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Student Perceptions of Mathematics Readiness from a University Preparatory Program to Undergraduate Studies

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Abstract

For many mature-aged students, there can be a considerable gap between finishing formal study and beginning university. They are often required to draw on qualifications and skills, including mathematics, which are dated, but necessary for success. Most universities offer several pathways that prospective students can take to enter university: from school; from vocational education; based on prior learning; or via a university preparatory program. Even with extra preparation from a preparatory program, success is not guaranteed, as the assumed skills can be quite specific to particular degrees.

Mathematics prerequisites for entry into undergraduate programs are not enforced in many Australian universities. Students are only advised of the level of senior mathematics that is 'assumed' or 'recommended knowledge' for their degree and are often uncertain if their current mathematical skills are enough to understand the content of a particular course.

A survey to investigate students' perceptions of how well their pre-university studies prepared them for first year undergraduate courses that required quantitative skills was conducted at one regional university in Australia. As part of this survey, the perceptions of mathematical preparedness of students who had qualified for entrance to undergraduate studies via the university's tertiary preparation program were investigated. Most respondents who transitioned through the preparatory program felt well prepared for their undergraduate mathematics. However, a greater proportion of these students either withdrew from the undergraduate quantitative course that they had enrolled in or achieved lower grades when compared to other survey respondents who had entered university through more traditional pathways.

*Keywords***:** mathematics; tertiary preparation; student perceptions; enabling; pre-requisites; STEM

Introduction

Worldwide, there is government and industry impetus to lift the overall scientific literacy of their populations, as there is a strong link between nations with leading economies and strong science education and research systems (Marginson, Tytler, Freeman, & Roberts, 2013). In many English-speaking countries, including the United States (Atkinson & Mayo, 2010), the United Kingdom (Morgan & Kirby, 2016) and Australia, there is concern over the declining trends in Science, Technology, Engineering and Mathematics (STEM) participation, and the longer tail of low-achievers at school level compared to many Western European and East Asian countries (Wright, 2010).

At the university level, mathematics lecturers have noted the increase in the number of students who lack the appropriate mathematical background to cope with first year science (Poladian & Nicholas, 2013a; Rylands & Coady, 2009) and mathematics subjects (Vandenbussche, Ritter, & Scherrer, 2018). Many universities around the world attempt to ameliorate the difficulties encountered by mathematically under-prepared students by offering mathematics courses within various programs, often referred to as enabling, preparatory, bridging or remediation programs. The aim of these courses is to allow students to obtain prerequisite or assumed knowledge in mathematics before commencing their degree program (Croft, Harrison, & Robinson, 2009; Greefrath, Koepf, & Neugebauer, 2017; MacGillivray, 2009). Successful completion of a mathematics component in such programs has been shown to be a predictor for engagement and success in further university mathematics studies (Varsavsky, 2010).

Mathematics is a major part of many Australian university preparatory programs (Irwin, Baker, & Carter, 2018).The Tertiary Preparation Program (TPP) at the University of Southern Queensland (USQ) is one of these preparatory programs. It is a fee free program with an open entry policy and provides students with a direct entry pathway to an undergraduate degree at the university. Approximately 10% of students enter their undergraduate degree at USQ through the TPP. Determining whether there is a successful transition of this group of students into their undergraduate studies is therefore of importance to the university.

Research conducted in 2013 on students' perceptions of their preparedness in first year undergraduate mathematics at USQ (Dalby et al., 2013), found a significant number of students in the science based degrees acknowledged that they were inadequately prepared. Further investigation particularly around STEM related degrees was conducted in 2015 (Galligan et al., 2017). As part of this research, those students who had completed the TPP were identified. The focus on these students had two aims. The first was to determine whether TPP respondents in the study perceived themselves to be well prepared for their undergraduate mathematics, and to identify particular mathematics topics in which these students felt underprepared. The second was to compare their perception of preparedness and their overall achievement in their undergraduate course, with that of the other respondents who had entered university through more traditional pathways.

Literature Review

This section provides a background to this paper, discussing the reasons behind the decline in mathematics and science participation and success at university level in Australia, factors affecting degree completion as a whole, and the role of university preparatory/enabling programs.

Decline in mathematics and science participation in Australia

An Australian government report (Office of the Chief Scientist, 2013p. 13) notes that despite an increase of nearly 30% in science enrolments in higher education since 2007, student enrolments in key fields such as chemistry, physics and mathematics drop steeply after first year. This could be linked to a decline of student enrolment in challenging mathematics and science based subjects at school level (Education Council, 2018; Marginson et al., 2013). There has also been a trend for school students to take lower levels of school mathematics, attributed to several factors including the lowering of prerequisites by universities in order to attract more enrolments (Wright, 2010). Studies have also determined that the level of secondary mathematics completed and quality of achievement at that level is one of the factors associated with successful/unsuccessful outcomes in first year mathematics courses (Greefrath et al., 2017; Peard, 2004; Universities Australia, 2013; Wright, 2010).

