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How are we progressing with academic numeracy at regional universities? Perspectives from first-year undergraduate studies

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How are we progressing with academic numeracy at regional universities? Perspectives from first year undergraduate studies

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How are we progressing with academic numeracy at regional universities? Perspectives from first-year undergraduate studies

Introduction

First-year academic numeracy programs at universities, colleges and other higher education institutions across the industrial world have high attrition rates (Bressoud, 2014; Crocker, Kahla, and Allen, 2014). Typically, the educational background of students who are enrolling in a professional degree or other programs, such as business, nursing, agricultural science and education, shows a lack of preparedness for even the level of numeracy required in introductory subjects (Croft, Harrison and Robinson, 2009; Groen et al., 2015; Rylands and Coady, 2009). Furthermore, there are also a decreasing number of students progressing from first-year programs to studies of higher-level mathematics (Croft et al., 2009; Groen et al., 2015). A resulting issue is a shortage of graduates with the knowledge and skills of numeracy upon which our modern economies depend for sustainability and growth (Australian Academy of Science, 2015; Holdren and Lander, 2012; Office of the Chief Scientist, 2014).

Student participation in first-year academic numeracy ~~programs~~ is generally within undergraduate mathematics and statistics subjects but could also be as components of other subjects. Numeracy, or mathematical literacy, is defined similarly to Geiger, Goos and Forgasz (2015) as being able to identify the knowledge and capabilities required to accommodate the mathematical demands of private and public life, demands known to be increasing with technological development. Within universities this is the mathematical demands of the different subjects within the context of the subjects. Numeracy is not equivalent to number or mathematics, but embraces a broader conceptualisation, however, numeracy programs within higher education are primarily ~~dedicated to~~taught through introductory mathematics and statistics often without reference to context or contain an element of introductory mathematics as an essential component (Author G).

Students have different academic numeracy requirements depending on the program they are planning to study and their mathematical and numeracy backgrounds and capabilities. Some students will access academic numeracy programs to support their learning in assessable subjects. Students engage in first-year academic numeracy for a number of different reasons. A subject may be compulsory (e.g., offered within engineering), students may see employment opportunities (e.g., in big data analytics), or students may be motivated by a perceived need to obtain educational experiences in mathematics that lead to other educational and/or social goals (Kim and Keller, 2010; Sharma and Nasa, 2014). While many students believe these goals are attainable, academic numeracy is sometimes the critical filter that prevents these goals from being realised.

Higher education institutions have taken steps to respond to the high attrition rates in academic numeracy programs through the provision of resources that identify and support students with less than adequate skills and who are vulnerable to withdrawing (Author F; Gale and Parker, 2013; Grebennikov and Shah, 2012). Retention and attrition within these programs, as is the case more generally, is also related to the personal agency of students in engaging with such enabling and support services at appropriate times on their quest to satisfy life choices (Crocker et al., 2014; Stone, Walton, Clark, and Ligertwood, 2016; Walton, 2016)). Academic numeracy support can take a number of differing forms, such as mentoring and other motivational programs, but there is a focus, particularly in the 'just-in-time' support, on programs that exclusively support learning of content (Croft et al., 2009; Groen et al., 2015).

Many universities lack a systematic approach to support academic numeracy and any such support is often found in pockets within individual subjects, learning centres, enabling programs and university departments (Author E). As a consequence, universities face challenges in efficiently utilising the limited resources available and to fully support students in their aspirations towards success in academic numeracy. A recent talk by the current Chief Scientist of Australia highlights the critical nature of this issue within Australia (Finkel, 2018), pointing to the economic and social costs of not dealing adequately with the issue of academic numeracy at the university level.

Academic numeracy and regional universities

The study context

In Australia, universities and other higher education institutions face a situation where many students enter mathematics or other numeracy-allied programs with suitable Australian Tertiary Admission Ranks (ATAR) or equivalent entry qualifications across a range of different subjects, but with minimal or limited background in numeracy (Mack and Walsh, 2013; Smith, Ladewig, and Prinsley, 2018). Regional Australian universities have a number of first-year undergraduate programs that offer subjects that contain a small component of academic numeracy. A science student, for example, may need to understand a log graph in a first-year biology subject, or a nursing student will need to calculate dosage. While these two examples only require basic numeracy, there is usually no prerequisite 'recommended' or 'assumed' mathematics knowledge for entry. In addition, a number of programs, such as engineering, some sciences, and secondary mathematics teacher education, do require higher level prerequisite mathematics, however, teaching staff assume that students entering any of these subjects have the requisite knowledge and skills, and are often ill-equipped to assist those students who do not (AurthorF; Wandel et al., 2015).

Typically, the educational background of students enrolling in professional degrees such as business, nursing and education, show a lack of preparedness for the level of numeracy required (Australian Academy of Science, 2016). This limited numeracy background may lead to students forming attributes and perceptions of their reduced capability to study subjects that require numeracy, specifically mathematics, and further contribute to student anxiety and self-fulfilling failure (Boyd, Foster, Smith, and Boyd, 2014; Lake et al., 2017). The students undertaking these programs may also have broader issues related to equity and diversity, and engagement (Hayden, 2010; Nelson, Clarke, Kift, and Creagh, 2011; Nelson et al., 2017) and these may act in combination to exacerbate numeracy difficulties.

The number of students who go forward to enrol in and complete higher-level mathematics subjects is small in regional universities when compared to larger urban universities (Barrington and Evans, 2016; Maltas and Prescott, 2014) and the relative problems with retention and progression tend to be more acute due to the disproportionally disadvantaged nature of the student population (Lyons et al., 2006). In addition, a number of regional universities neither have mathematics departments nor sufficient enrolment to maintain higher-level mathematics subjects. These universities often scatter any mathematics or statistics expertise to different areas of the university. In short, the voice of mathematics as a unified element is often lost and along with it any coordination of academic numeracy learning. As stated in the report on the Discipline Profile of the Mathematical Sciences in Australia (Wienk, 2016, p. 22):

> …some departments within smaller universities, many of whom have not responded to the 2015 survey, are not in a position to offer a major. A web search revealed seven, and possibly nine, universities [who] do not have a major in the mathematical sciences.

As part of a broader collaborative study, *XXX* (XXX), this paper presents a summary of the first-year ~~programs~~ subjects in academic numeracy, and strategies to support students within them, at the six regional YYY (yyy). These universities all have a substantial proportion of students enrolled with little or no mathematics or numeracy background or who have completed schooling more than 10 years ago, with large numbers of these students also from low- to mid-socioeconomic status (SES) backgrounds (Australian Academy of Science, 2016; Burnheim and Harvey, 2016; Lyons et al., 2006).

