should be appreciated that this study aims to capture the views of students later in their first year, where they have had a range of experiences and have developed attitudes informed by a reasonable length of time at their studies. Because the study focuses on students' perceptions towards the end of their first year of study it does not capture the views of rural (nor urban) students who may have dropped out at a point earlier than the survey.

While acknowledging this important caveat, the fact that students from small rural/remote schools were no more inclined to withdraw from their STEM course than those from other locations could indicate that this stage of their education is less critical than other stages (e.g. junior high school, senior high school, first months at university) in the pattern of attrition around rural and remote education. It may indicate that those rural/remote students who make it through most of their first year of university study have already avoided or overcome many of the 'attrition traps' lining the educational path of such students and will therefore be no more likely to withdraw than their urban peers. If this is the case, then it is all the more imperative to identify these earlier traps, and instigate strategies to combat them.

On the negative side, a potential attrition rate of 9% is still a reasonable proportion at this stage of their course and one that has considerable financial consequences for the institution, as well as a raft of implications for the individuals concerned. It must be noted that the reasons for these rural/remote students considering withdrawing from STEM are not necessarily 'dropping out'; with quite a few of this number moving sideways into other courses. The wide range of reasons cited points to the complexity of dealing with student retention, with several factors such as family, personal, and financial issues sitting outside institutional control. However the majority of reasons cited are directly related to university experiences, indicating the possibility of institutional action that might help to address these problems. This is particularly important in the first year of university education (Krause, 2005; Williford and Schaller, 2005) as in the first year "decisions to stay or leave are still unresolved" (Tinto, 1999, p. 5).

It must also be emphasised that the students' explanations for considering withdrawing relate to direct and immediate reasons: for example, 'lacking clear goals'. However, the more distal underlying reasons for these proximate answers are more complex and perhaps of more interest. Why might these students 'lack clear goals' and might this have anything to do with rurality? In this example, for instance, it could be that as some research has suggested, aspiration to university is lower among rural and remote students (Heagney, 2004). If so, this then raises the question of why this is the case – the answers to which will relate to an even more distal nest of interrelated socio-cultural and familial elements of the students' individual context. Research has traced influences on degree completion back to high school, not just experiences during the degree itself. For example, Adelman (2006, p. 108) analysed variables which influenced degree completion and found that secondary school studies had an impact. "What you study, how much of it, how deeply, and how intensely has a great deal to do with degree completion. Secondary schools must provide maximum opportunity-to-learn". This argument highlights once again the importance of good science teaching in rural and remote schools, especially senior high school, as this is where subject choices are made that can impact students' options of future tertiary studies in STEM courses.

Adelman (2006, p. 108) goes on to argue that "… postsecondary institutions have got to be active players and reinforcers at the secondary school level". We agree, but we would also argue that although universities can, should and do deploy strategies to enhance retention (the 'bums on seats' imperative is testimony to this), there is a limit to the likely effectiveness of these actions given the power and the complexity of the ultimate reasons for students' decisions.

These are important issues to rural Australia, as leaving home to attend university has important financial, personal and social effects on rural students and their parents, and hence on their communities (Alloway, Gilbert, Gilbert, & Muspratt, 2004; Godden, 2008; James et al., 1999). In addition, Drummond, Halsey and van Breda (2011) found that rural people perceived that it was very important to have universities in rural areas, and concluded "… in terms of the tertiary education system, the inequity in access for rural students is a major barrier to those students attending university" (p. 3). This is an interesting question in the context of the changing tertiary education landscape being described in the media, with recent headlines predicting that "Only elite to survive slump in university funds" caused by changing business models in reaction to online technologies and increased competition. (The Australian, 24 October 2012). On the other hand these technologies may enhance the ease of access and reduce dislocation for rural students and their families.

Within this changing higher education context, this study points to the need to identify factors that positively impact on rural and remote students' interest and achievement in science and mathematics. Reflecting on the specific issues faced by rural and remote students may help to focus on possibilities to facilitate better representation in higher education in general, and STEM in particular. It also highlights a need for future research into the particular issues remote students may face in deciding whether or not to do science at the two key transition points of senior school and university/TAFE studies, and whether or not to persist in their tertiary studies.

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