There has been concern that students transitioning to university from the vocational education sector may not have the mathematical background to cope with science based degrees (King, Dowling, & Godfrey, 2011; Penesis et al., 2015). Another study found that students who entered engineering

degrees on the basis of vocational education studies or on mature[1] age or special entry criteria had a far lower degree completion rate than the rest of their cohort (King et al., 2011).

Factors affecting degree completion

Many factors can affect the completion of a degree. A recent Australian Grattan Institute report identified some of these factors as academic ability, motivation, persistence, time put into study, study practices, financial support, social support, academic support and teaching quality (Norton, Cherastidtham, & Mackey, 2018). This report singles out mature aged students as being particularly vulnerable to dropping out. Being mature aged and from a low SES background compound the difficulties with academic integration (Tones, Fraser, Elder, & White, 2009).

Regional universities in Australia have a more diverse cohort in terms of age, SES, and academic experience and have lower completion rates in comparison to metropolitan universities (Australian Government, 2017; Norton et al., 2018). In terms of STEM, National benchmarking data also indicate a drop in the level of achievement of students in school mathematics and science in regional and rural areas of Australia compared to metropolitan areas (Panizzon & Pegg, 2007). Additionally, low SES students are four times as likely to be low performers in mathematics compared to high SES students (Thomson, 2016).

University preparatory programs in Australia

In an extensive review of university preparatory programs in Australia, it was found that these programs primarily provide alternative pathways to university for non-traditional students, with the intent to address the outcomes of disadvantage (Bird & Morgan, 2003; MacGillivray, 2009). Non-traditional students belong to one or more of the following groups: low socio-economic background, regional and remote areas, people with a disability, Aboriginal and Torres Straight Islanders and Non-English speaking backgrounds. The Australian government has recognised the importance of preparatory programs in the provision of both general study skills and discipline specific knowledge to students with social or economic disadvantage (Australian Government, 2017). In 2010, the Australian government stated the aim to increase the percentage of university students from low socio-economic status (SES) background from 16% to 20% by 2020 (Bradley, 2008). As a result, one of the proposals put forward by Universities Australia (Universities Australia, 2013) was for Australian universities to broaden pathways into university, and for the government to maintain equity programs to improve access for students from low SES backgrounds. Low-SES students are overrepresented in regional universities (Network Regional Universities, 2013) and therefore these universities have a higher percentage of total student load from preparatory courses (Pitman et al., 2016). This research also noted that students who had entered university via a preparatory pathway were below the national average in terms of retention and success in their subsequent undergraduate studies (Pitman et al., 2016).

Students enrolling in preparatory programs may have many of the recognised difficulties associated with adjusting to university, including having the key skills to succeed. One key skill is the required mathematics level for STEM programs (Rylands & Coady, 2009). Hence, there is a need to assess whether these students have attained key mathematics skills within their preparatory courses. While some data can be collected through the use of student evaluation and undergraduate performance (Shah & Whannell, 2016), asking students their perceptions of the attainment of these skills is important, as self-efficacy and confidence are known to be indicators of success in mathematics (Ernest, 2003; Parsons, Croft, & Harrison, 2009).

[1] Defined as 25 or over

Method

For this paper, we drew on data from students enrolled in Semesters 1 and 2 in 2015. Ethics clearance was obtained to survey and communicate with students enrolled in thirteen STEM related first year courses (two physics course, one chemistry course, one biology course, three engineering courses, two nursing courses, two engineering mathematics courses, one other mathematics course and one standard statistics course). All the examiners (coordinators) of these key first year courses within the university gave permission for the researchers to email their students with an invitation to fill out a survey that investigated the respondent's perception of preparedness for the mathematics based course undertaken in the previous semester. Students were encouraged to participate by offering them the chance to win a $100 book voucher. The survey was emailed to the students after the semester results had been released (including students who had dropped the course) and elicited responses from 688 students over the two semesters (with 93 respondents having previously completed a TPP mathematics course). The response rate was 10.9 % of the total number of students enrolled in the selected courses. A significant number of students also agreed to be interviewed, but once approached, were less responsive.

The survey questions sought students' perceptions of their preparation in various mathematics topics using a Likert scale (see Appendix). The topics included calculator use, decimals, percentages, ratio, algebra, statistics, problem solving, trigonometry, and calculus. Students were also asked if they considered their overall mathematical preparation to have been adequate for the course in question. There were a number of open-ended questions to explore other factors that students may have felt had contributed to their success or failure. Qualitative data from the relevant questions were analysed in NVivo using constant/comparative method (King et al., 2011). Some attempt was made to capture the conceptual as well as the thematic regularities in the data but most of the answers were too terse to be particularly useful in this regard. The grade achieved by each respondent in his or her undergraduate mathematics course was also recorded. Basic demographic information was also collected.