Commented [R1]: For further clarity in terminology, we have made changes as follows.
Program – is the whole course - nursing, education etc or when talking about a numeracy program across a range of subjects etc
Subject when talking about a particular subject eg mathematics

There appears to be three issues for these universities, compared with their urban counterparts, that disproportionally affect students: high attrition rates, especially from numeracy-allied first-year subjects; appropriate access to resourcing of support services (both financial and pedagogical); and, students' understanding of the culture of the university, particularly their critical literacy, (see Lawrence, 2013) and their willingness and ability to seek support and/or accept it when offered (Author C). These challenges may be exacerbated by recent proposed changes in government funding whereby, in the future, many already disadvantaged students may have to pay for enabling programs. Regional universities, however, do have some commonalities with peri-urban and urban universities in the need for collection and use of evidence to plan for the support of at-risk students (MacGillivray and Wilson, 2008).

The participating regional universities

The six participating universities are all headquartered in regional Australia and all have extensive experience in the provision of teaching academic numeracy, with the majority offering online or blended education across multiple campuses. The regions represented by the participating institutions reflect a range of communities not found in more densely populated urban centres, even though they embrace some aspects of urban life. All six universities have established track records in increasing engagement with academic numeracy, including successful professional development and community outreach programs, such as those run by the Australian Mathematical Sciences Institute (AMSI). Some bodies engaged with these universities, such as the National Centre of Science, Information and Communication Technology, and Mathematics Education for Rural and Regional Australia (SiMERR), have a regional focus. Several of these universities have been at the forefront of distance and online education and community outreach for over three decades and are now leaders in online education.

All six universities have established relationships with schools and community groups in their educational footprint, forming an extensive but truncated network across a broad section of Australia's eastern seaboard. All six have strong active engagement with industries in the community that employ students with numeracy competencies. The participating institutions also have strong track records in supporting the significantly diverse student cohorts that they attract, including support for the high proportions of regional, disadvantaged and other under-represented students (Author B; Australian Academy of Science, 2016).

Four of the universities have a school or department dedicated to mathematics and statistics teaching and the other two, more typical of regional and rural universities, have mathematics subjects and programs that are administered from non-specialist departments, such as education or engineering. All six universities have proven track records in relevant areas of applied research, such as nursing and education. Four of the participating universities bring a range of research expertise across different mathematics related disciplines as assessed in Excellence in Research Australia (ERA) 2015, including multiple ratings at 'well above' (a rating of 5) and 'above' (a rating of 4) world standards.

Over the period 2001 to 2014, however, all six of the study universities have had some of the highest attrition rates of any Australian university. In 2014, these were significantly higher, at or above 19.9%, than all but one of the urban universities, which were mostly below 16% (Department of Education and Training, 2017). The situation of these universities in regional Australia reflects current challenges in regional education more broadly—many of the students come from high schools in regional and peri-urban areas that have high proportions of disadvantaged students, including many who live in low SES environments with problematic access to schools, suitable curricula, and higher education and training programs (Lyons et al., 2006; Quinn and Lyons, 2016).

First-year Academic Numeracy at the Participating Universities

As is the case with most universities, the subjects targeting academic numeracy offered at preparatory and first-year level have been adapted to cater for increased student diversity and an accompanying broadening of the mathematics or quantitative competencies that these students bring to their tertiary studies (Author F; King and Cattlin, 2015). For example, associate degrees and diplomas (such as engineering) attract students who are often underprepared for the numeracy demands of their qualification, while journalism or marketing students require an increasing level of understanding of statistics to meet their professional requirements. The professional degrees, such as those dedicated to the qualification of teachers and nurses, have until recently offered only a narrow range of knowledge and skills in numeracy, if offered at all. While there is now a requirement for proof of a sound level of competence in academic numeracy for initial teacher education in ~~some states and territories~~Australia (https://teacheredtest.acer.edu.au), this has been only a recent requirement. Until recently, teachers other than specialist high school mathematics teachers did not need any proven mathematics competencies.

An additional factor in the declining level of academic numeracy possessed by first-year undergraduates has been the smaller number of students taking intermediate and advanced high school mathematics and the dropping of specific mathematics prerequisites for university entry. The Australian Academy of Science (2016, p. 30) encapsulates concern over this development:

> This puts pressure on standards in universities, has led to a reduction in the content taught and in the achievement levels needed to pass a subject, and has contributed to the closure of mathematics departments in several universities. Consequently, the availability of undergraduate majors in the mathematical sciences is vulnerable or excessively narrow in scope in many capital city institutions and is inadequate in regional universities.

Such concern is reflected in reports that students at regional and rural schools remain under-represented in academic numeracy and mathematics ~~programs~~ at both secondary school and university (Australian Academy of Science, 2016; Lyons et al., 2006). Many of the schools in regional Australia, from which undergraduates in regional universities are largely drawn, are struggling to maintain equivalent educational standards in numeracy compared with metropolitan areas, for example, in mathematical literacy and problem-solving (Quinn and Lyons, 2012). Wienk's (2016, p. 10) report notes that:

> students in disadvantaged schools who score high on numeracy in Year 3, end up making 2 years and 5 months less progress by Year 9 than similarly capable students in high advantage schools.

This article provides an update on how regional universities are progressing with academic numeracy, commencing with an outline of the participating universities' provision of learning and teaching of academic numeracy in first-year undergraduate programs, identification of at-risk students and strategies for support services at these universities. The paper then examines in more detail the undergraduate population undertaking academic numeracy subjects or programs at one of the participating universities, using attrition data for mathematics students who enrolled in the first year of undergraduate study in 2014. The paper concludes with a discussion of how this information could be used to jointly address the challenges of providing the teaching and learning of academic numeracy at regional universities.

The following research questions directed the research presented in this article.

1. What is the nature of the academic numeracy in subjects taught in the first year of regional universities?

2. What strategies have regional universities established to identify the short-comings of students undertaking first-year academic numeracy subjects?

3. What strategies have regional universities investigated and/or enacted in order to deal with the broad range of academic numeracy competencies of students undertaking first-year academic numeracy?

Method

The study utilised a longitudinal mixed methods approach drawing from both primary and secondary data (Yin, 2013). Secondary data from 2014 to 2016 was obtained from publicly accessible databases, such as those held at the Australian Government Department of Education and Training (e.g., https://docs.education.gov.au/node/41761) or was supplied by each university:

- first-year subjects that offered academic numeracy in part (e.g., biology or business subjects), or as an entire subject (e.g., introductory mathematics);
- the rationale behind these subject offerings;
- research that had been conducted on the development or implementation of support structures or interventions for students within these subject offerings; and,
- whether or not these support structures or interventions had been taken up by students.

Secondary data also included information collected as part of the everyday management and collaboration practices within the project and included daily internal correspondence, project journals and minutes, and other records of meetings and workshops.