The survey responses of students that identified as having entered their undergraduate degree via the TPP were analysed according to their exit level of TPP mathematics. The level of mathematics completed within the TPP depends upon the student's intended degree. Table 1 lists the prerequisite level of TPP mathematics required for various degrees, an outline of the topics covered in each course and the approximate secondary school equivalent. There are three university entrance levels of final year mathematics in Queensland, with Mathematics C being the most challenging. None of the mathematics courses in this survey had Mathematics C as a prerequisite. Although an approximate equivalency has been drawn between TPP mathematics and Queensland school mathematics, the time frame of the former courses (one semester) does not allow for the same breadth and depth of study of mathematics topics as in school

Results

Demographics of the participants

For this paper, the 688 survey participants were divided into the following two groups for comparison:

- Ex-TPP respondents: those students that had entered their undergraduate studies via the TPP (14% of total respondents); and
- Other pathway respondents: those students that entered their undergraduate studies having completed a level of year 12 mathematics (71% of total respondents), those respondents that only formally completed Year 9 or 10 at school (9%), vocational mathematics (2%) or did not indicate their last level of mathematics (4%).

Table 1: Summary of TPP mathematics courses

	Intended degrees	**Topics covered**	**Approximate secondary school equivalent**
TPP–Maths 1	Nursing, education, commerce and business degrees.	Basic arithmetic, introduction to statistics, graphing and basic algebra.	Queensland Year 12 Mathematics A
TPP–Maths 2	Physical science, environ and sustainability, wine science and associate degrees in engineering.	Algebra, functions (linear, parabolic, exponential and logarithmic), trigonometry and matrices.	Queensland Year 11 Mathematics B
TPP–Maths 3	Bachelor of Engineering degrees or a Bachelor of Science majoring in mathematics/statistics.	Introduction to calculus, analytical geometry in two dimensions and trigonometric functions.	Queensland Year 12 Mathematics B

The second group includes students who stated that their last formal mathematics study was year 9 or year 10 school mathematics. As these students had not needed to transition through the TPP to gain university entrance, it is assumed that their overall qualifications were deemed sufficient for their degree of enrolment.

In 2015, 23.4% of all USQ students were identified as low SES compared to 36.3% of TPP students. In this survey, 35.6% of students who had entered university via the TPP were identified as low SES, which suggests that they were a representative sample in terms of overall TPP pathway enrolments at this university.

Figure 1 shows the ages of respondents to the survey according to university entry pathway. The percentage of ex-TPP respondents over 30 years of age (57%) is greater than that of other respondents (43%). Only 8% of ex-TPP students were below 21 years of age compared to other respondents (24%). The high percentage of mature-aged and low-SES students in the ex-TPP respondents suggest that some of these students could be at greater risk of dropping or failing their mathematical course compared to other respondents (Thomson, 2016; Tones et al., 2009).

Ex-TPP student perceptions of preparedness according to mathematics topic.

Students were asked to select their level of preparedness for various mathematical topics using categories of "Well prepared", "Prepared", "Poorly prepared" and "Very poorly prepared". The last two categories were combined due to the relatively small number of responses. The topics were Calculator Use, Decimals, Fractions, Percentages, Graphs, Ratios, Basic Algebra (e.g. using a formula), Advanced Algebra (e.g. rearranging equations, factorising), Problem Solving (e.g. interpreting and solving word problems), Statistics, Trigonometry (e.g. sine, cosine, tangent) and Calculus (e.g. basic differentiation and integration). Figures 2 to 4 reflect perceptions of preparedness according to level of previous TPP mathematics completion. From Figure 2 it can be seen that although generally confident in areas of arithmetic, a high proportion of students that had completed TPP-Maths 1 indicated feeling underprepared for statistics and what they perceived to be "advanced" algebra (over 40%). Thirty percent of students also felt underprepared for problem solving. As this course does not cover calculus,

the few students that attempted undergraduate courses with a calculus component naturally felt underprepared.

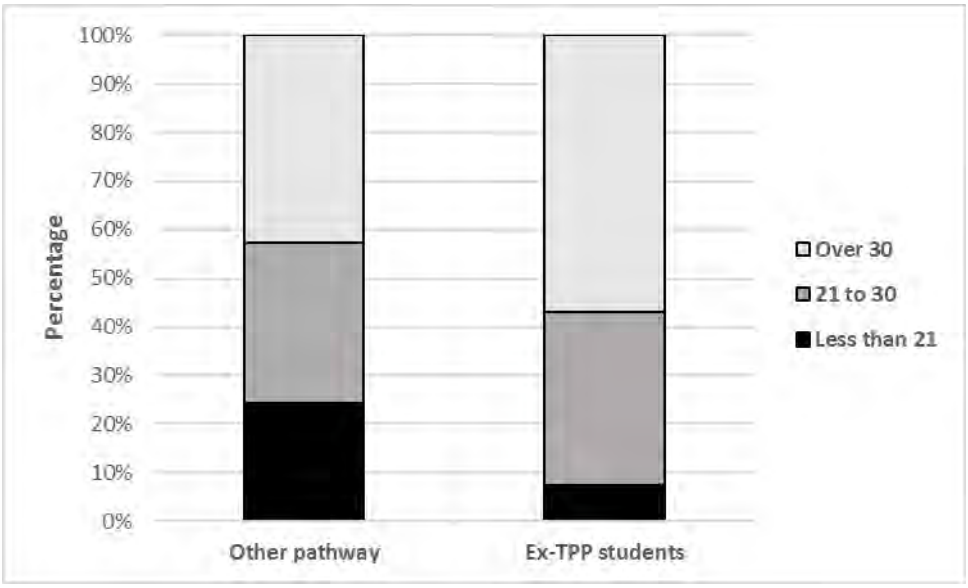

Figure 1. Comparison of age distribution of other entry pathway respondents (n=567) and ex-TPP respondents (n=93)

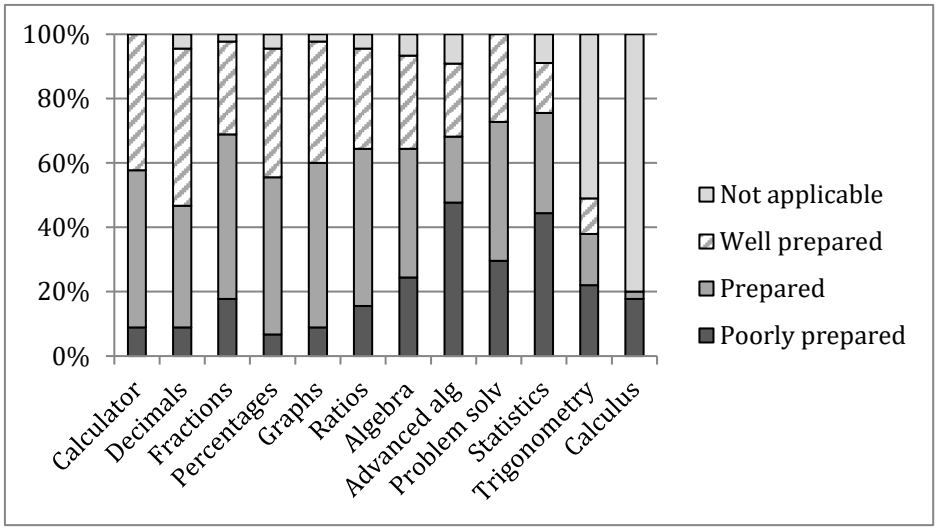

Figure 2. Perceptions of preparedness of ex-TPP-Maths 1 students (45)

Figure 3 shows that most students felt underprepared for their initial encounter with calculus. This is not surprising as this topic is not covered in TPP-Maths 2. Over 20% of students felt underprepared for the problem solving and statistics in their course. The emphasis in TPP-Maths 2 is on trigonometry rather than statistics, for students that plan to enrol in engineering degrees. All students felt prepared for basic algebra, while approximately 20% indicated a problem with advanced algebra.

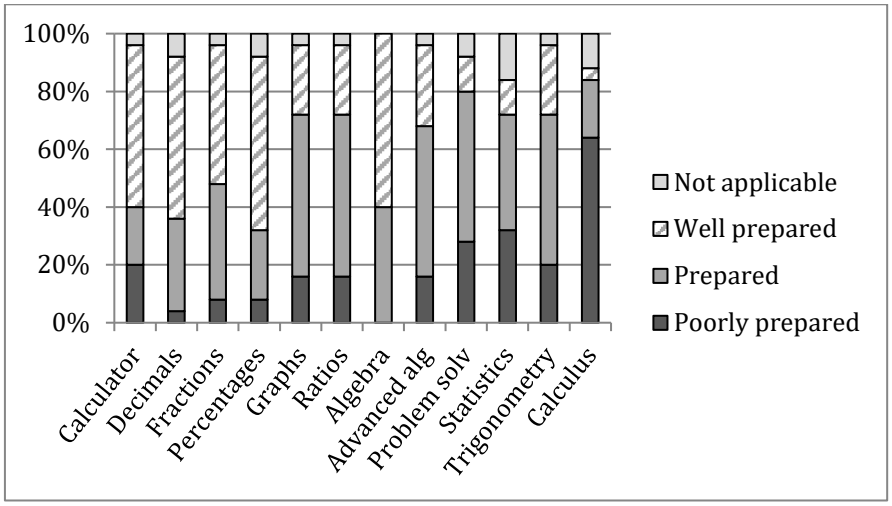

Figure 3. Perceptions of preparedness of ex-TPP-Maths 2 students (25)

In contrast to the confidence with algebra shown by ex-TPP-Maths 2 students, Figure 4 reflects that over 20% of students felt poorly prepared for the advanced algebra in their course after having completed TPP-Maths 3. These students would have enrolled in higher-level undergraduate courses with more challenging algebra. As with TPP-Maths 2, the emphasis is on trigonometry rather than statistics for students that plan to enrol in engineering degrees. This is reflected in the 20% who felt underprepared for statistics.