Primary data included results from a survey of nine academics at the six study universities who were involved in first-year programs (2014 to 2016) that included introductory academic numeracy. The survey is given in Appendix 1. Seven of the nine respondents also participated in follow-up semi-structured interviews that allowed for the appropriate development of the survey responses in the light of data reported from across all six institutions. A research journal, kept by the project leader, was also a source of primary data. The journal was a written reflection, recorded at irregular but frequent intervals (less than a week apart) during the project and documenting project progress, opportunities and challenges.

Drawing on data reported in the broader XXX project, analysis also focussed on a cohort of undergraduate students from the single year 2014 at a single university. Within the XXX project, analysis took the form of an in-depth single case study with a purposeful case selection (Cohen, Manion, and Morrison, 2013), as is appropriate in a government-funded collaborative project in a higher education setting. Both primary and secondary data sources informed the construction of the case study, but the current article summarises findings reported in detail elsewhere (e.g., Author C; Lake et al., 2017)

All data collected or generated was subjected to thematic analysis and assessed against the research questions. The study followed ethical protocols as per ethics requirements, with the names of project team members and universities de-identified.

Results and Discussion

First-year academic numeracy ~~programs~~

Each university offered mathematics and statistics subjects as well as enabling or bridging programs (preparatory programs), and academic numeracy within other programs. The enabling or bridging programs are those offered prior to enrolment in an undergraduate degree and are intended specifically to enhance preparedness for undergraduate study with both knowledge and skills prior to the commencement of classes. Within degree programs the six universities offer a range of numeracy knowledge and skills in both online and blended learning formats: students may be able to complete a first-year mathematics subject either online; as a combination of online and face-to-face; or, in an exclusively face-to-face setting at a number of campus locations.

Analysis of the surveys and in-depth interviews supported the view that many students are mathematically ill-prepared when they enter preparatory and/or introductory mathematics subjects. Many of the respondents commented on the challenges with the pre-requisite content of the quantitative skills in their subjects. As one interviewee noted:

> They're not very comfortable doing it because they haven't spent enough time, (so maybe) not enough practice at school…I think it is a lack of practice. (Interviewee A)

Interviewees reported that students experience particular difficulties with algebra, fractions, graphs, logarithms and unit conversions, with more specific difficulties related to operations with fractions, connecting graphs to formulas, finding patterns and relating them to mathematical formulas, and accurately using line intervals. Many of these concepts are addressed in the junior secondary mathematics curriculum and should be well developed by Years 11 and 12. One interviewee stated that:

> Students found letters in formulae problematic. Algebra is a great problem and again they are afraid of letters and they are not able to connect the formula...letters a and b with the actual expression, so if you ask, 'What is a, what is b?', they're sometimes lost. (Interviewee D)

Interviewees also reported that many students were not *au fait* with the language and conventions of mathematics and this impeded learning in introductory undergraduate numeracy. One comment that illustrated this situation was:

> I had a problem (explaining) to the students what rational numbers or real numbers are…for example, if we have a question about the intersection of two intervals, I explain what an interval is. I explain the wording. I explain the symbols. I think I have explained everything and at the end they understand what an intersection is, but they just list the integers which are in this interval...They really do not understand this continuity across [of] numbers. (Interviewee E)

Other issues identified that contributed to high rates of attrition or academic failure were clustered around institutional processes and personal factors (including critical literacy); students had trouble adapting to the university culture, with its own requirements, expectations and discourse. The interviewees expressed frustration at both the failure of pre-enrolment processes to identify students at risk, and the lack of preparation courses for these students once they had been identified, as well as the lack of uptake of available support by at-risk students. Personal factors reported included students' anxiety and lack of confidence with mathematics, and their lack of cognitive preparedness for tertiary mathematics study.

One interviewee also bemoaned the fact that "there is nothing to prepare them for it (university numeracy programs)". There was a consensus among the study participants that the current approaches were not providing the necessary upskilling for students in need. While bridging and additional support and enabling programs are available in mathematics and numeracy at the participating institutions, their use is not targeted appropriately and institutions appear to allow students to self-select involvement and to navigate the processes involved; something many appear unwilling or unable to do.

Identifying students at risk

Processes to identify students at risk of attrition or academic failure in introductory academic numeracy subjects or programs vary widely between and within the study universities, and even within programs. The approaches identified from the surveys were grouped into two broad categories, namely those used during early intervention prior to commencement and those during the first year of study. Based on analysis of the surveys and interviews, the project team developed the following schema for potential use in identifying students at risk of early attrition and academic failure. The schema is presented in Table 1. Where strategies or interventions identified have been previously described in the literature, the reference has been provided.

Table 1 Schema for identification of at-risk numeracy students

Early intervention strategies
Results from Foundation programs and bridging programs
Results from the first low-level mathematics subject attempted at university in an introductory mathematics subject at the lowest level OR an introductory algebra or calculus subject
Results from processes that guide enrolment or help in determining academic numeracy enrolment pathways, including diagnostic placement tests
Previous educational experience in mathematics as ATAR or equivalent; years since last mathematics course; and/or other risk factors used by each university (Author A)
Pre-testing within a subject e.g., for calculus or linear algebra
Advice on ~~program~~subject outlines for an introductory mathematics subject at the lowest level OR an introductory algebra and calculus subject.
Intervention during the first year of undergraduate study
Results from Literacy and Numeracy Test for Initial Teacher Education (LANTITE) trials (see https://teacheredtest.acer.edu.au/ for further information)
Results from support materials, such as units within an online support program based on incremental learning (see e.g., Author D)
Use of relative risk and/or network analysis to examine risk factors for academic numeracy in commencing cohorts (see e.g., Author C)
Results from assignments within the subject
~~Provision to~~Opportunity for students to attempt previous assignment and exam samples ~~and~~with solutions for an introductory mathematics subject at the lowest level OR an introductory algebra or calculus subject
Provision ~~during study~~ of frequently asked questions related to students' or staff feedback, for example, topics that many students have found difficult in previous offerings
In-program survey about attitudes and mathematics experience (see e.g., Lake, Boyd, Boyd, and Hellmundt, 2017)
Case studies: in depth interviews of one or two mathematics students, or in one case of all students in a particular subject

The processes used to gather data on students' mathematical ability range from diagnostic tests and formal assessments, to informal observation of students in tutorials. While the ideal might be to conduct pre-enrolment diagnostic tests, most at-risk students are only identified within the first three weeks of semester. This variation in identification of at-risk students echoes the unsophisticated approach mentioned earlier—one interviewee highlighted the issue as "what is said to be done, compared to what is done". Analysis of the survey showed that, when data is gathered about student performance, it may, or may not, be analysed and feedback may, or may not, be provided to the students in question.

Resource issues impact the capacities of mathematics staff to identify and support at-risk students. Respondent responses, in fact, raised the question of who should be ~~doing this sort~~identifying and supporting students to build their numeracy capability ~~of thing~~ and then how should their efforts ~~should~~ be evaluated in terms of success and accountability—some support programs were well-funded, but there appeared to be no accounting process to establish whether or not funds were well spent and how effective the support was. Additionally, the separation between the academics teaching in subjects that include numeracy ~~programs~~ and those meant to be supporting them (and students) indicated that there was a clear divide between the core academic pursuits and support practices and needs.

Strategies for student support and first-year academic numeracy ~~programs~~

All survey and interview respondents reported that the study universities are acutely aware of the problems (both institutional and personal) of early attrition and academic failure, including in academic numeracy, with a number of initiatives in place to identify and support students at risk. Respondents agreed that institution-wide research into such support mechanisms has been patchy and not always effective. Several of the project team undertook a meta-analysis of research on first-year undergraduate mathematics attrition and the mechanisms through which this problem is being addressed at one of the study universities (Lake et al., 2017). They determined that the most helpful research identified gaps in student mathematical knowledge, providing insights into how to best identify at-risk students, and suggested ways to assist these students. However, there were very few instances of implementation and evaluation of interventions or updating of university processes.

Interventions to support students struggling with introductory mathematics might be loosely grouped under two categories—those that involve mentoring and building student motivation, and those that focus on learning content itself. These approaches are not mutually exclusive, and many successful interventions drew on both (see also Stone et al., 2016). All respondents interviewed indicated that they were undertaking multi-university research into student attrition or academic failure, and how to best address this problem as it pertains to academic numeracy, with the XXX project a recent example. The respondents supported the view that in all cases, whether within or across universities, research in this area suffered from a lack of dedicated funding and a failure in many instances to transfer findings into actual institutional practices and processes. As one interviewee commented:

> My experience is that once the research is done, there is no commitment to implementation… academics operate with the view that it's the research that gets you

> promoted, not doing something about the problem that prompted the research in the first place. (Interviewee C)

This failure suggests using the principles of design-based implementation research may be more successful. These principles take up the issue of collaborative research and practice that involves multiple stakeholders, in a process that aims to design, test and implement innovations through iterative functionality (Author D).

The survey identified a range of institutional support practices for students 'at risk', including enabling subjects or units (Tertiary Preparation Program and Learning Centre initiatives) or placement programs, and support services such as mentoring programs, drop-in centres and study groups. The uptake of both enabling subjects or units and support services by first-year students was considered very low (5% of the cohort), although drop-in centres showed more promising usage patterns. Respondents were concerned that there were no evidence-based support programs available for at-risk students in academic numeracy, and specifically in mathematics subjects. Several respondents argued that universities often operated with anecdotal evidence of the effectiveness of the diverse support services on offer. Of particular concern was that students did not access support in a timely manner. One interviewee indicated that staff working on the subject made themselves available to students, but noted:

> We encourage students to come to us and we're really happy to help them and we have office hours, but unfortunately they do not use this very much. Somehow they are afraid of this. (Interviewee G)

Some institutions offered additional classes or mentoring programs where previously successful students helped new mathematics students. Acting as a mentor was reported by successful students as a useful initiative, but mentees did not always report their experiences as useful, and there were some reports of mentors/academics not offering the required level of assistance. When mentoring or extra classes were offered online, students did not always take up the opportunity, citing difficulties in attending online tutorials and preferring instead to look at pre-recorded materials or request one-on-one tutoring.

Staff working on introductory undergraduate mathematics subjects suggested that institutional strategies to support students at risk of attrition or academic failure were not always in place across academic numeracy programs. The lack of involvement of academics in support programs was felt to contribute to a reported over-dependence on casual tutors with insufficient skills and experience to aid students who were underprepared and were struggling. Study interviewees also commented on the lack of funding for, and the failure to integrate a well-targeted support network at the institutional level.

Despite such difficulties, the interviewees were positive about embedding opportunities for students to keep practicing until they had mastery of a particular concept. Interviewees, however, stressed the importance of ensuring that such mastery be based on interaction with existing subject structures, be complementary to those structures, and keep students on-task until completion of any such modules attempted. As one interviewee noted:

> A lot of students that are struggling… that are having trouble with the course… if it's too long they would probably get bored with it, and they would just leave it half way and then they wouldn't progress through the whole thing, whereas the benefit they'd actually have (would be) to finish the whole thing. (Interviewee H)

A focus on first-year academic numeracy ~~programs~~ subjects at a single university

The XXX project had a significant focus on a single YYY university, where secondary data collection was more extensive, drawing from archives as well as student surveys as a single in-depth case study. Demographic information related to statistical evaluation of disadvantaged groups typical of undergraduate student cohorts undertaking education programs in regional universities is summarised in Table 2 (from Lake and Boyd, 2015; Lake, Boyd, and Boyd, 2015). For example, one third of these students were from low SES background, with many of them previously attending high schools with a strong focus on application rather than theory. As such, mathematics was often not offered to students as a discrete subject or was taught only at a rudimentary level, and numeracy was not evaluated across the curriculum. In addition, two-thirds were 'first in family' to attend university, thus lacking the critical literacy and the family support that might assist them to adapt quickly and easily to university life (see also Clarke, Nelson, and Stoodley, 2011).

Many students lacked the preparedness for studying mathematics, including the significant majority (80%) of students who were women as well as students of Aboriginal and Torres Strait Islander background (2%) who, although a minority of students, appeared well-supported within that particular cohort. Significantly for regional universities, one third (33%) of education students at this institution were mature age and hence well-removed from their mathematics study at high school, a factor known to impact negatively on preparedness for tertiary study (e.g., see Author G).

Table 2 A summary of educational disadvantage at one of the study universities

Category of Educational Disadvantage	Percentage studying Education
Female	80%
Regional and remote	74%
First-in-family to attend university	64%
Mature age	33%
Low socioeconomic	31%
Aboriginal and Torres Strait Islander	2%

While this data has been obtained from what are considered categories at high risk of attrition (e.g., Coates, 2014; Nelson et al., 2011, 2017), the overall study here suggests that great care needs to be taken in extrapolating from single statistics, or even from statistics considered across selected groups. For example, the large female sub-cohort undertaking academic numeracy subjects cannot be considered as a high-risk group, since this large proportion (80%) limits any discriminatory value, regardless of whether universities have or have not identified females as at risk of failure in academic numeracy.

Within XXX, data was analysed from the 2014 commencing cohort of the single university (see e.g., Author A). This analysis enabled a focus on attrition from mathematics and statistics subjects offered to first-year undergraduates and attrition across other subjects across the university (detailed in Author C), as well as a focus on demographics and their relevance to academic numeracy. The 2014 cohort analysis suggests that new techniques for examining attrition, such as structural equation modelling (Farr-Wharton et al., 2017) and social network analysis (Author A) may be a way of complementing conventional statistical analysis. Such techniques, alone or in combination, offer a way to correlate multiple statistical values, leading towards a person-centred and place-based analysis. Author A have shown that such holistic approaches enable connections to be made between multiple student social interactions and other behaviours and any previously determined single-factor predictors of academic retention and, as well, provide new risk factors determined with reference to particular students at particular places; what van der Meer at el. (2018, p. 2) refer to as: “tailored for particular contexts, taking into account local affordances and constraints”.