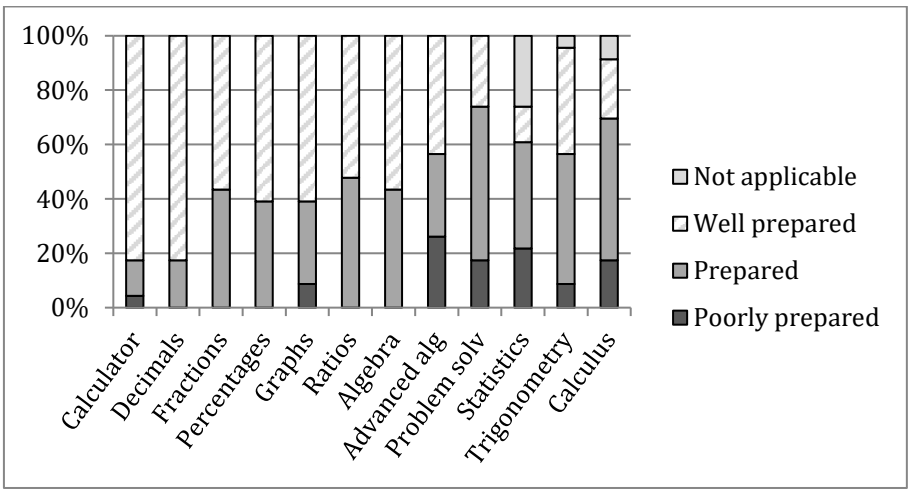

Figure 4. Perceptions of preparedness of TPP-Maths 3 students (23)

Topics that show high percentages of students that felt underprepared give an indication as to where the relevant TPP mathematics courses should be reviewed, from a student's perspective.

Ex-TPP student perceptions of overall preparedness for undergraduate mathematics

In the survey, students were asked to select a response to the statement "Overall, my mathematics preparation was adequate for this first year course that I studied" with either "Strongly" Agree", "Agree", "Neutral" , "Disagree" or "Strongly Disagree". Although the majority of ex-TPP students felt prepared (71%), there were 16% of respondents that felt under-prepared and 13% that felt neither well nor poorly prepared. Figure 5 compares ex-TPP student responses to this question with their final grade achieved in their undergraduate course. Ten students perceived themselves to be underprepared despite

having passed their course. Most of those that did not complete their course also felt well prepared, but the survey did not identify their reasons for not completing.

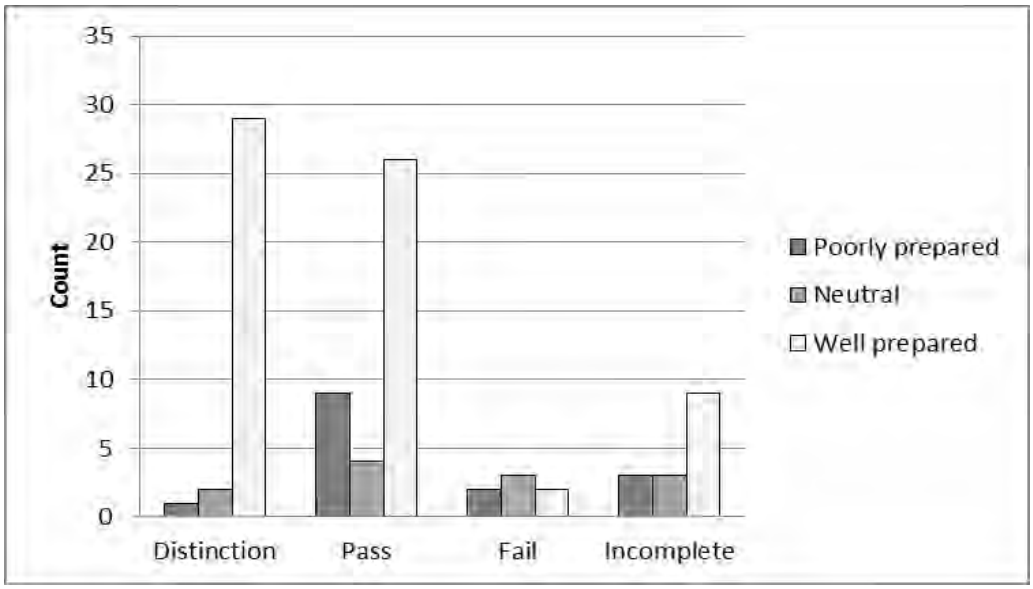

Figure 5. Ex-TPP students' perception of preparedness compared to final course grade

Entry level into undergraduate mathematics courses

There are no official figures as to how many TPP students do not complete the required level of preparatory mathematics (as listed in the University handbook) before enrolling in undergraduate mathematics courses. As shown in Table 2, the results from this survey reflect that this may be an issue, where 24% of ex-TPP Maths 1 respondents and 20% of ex-TPP-Maths 2 respondents attempted undergraduate mathematics courses without having completed the prerequisite TPP mathematics course. Of the eleven ex-TPP Maths 1 students in this category, six either failed or did not complete their undergraduate course. However, of the five ex-TPP Maths 2 students, four continued to pass their undergraduate course. These students may have increased the proportion of students in the survey who felt underprepared for their undergraduate mathematics.

Table 2. Percentage of ex-TPP respondents enrolling in undergraduate mathematics courses without the correct prerequisite level of TPP mathematics

TPP mathematics exit level	**Percent of exit level that did not complete prerequisite course**
TPP-Maths 1	11 / 45 (24%)
TPP-Maths 2	5 / 25 (20%)

Responses by ex-TPP students to an open-ended question in the survey are shown in Table 3. The level of TPP mathematics previously completed and their undergraduate course have been included to add perspective. Apart from positive opinions about the TPP pathway, some of these responses reflect concern and uncertainty about the lack of clarity of mathematical pre-requisites.

Table 3. Student responses to the question "Are there any other courses that you wish to comment on with regard to your mathematics preparation?"

TPP Maths level	Comment	Course studied	Course Grade achieved
TPP-Maths 1	Both the TPP courses [maths and non-maths] were invaluable to preparing me for University. I highly recommend them both especially if you haven't studied in a while.	Nursing Maths	Distinction
TPP-Maths 1	Have more advertising for students about TPP so they know they have a program to assist them before they begin a course.	Biophysical Sciences in Health	Distinction
TPP-Maths 1	The TPP course prepared me well. So I thought.	Introductory Engineering Mathematics	Fail*
TPP-Maths 1	[Physics] should have a Maths pre-requisite course. I only had the TPP Maths course for preparation which was very basic compared to the requirements of this course.	Physics 1	Pass*
TPP-Maths 2	I studied the TPP Maths 2 unit from the Tertiary Preparation Program at USQ prior to commencing my studies of the Spatial Science degree in semester 2. Since starting mathematics studies at USQ I have had nothing but positive experiences in the subject. Therefore I would not change anything.	Introductory Engineering Mathematics	Distinction
TPP-Maths 2	As a mature student if I had not completed TPP Maths 1 and TPP Maths 2 I would have been completely lost with ENG1002	Introductory Engineering and Spatial Science applications	Pass
TPP-Maths 2	The TPP was a well-structured program which helped me greatly in Semester 1 with ENM1500	Introductory Engineering Mathematics	Distinction
TPP-Maths 2	ENG1002 may be better as not an introductory course as it assumes a lot of background knowledge of the subject. … there could be stipulations for the required amount of prior engineering mathematics needed to enter.	Introductory Engineering and Spatial Science applications	Pass
TPP-Maths 2	PHY1104 required some high level mathematics. I know of several other students who found it too difficult and were not prepared. I believe a prerequisite of Maths B or the equivalent TPP course should be applied.	Physics 1	Distinction

** Comments were from students that entered their degree with the wrong prerequisite level of preparatory mathematics*

Comparison of ex-TPP respondents to other entry pathway respondents

Using the response to the question about overall perception of preparedness, respondents were compared across all pre-university mathematics attainment groups. Figure 6 shows the percentage of students within each pre-university mathematics group that felt prepared/poorly prepared for their undergraduate course. The majority of respondents that had either completed 12 years of schooling[2] (last 3 columns) or a TPP mathematics course (first 3 columns) felt prepared for the course in which

[2] Maths A = non-calculus based mathematics; Maths B = calculus based mathematics; Maths C = advanced mathematics

they were enrolled. The lower the students' school exit level, the greater the proportion of students that felt underprepared for the mathematics encountered in their degree. This was also reflected in the responses given by students who had completed some mathematics in a vocational program. The proportion of TPP students that felt well prepared is comparable to those students that entered university with Queensland Year 12 Mathematics B (this includes basic calculus). Those students that did not indicate their pre-university mathematics attainment were not included in Figure 6.