The structural equation modelling reported in Farr-Wharton et al. (2018), for example, was used to analyse undergraduate survey data across disciplines, showing that, where demographic and socio-economic factors were controlled for, students’ levels of engagement and course satisfaction fully mediated lecturer-student relationships and intention to leave university prematurely. This is reflected in a comment from one of the interviewees:

> The large majority of failure was attributed to a lack of engagement, where students enrol in a unit and either do not engage at all, or withdraw from active involvement in the unit within the first few weeks of commencement. (Interviewee I)

The social network analysis (mapping and measuring the relationships between factors such as students’ demographics, engagement with teaching resources (eg attendance, Blackboard, etc), previous education experiences) of the same cohort highlighted how factors related to risk were connected to other factors in a student’s lived experience at a particular institution (Author A), a finding pertinent to the current study. Use of social networks in this case has shown that successful students may share a number of risk factors with students who withdraw or fail, and this may apply in academic numeracy contexts (Author A). Such multidimensional modelling techniques would be most suitable for use at higher administrative levels, including across disciplines within the university, and would provide high level managers with the sound empirical evidence required upon which to base strategic management decisions with regard to numeracy support that caters for individuals’ career and personal aspirations (Author C).

For the 2014 cohort, a combination of relative risk analysis combined with social network analysis showed that attrition from those subjects serving numeracy ~~programs~~ requirements for students from a number of academic disciplines (service subjects) was comparable with other subjects across the university, suggesting that some numeracy demands were being met for at least some members of this cohort. Service subjects, which are usually completed in the first year of undergraduate study, are completed by students from a number of disciplines and often involve a diverse range of student backgrounds and abilities (Macbean, 2004). Although students reported that several academic numeracy subjects considered to be service subjects, were easier than expected, the analysis for this cohort indicated that these low risk and low attrition subjects may, in fact, require revision to bring them to a higher overall standard. The academic numeracy offerings to initial teacher education students proved an exception, where attrition was higher than the university norm. It is well known that students entering initial teacher education have broad competencies that may, or may not, include the knowledge and skills required for development of academic numeracy (Cooke, Cavanagh, Hurst, and Sparrow, 2011; Hurst and Cooke, 2014) and this was apparent in this cohort.

Conclusion

This study presents findings from an analysis of data from six regional universities in Australia. The academics who responded to the survey and were interviewed for the study represent the key personnel across those six universities. Thus, the evidence presented summarises the available evidence from a substantial proportion of the regional universities in Australia and provides a good basis for understanding the current situation relating to the mathematical preparedness within these institutions, particularly those universities that have campus locations outside of urban or peri-urban locations.

Many programs of study involve the completion of academic numeracy subjects and form a critical early component that must be met in order to achieve students' educational and social goals (Author F; Smith et al., 2018). Regional students, particularly those non-traditional students enrolled in non-mathematics-based programs ~~such as education~~, appear to be challenged in their preparedness for subjects requiring a sound level of mathematics. The data analysis here suggests that, even when support services are available to at risk students, these services are not necessarily accessed (only 5% of students accessed numeracy enabling and support) and some students appear resistant in obtaining the available assistance that is available that would enable them to meet their educational goals. Additional research is required to investigate how to make support services a more viable option for students requiring additional numeracy support. This view was also explored in Author G who, in a study of diversity in first-year regional mathematics students, suggested that strategies are needed to improve the preparedness of students, in part to overcome the broad spectrum of competencies that present at university level. It appears, based on the findings in this study, that progress on these issues may require longitudinal approaches as well as an accompanying level of resources sufficient to the task.

This study found that these universities have a range of strategies to identify the short-comings of students undertaking first-year academic numeracy subjects both prior to commencement and during the students' first year. This study~~It was~~ concluded ~~in this study,~~ that considerable research has been conducted with a view to understanding the issues associated with numeracy related attrition ~~related to numeracy units~~ and that each institution maintains a range of support services to support students in this area. It appears, though, that the application of the findings of such research in a way that would reduce attrition requires a more nuanced approach within a local context. The current study begins a discussion on how such findings can be shared and adapted across regional settings. The localised approach used in this study for the case study, using data analytics that incorporates multiple person and place-based factors may provide additional insights and assist in understanding the phenomenon (Author A). This suggestion aligns with the view that the current limited level of sophistication in approaching the issue of academic numeracy and addressing related high attrition rates may warrant design-based implementation research approaches that address the problem in a more coherent way while providing feed forward and feedback interactions that would bridge the gap between research and practice in this area. The findings in this study may also be applicable to large metropolitan universities and further research in this context is considered appropriate to identify whether the challenges presenting in regional and rural universities also apply.

The focus on analysis of the extensive data collection at the single case study university provided insights into the considerable effort being made in the six regional universities to encourage and support students' development of a positive learning trajectory in academic numeracy. The case study also emphasises, however, that findings should be applied at the local university and student level, highlighting the need for a discussion on approaches that can provide a focus on examining particular cohorts at particular places. The approach used in the case study suggests further that a localised approach using data analytics that combines multiple factors may be useful in refining statistical research in order to make analyses more efficient and effective through a person-centre and place-based rationale. Users of these approaches, however, need to bear in mind that, while it has an advantage in being student-centred and place-based, problems may arise in any attempt to generalise across cohorts and across institutions.

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Author B

Author C

Author D

Author E

Author F

Author G

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Appendix A

Survey questions for partner members on identifying and supporting students at risk.

Part 1 Identifying students at risk
Q1 - What data is collected at your institution with a view to identifying students who may be at risk of early attrition or academic failure in introductory undergraduate mathematics units? (Include examples of standard data collection instruments, if available.)
Q2 - How is this data collected?
Q3 - When is this data collected?
Q4 - Who is the data collected by?
Q5 - Who conducts the analysis of the data?
Q6 - How are the findings of the data analysis disseminated and who receives these findings?
Q7 - What actions are taken based upon the findings of the data analysis?
Q8 - What role does the academic who coordinates the first-year mathematics unit/s play in the process described above?
Part 2 Institutional support for students at risk
Q 9 – What opportunities for additional support are available to firs year mathematics students at your university? E.g. Enabling program/s, mentors.
Q10 - How process(es) are in place to inform students of how to access existing student support programs?
Q11 - What percentage of students use these existing support programs?
Q12 - In your view, what benefit do the existing support program/s have for students who access them?
Q13. What do you think are the main limitations of the existing support programs at your university?
Part 3 Previous institutional research on mathematics student attrition/failure
Q14 What research has been conducted at your institution in relation to mathematics student attrition/failure? Please include reference to any publications which have resulted.
Q15 - What impact did this research have at your institution in relation to practices/processes for identifying and/or supporting students at risk of attrition/failure in first year mathematics units?
Q16 - What research is currently in progress in relation to addressing the incidence of student attrition/failure in first year mathematics units?
Final Comment
Q 17 – What do they think the major issues are that contribute to the high rates of attrition and/or failure in first year university mathematics units?

Dear Editor and Reviewers,
Thanks very much for your thoughtful comments. We have carefully addressed all of the comments as per the below table and tracked changes as well in the blinded (and unblinded) manuscripts.
Regards
Authors

Reviewer 1

Comment	**Action**
Some of the findings also apply for students at universities located in the larger metropolitan cities (e.g., first-in-family) so it would be good to acknowledge this in relevant parts of the article. Then, highlight those findings which are unique to regional universities or acknowledge that the factors are more prevalent in regional universities.	In the second last paragraph of the Conclusion, the following sentence has been added to highlight that what is presented may also be applicable in metropolitan universities. *The findings in this study may also be applicable to large metropolitan universities and further research in this context is considered appropriate to identify whether the challenges presenting in regional and rural universities also apply.*
p. 3) socioeconomic status (SES) background	Updated to: …*socioeconomic status (SES)*…
p. 4) Reword the phrase "minimal competence" given that meeting the standard for the Literacy and Numeracy Test for Initial Teacher Education (LANTITE) places pre-service teachers in the top 30% of the adult population	Updated to: …*of a sound level of competence in academic numeracy*…
p. 7) Need to lead into the two quotes. Alternatives: for example OR one interviewee said	Both quotes now have text to introduce them.
p. 8) Table 1 subheadings could be more precise - make it clear that the items are for identification of at-risk students and not the intervention (e.g.,	The following text has been included at the point where Table 1 is referenced:

Identification for potential early intervention, Identification for potential intervention during the first year…)	*The approaches identified from the surveys were grouped into two broad categories, namely those used during early intervention prior to commencement and those during the first year of study. Based on analysis of the surveys and interviews, the project team developed the following schema for potential use in identifying students at risk of early attrition and academic failure. The schema is presented in Table 1.* The headings for Table 1 have been changed to: *Early intervention strategies: and,* *Intervention during the first year of undergraduate study*
p. 8) Two of the potential identification strategies were unclear * "Provision of previous assignments…" - to allow educator of current course to examine and identify gaps in expected prior knowledge? * "Posting during duration of a subject…" - was this referring to students' posts and did the lecturer monitor the quantity or content of posts for warning signs?	Update to: *Opportunity for students to attempt previous assignment and exam samples with solutions for an introductory mathematics subject at the lowest level OR an introductory algebra or calculus subject* *Provision of frequently asked questions related to students' or staff feedback, for example, topics that many students have found difficult in previous offerings*
p. 9) "The uptake of both enabling units and support services by first-year students was considered very low (5% of the cohort), although drop-in centres showed more promising usage patterns." Better to include a figure for the drop-in centre usage as a proportion of the cohort to justify claim of "more promising usage patterns".	"More promising usage patterns" were reported from survey, but data were not provided as part of the survey responses, unfortunately.
p. 11) "A significant majority (80%) of the students were women, who lacked preparedness for studying mathematics." Need to make the link between being a woman and lack of preparedness. Surely not all of the women (80%) had inadequate numeracy preparation? Perhaps reword and justify why being a woman is an educational disadvantage. (e.g., A significant majority (80%) of the students were women, [many of whom] lacked preparedness… as demonstrated by…)	The wording has been altered to clarify, as follows: *Many students lacked the preparedness for studying mathematics, including the significant majority (80%) of students who were women as well as students of Aboriginal and Torres Strait Islander background (2%) who, although a minority of students, appeared well-supported within that particular cohort.*

pp. 10-12) Make the link clearer for research question 3 ("approaches that focus on student goals and personal agency"). The identification approaches are discussed in detail but not how the student support services are then modified to meet the identified student need.	The research questions have been updated to more accurately reflect the focus of the article. The existing research question 2 is now question 3, while a new question 2 has been added and the current research question 3 has been deleted. The section now reads as follows: The following research questions directed the research presented in this article. *1. What is the nature of the academic numeracy in subjects taught in the first year of regional universities?* *2.What strategies have regional universities established to identify the short-comings of students undertaking first-year academic numeracy subjects?* *3. What strategies have regional universities investigated and/or enacted in order to deal with the broad range of academic numeracy competencies of students undertaking first-year academic numeracy?*
pp. 14-17) When listing multiple authors in reference list, use ampersand (&) not "and"	Corrected.

Reviewer 2

Comment	**Action**
I found this article very hard to follow for the most part. One issue I have is that the author/s continually refer to a larger study of which this article/study is a part and results from the larger study are presented throughout this article. That does not make for ease of understanding as the actual data from the larger study is not presented for perusal. For example, the reader has little to go when trying to make sense of the discussion about social network analysis.	This presents a difficulty in that the major study and all references to it have been de-identified. We have, however, added a definition of social network analysis: *(mapping and measuring the relationships between factors such as students' demographics, engagement with teaching resources (eg attendance, Blackboard, etc), previous education experiences)*
The research questions do not focus on the notion of disadvantage so it is hard to see why there is a significant amount of discussion around that idea. Indeed, much of the discussion about 'A focus on first-year academic numeracy programs at a single university' does not focus on those programs - it talks about 'disadvantage' which does not seem relevant in seeking to answer the research question.	Identifying the universities as regional have been added to the research questions. The disadvantage of students transitioning into university who come from regional and rural schooling backgrounds is well established in the literature. The initial references to this issue on pages 3 to 6 were to set the issues with numeracy preparedness within the overarching context of the challenge associated with regional and remote schooling. It was also intended to provide an explanation based on the literature about why these students are challenged in their numeracy. The description of the larger (deidentified) project at the 'single university' was intended to illustrate this in depth.
Table 2 (p. 11) does not add anything to the discussion. What is the basis for choosing 'female' and 'first-in-family to attend university' as categories of educational disadvantage? No evidence is presented in support of that.	This table was added to the text to present the nature of the student cohort that presents at regional universities as the reader may not be familiar with this. The basis for choosing the categories for educational disadvantage was that used in literature referenced, as shown in the following sentence from the article: *Demographic information related to statistical evaluation of disadvantaged groups typical of undergraduate student cohorts undertaking education programs in regional universities is summarised in Table 2 (from Lake and Boyd, 2015; Lake, Boyd, and Boyd, 2015).*