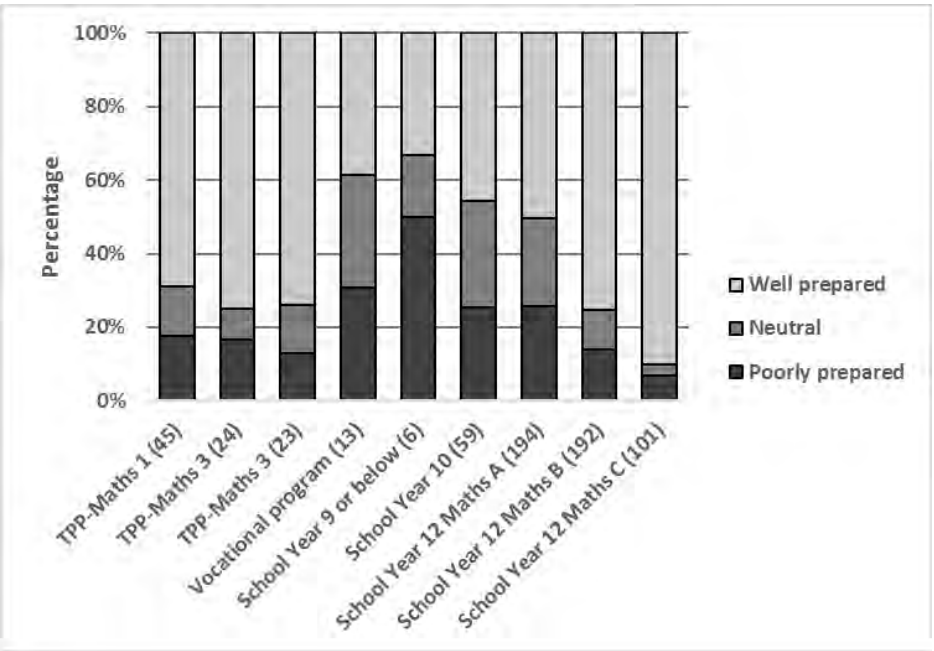

Figure 6. Perception of preparedness of respondents by entry to university pathway (n = 661)

Although the proportion of ex-TPP students that perceived themselves to be well prepared for their undergraduate mathematics was relatively high, this does not reflect their actual achievement (76% pass rate) when compared to the other respondents (84% pass rate). Figure 7 compares the final grade results for the undergraduate course identified in the survey for the two groups. To simplify results, a grade of 75% or higher is classified as a "Distinction" and a grade between 50% and 74% is classified as a "Pass". Figure 7 shows that although the majority of students in both cohorts passed their course, only 34.5% of ex-TPP respondents achieved a distinction in their course compared to 45% of the other students. The proportion of ex-TPP students that did not complete their course is approximately double that of other university entrance pathways.

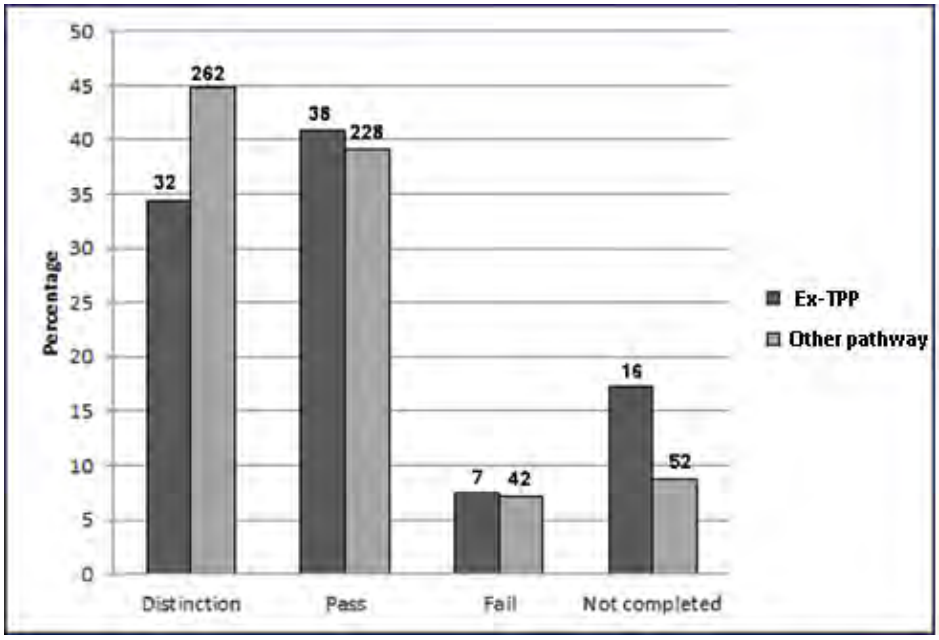

Figure 7. Final grades acheived as a proportion of each cohort: Ex-TPP (93) respondents versus other pathway entry respondents (584)

Discussion

The main purpose of this study was to investigate students' perceptions of their preparedness for the quantitative skills of their first year undergraduate mathematics courses. For this paper, the focus was on students who entered university after completing a pre – undergraduate university preparatory course (TPP).

Perception of preparedness of quantitative skills

This study explored students' perceptions of preparedness for: calculator use, decimals, fractions, percentages, graphs, ratios, basic algebra, advanced algebra, problem solving, statistics, trigonometry, and calculus. Identified mathematical topics, where a large percentage of respondents that had completed TPP-Maths 1 felt underprepared, were statistics and advanced algebra (Figure 2). This may not necessarily be due to the cognitive skills of algebra and statistics, but non-cognitive skills as the latter have been known to affect student results. These include university expectations, preconception of the degree of difficulty of algebra (Tariq & Durrani, 2012), anxiety (Ashcraft, 2002), beliefs of the usefulness of this topic (van der Wal, Bakker, & Drijvers, 2017), and unfamiliar writing and language related to the understanding of mathematics and statistics (Dunn, Carey, Richardson, & McDonald, 2016). These factors should be taken into account when designing content of preparatory mathematics programs.