	These categories are also outlined in other references provided, *While this data has been obtained from what are considered categories at high risk of attrition (e.g., Coates, 2014; Nelson et al., 2011, 2017),*
Table 1 (p. 8) presents 'potential' interventions whereas it would be appropriate for the study to look at 'actual' interventions. If they are 'potential' interventions, it infers that they are not in place, whereas that is what the study is meant to be researching.	The reason the original text used the term 'potential' was because the listed interventions in Table 1 had been identified to be used in at least one of the universities in the study. Thus, each of these then becomes a potential intervention that a university might implement to address the preparedness of students. For clarity, however, the word potential has been removed from the table headings.
It is not made clear if the data summarised in Table 1 came from data emanating from interviews or surveys, or from data supplied by universities. The authors talk about 'a survey of nine teachers' yet it seems that only interview data is presented. Also, instead of referring to them as 'teachers', are they not university academics? Whatever the case, this is not clear.	The following lines have been added to introduce Table 1. *The approaches identified from the surveys were grouped into two broad categories, namely those used during early intervention prior to commencement and those during the first year of study. Based on analysis of the surveys and interviews, the project team developed the following schema for potential use in identifying students at risk of early attrition and academic failure. The schema is presented in Table 1.* The word 'teachers' has been changed to 'academics' when referring to the interviewees used in the study.
The introduction does not set up the article well. 'Academic numeracy' and academic numeracy programs' have not been adequately defined. They are loosely discussed but tight definitions are needed. Are they remedial in nature? Are they primarily designed as preparatory in nature? Do students have to pass at a certain level to enter a program?	For clarity, we have deleted the word "programs" in places where it seemed ambiguous and have made clearer the difference between subject and program. We have altered paragraph 2 as below with this and other issues of clarity in mind. *Student participation in first-year academic numeracy is generally within undergraduate mathematics and statistics subjects but could also be as components of other subjects. Numeracy, or mathematical literacy, is defined similarly to Geiger, Goos and Forgasz (2015) as being able to identify the knowledge and capabilities required to accommodate the mathematical demands of private and public life, demands known to be increasing with technological development. Within universities this is the mathematical demands of the different subjects within the context of the*

	subjects. Numeracy is not equivalent to number or mathematics, but embraces a broader conceptualisation, however, numeracy programs within higher education are primarily taught through introductory mathematics and statistics often without reference to context or contain an element of introductory mathematics as an essential component (Whannell and Allen, 2012). Students have different academic numeracy requirements depending on the program they are planning to study and their mathematical and numeracy backgrounds and capabilities. Some students will access academic numeracy programs to support their learning in assessable subjects. Students engage in first-year academic numeracy for a number of different reasons. A subject may be compulsory (e.g., offered within engineering), students may see employment opportunities (e.g., in big data analytics), or students may be motivated by a perceived need to obtain educational experiences in mathematics that lead to other educational and/or social goals (Kim and Keller, 2010; Sharma and Nasa, 2014). While many students believe these goals are attainable, academic numeracy is sometimes the critical filter that prevents these goals from being realised.
Discussion on things like summer schools, and the encouragement for students to engage with on-line platforms such as Mathspace would be useful. It would seem to be important to discuss the numeracy levels and programs provided to improve such levels for mathematics education student, given that they will be future teachers of mathematics. However, this important aspect has not been differentiated.	The study presented findings in relation to the strategies being used to enhance the preparedness of students at the participating universities. Online platforms, such as summer schools and Mathspace were not identified as they were not used with the study universities. The strategies identified were described. While the article makes reference to the preparedness of future teachers of mathematics, this was done only to give an example of where preparedness has been questioned in the literature and in public discourse. The article was not intended to address the requirements of any particular sub-group of students.
there is insufficient discussion of where LANTITE fits into this study, apart from the fact that it was introduced a couple of years ago. It would have been prudent for this study to assess what universities had been doing in that time to address the LANTITE related needs of their students.	Discussion of LANTITE was not considered necessary for this article. LANTITE trials was only used as an example of a data source being used at the universities involved in the study. To assist the reader, a link to the ACER website relating to LANTITE has been added.

The section starting 'While bridging and additional support and enabling programs . . .' (p. 7) needs further discussion.	The following sentence was added to the first paragraph of this section to provide additional information for the reader to assist understanding what a bridging/enabling program was: *The enabling or bridging programs are those offered prior to enrolment in an undergraduate degree and are intended specifically to enhance preparedness for undergraduate study with both knowledge and skills prior to the commencement of classes.* This will provide additional context for the conclusion in that section.
The data from the sample of nine teachers is not well presented. There is mention of a survey yet only anecdotal comments from interview appear to be presented. It would be useful to provide a summary of the survey data. Also, the sample size is too small for any generalisation to be made, yet that is not acknowledged by the author/s	This claim is disputed. The nine academics who responded to the survey and were interviewed were the key personnel involved in first year mathematics from six Australian regional universities. The nature of the large majority of the data collected, as indicated by the survey questions, is not open to personal interpretation or opinion. Each of these academics is a reliable source of data for the institution they represent. Six regional universities is a substantial proportion of the regional universities in Australia. The following sentence has been added where the survey is discussed initially: *The survey is given in Appendix 1.* The article makes no attempt to produce evidence to support generalisation. Rather, it is reporting the current situation in the six regional universities.
The concluding discussion Is not convincing. For instance - 'Regional students, particularly those non-traditional students enrolled in non-mathematics-based programs such as education, appear to be at a disadvantage when compared to their urban counterparts' - this does not address the research questions and is not supported by evidence. As well, the conclusion then talks about a resistance to access assistance programs on the part of regional students, which again does not address the research questions.	The sentence making the comparison to urban students has been rewritten as: *Regional students, particularly those non-traditional students enrolled in non-mathematics-based programs, appear to be challenged in their preparedness for subjects requiring a sound level of mathematics.* The comment by both reviewers 2 and 3 in relation to this issue is acknowledged.

Reviewer 3

Comment	Action
From my reading of this paper, the basis of this research springs from a national research grant awarded to a collaboration of mathematics education researchers from 6 regional universities. I am only gleaning this by the use of 'xxxx' to replace a named project as well as other symbols (e.g, yyyy and reference to Authors A-G) throughout the paper. However, the actual intention of the grant as well as the results gathered to date are more difficult to glean.	The title of the project has been removed as part of the de-identification process, as have the refences to authors and other studies related to this project. This title of the project, once known, describes the aim of the overarching project well and will make the intention of the grant and the results reported in this article easier to understand.
The authors cleverly introduce the term 'numeracy' in association with 'knowledge and skills … upon which our modern economics depend for sustainability and growth', and then discuss the difference between numeracy and mathematics. However, they then refer to first year mathematics courses as how students engage in 'academic numeracy'. This position requires further clarification and possibly a bit of a rethink particularly as the authors state that there is a difference between mathematics and numeracy, and this may not be specifically identified by the course coordinators of these first year mathematics and statistics courses. As the authors state, "numeracy programs within higher education are dedicated to introductory mathematics or statistics", which indicates that the course coordinators of these first year courses may not fully understand their important role is also promoting their students' numeracy capabilities. The introduction to the paper is well-structured and provides a clear statement of issues associated with first year programs. Further in the paper, the authors use the co-terms, 'mathematics or numeracy-allied programs'. Referring to first year mathematics and statistics courses as 'numeracy allied' may overcome the issue of such courses being determined as having the potential to promote students' numeracy, when in fact the predominant learning goal may be associated with promoting students' mathematics and statistics capabilities. The authors need to do further work on making this distinction clear. It may be from their stated first research question, where	This paper is not just considering mathematics but also the requirements that students can use numeracy or mathematical literacy within the contexts of their chosen degree programs. The second paragraph has been rewritten to provide clearer definitions as per comments also from other reviewers: *Student participation in first-year academic numeracy is generally within undergraduate mathematics and statistics subjects but could also be as components of other subjects. Numeracy, or mathematical literacy, is defined similarly to Geiger, Goos and Forgasz (2015) as being able to identify the knowledge and capabilities required to accommodate the mathematical demands of private and public life, demands known to be increasing with technological development. Within universities this is the mathematical demands of the different subjects within the context of the subjects. Numeracy is not equivalent to number or mathematics, but embraces a broader conceptualisation, however, numeracy programs within higher education are primarily taught through introductory mathematics and statistics often without reference to context or contain an element of introductory mathematics as an essential component (Whannell and Allen, 2012). Students have different academic numeracy requirements depending on the program they are planning to study and their mathematical and numeracy backgrounds and capabilities. Some students will access academic numeracy programs to support their learning in assessable subjects. Students engage in first-year academic numeracy for a number of different reasons. A subject may be compulsory (e.g., offered*

they state that their purpose is to determine the 'nature of the academic numeracy in subjects taught in first year of regional universities'. To answer this question, it is assumed that the researchers would undertake an analysis of the mathematics and statistics first year courses to determine the degree to which they had the potential to promote students' 'academic numeracy. This would then enable the researchers to discuss the courses in terms of whether they were numeracy-allied, or mathematics/statistics courses.	*within engineering), students may see employment opportunities (e.g., in big data analytics), or students may be motivated by a perceived need to obtain educational experiences in mathematics that lead to other educational and/or social goals (Kim and Keller, 2010; Sharma and Nasa, 2014). While many students believe these goals are attainable, academic numeracy is sometimes the critical filter that prevents these goals from being realised.*
The authors then present the research questions, and the methodology. It is not clear if the research questions and methodology underpin the larger study as they are quite expansive. It would be helpful for this to be clarified here.	The words '*in this article*' have been added to the sentence introducing the research questions, as shown below. *The following research questions directed the research presented in this article.*
The authors then present their findings, which appear to be very selective and overly negative. The authors indicate that all six universities provide first year mathematics and statistics courses but then refer to interview data that emphasises what students cannot do in these first year courses. As stated above, the comments appear to be very selective and negative. The authors then address factors to identify students at risk and emphasise resource issues.	The purpose of the project was to identify how the mathematics preparedness of students transitioning into regional/remote universities, which necessitated the identification of the challenges confronting these students, the potential reasons for a lack of preparedness and what universities were doing to address these issues. This may have given rise to the view that article was selective and overly negative as commented on by this reviewer.
The authors then insert Table 1, but this is placed at an odd position in the text and Table 1 is not referred to, except by title. In relation to Table 1, the authors state that "the project team developed the following schema for potential use in identifying students at risk of early attrition and academic failure at one university", but then refer to published material by Author C, Author D, and other published works. This is at odds with the statement that the schema was derived from interview data. This needs to be clarified.	Table 1 has been re-located and more appropriately introduced. The schema includes strategies that were identified as being used at the institutions addressed in the research. Those strategies have been described in existing literature were referenced to support the reader if he/she wanted to read more in relation to that strategy. To make this explicit, the following sentence has been added to the introduction to Table 1. *Where strategies or interventions identified have been previously described in the literature, the reference has been provided.*

The case study is confusing. It provides little in the way of clear processes in terms of supporting students at risk. If the case study is to provide further evidence to support the findings of the interview and survey data, then this needs to be stated early in terms of this as a data source.	This is described in the second last paragraph of the methods: *Drawing on data reported in the broader XXX project, analysis also focussed on a cohort of undergraduate students from the single year 2014 at a single university. Within the XXX project, analysis took the form of an in-depth single case study with a purposeful case selection (Cohen, Manion, and Morrison, 2013), as is appropriate in a government-funded collaborative project in a higher education setting. Both primary and secondary data sources informed the construction of the case study, but the current article summarises findings reported in detail elsewhere (e.g., Lake et al., 2017; Woolcott et al., 2018)*
In the conclusion section, the authors make some claims that do not seem to be supported by the data provided. For example, they state: "Regional students, particularly those non-traditional students enrolled in non-mathematics-based programs such as **education,** appear to be at a disadvantage when compared to their urban counterparts." This claim is surprising, as it is not clear if education students were identified, interviewed, or even formed part of the cohort for which numeracy-allied courses were compulsory. It is even more surprising as there seemed to be no data presented associated with urban universities.	The research questions have been refined and the conclusion tightened to ensure better cohesion. Education as an example in a non-mathematics-based program has been deleted. The discussion is only about regional universities. It is suggested that future research could consider whether there are similar issues in urban universities, Added to the conclusion: *The findings in this study may also be applicable to large metropolitan universities and further research in this context is considered appropriate to identify whether the challenges presenting in regional and rural universities also apply.*

The authors also conclude that students did not avail themselves of the support services provided by their institutions Again, there is no detail of this in the reported data, and no details of student interviews as part of this project. Other statements of conclusion make reference to other authors of the paper. This serves to continue to obfuscate the focus of this paper and leads the reader to question, "what is the focus of this study?" when conclusions appear to be associated with previous research/reports rather than the data presented here.	This data was reported from the survey and interview data of the academics. The survey questions specifically asked for this type of report, but it was not possible, or logistically and ethically unsupported for the authors to collect and collate such data centrally. Research questions have been refined and the conclusions rewritten.
Finally, the authors conclude that 'addressing high attrition rates may warrant design-based implementation research approaches that address the problem in a more coherent way while providing feed forward and feedback interactions that would bridge the gap between research and practice in this area." This may be the case but this paper does little to present this as the direction for further research.	This paper is reporting on high attrition rates and other issues that relate to numeracy in regional universities. While, we respect this reviewers opinion, the comment was added in order to suggest future directions based on research this paper and in the larger project as well as in other regional univeristy studies presented in the literature.