Enabling Progression

Overall, preparatory courses are similar to the final year of high schooling (Shah & Whannell, 2016) but it is important to note that each TPP mathematics course in this study is geared towards a specific degree. This means that the mathematical topics covered in each course are different. Hence, as expected, different levels of ex-TPP students showed different levels of preparedness for these concepts as reflected in the results section. In this study, the majority of students that completed a TPP mathematics course felt well prepared for their undergraduate mathematics course. Unsolicited comments about the preparatory program reflect previous research that indicates that students who enrol in mathematics preparatory courses value these courses not only as a means of upskilling their

mathematics but as a means to facilitate their transition to university (Gordon & Nicholas, 2013). In addition, preparatory or bridging programs can serve as a "vehicle to nurture the student's 'will to learn'" (Poladian & Nicholas, 2013b).

To be noted, students in preparatory programs may on occasions undertake undergraduate courses with a high level of mathematical content without having completed the prerequisite level of preparatory mathematics and hence do not have the appropriate skill set required for the course. Students need greater clarity on quantitative expectations within an undergraduate course. This clarity is necessary at the preparatory and undergraduate program level. For example, from informal discussions, several students stated they dropped one physics course due to their lack of appropriate level of mathematics skills assumed within the course. We can speculate that this happened for other courses, but further research would need to be conducted to identify students' reasons for dropping mathematics related courses.

The issue of skill mismatch can be addressed in four ways. First, administratively, by automatically alerting such students to a possible mismatch between their current skills and the requirements of the degree. Second, in the preparatory program, by alerting students at the finalisation of their program or mathematics course to highlight possible mismatches, and thirdly in the degree course where there is quantitative content, by alerting students early to the numeracy demands of the course and offering pathways to overcome any gaps in knowledge. Finally, as implemented by other universities (e.g. University of Sydney) and recommended in reports, (Australian Academy of Science, 2016; Marginson et al., 2013) prerequisites could be reintroduced more broadly.

TPP versus other entry pathways perceptions and achievement

The proportion of ex-TPP respondents that indicated they were prepared for their undergraduate mathematical course was greater than those that had completed the equivalent of Queensland Mathematics A (non-calculus) or lower. However, ex-TPP respondents' final course grades indicate that they generally achieve lower grades and are at a higher risk of not completing their mathematics based course than other entry pathway respondents as suggested in the literature (Poladian & Nicholas, 2013b). This group of ex-TPP respondents had a high proportion of low SES students (at 35.6%) and a high mature aged proportion (at 78%). Given that research (Norton et al., 2018) suggests low SES and mature age are factors in progression and retention, the ex-TPP students' overall success rate of 76% is reasonable when compared to the 84% success rate of other entry pathway students' in this survey.

Conclusion

This research contributes to tertiary education literature by probing the effectiveness of tertiary preparatory mathematics courses through the lens of students' perceptions. Results from a survey on mathematical preparedness for first year undergraduate mathematics showed that approximately 70% of respondents who had completed TPP at the University of Southern Queensland in Australia felt well prepared for their undergraduate mathematical course studies. This is comparable to those respondents who had previously completed a high level of school mathematics, and is a good indication that completion of a university preparatory mathematics course had engendered self-efficacy and self-confidence in their mathematical ability. However, the survey also indicated that students in this group may be at greater risk of either failing or dropping out from their course compared to students who enter tertiary studies via other tertiary entrance pathways.

Conclusions drawn from this survey are limited to one regional university and may not reflect student perceptions or outcomes in other preparatory programs. Whilst these conclusions may be biased as the survey responses were voluntary, with only a small number of respondents having previously completed the TPP, this research provides some evidence that tertiary preparatory students are

transitioning successfully into their undergraduate mathematics and perceive themselves to be well prepared for these courses.

Further research is needed to investigate if preparatory mathematics courses act as a critical filter to a student's tertiary and later career aspirations (Shapka, Domene, & Keating, 2006). Although people working in the enabling sector share similar ideas about the mathematical requirements for academic preparation (Irwin et al., 2018), currently Australian university preparatory programs are not regulated or subject to external accreditation (Shah & Whannell, 2016). This study can feed into discussion of student attrition, success, and enabling provision (Department of Education and Training, 2017) and a push from some sectors to introduce clear prerequisite mathematics statements (Powell, 2018).

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Appendix

Survey questions:

1. If you wish to take part in the draw for a $100 book voucher, please put in your email address.
   _____

2. The degree and major that I am enrolled is _____
   For example BSc (Human Biology)
3. My mathematics preparation was (select one of the following)

   a) Tertiary Preparation Program (TPP) TPP7181 TPP7182 TPP7183
   b) High school

      Year 9 or below
      Year 10
      Year 12 Maths A (basic)
      Year 12 Maths B (including calculus)
      Year 12 Maths C (more advanced than Maths B)

   c) Other, please say what _____

4. How long ago did you last study mathematics?

   0 - 2 years 3 - 5 years 5 – 10 years more than 10 years

5. Which mathematics based course are the following answers referring to? For example MAT1000, MAT1008

   _____

6. In each of the following areas of mathematics, please select how well prepared you were prior to the start of the course listed in Question 5.

Calculator Use

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Decimals

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Fractions

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Percentages

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Using graphs

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Ratios

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Basic Algebra (e.g. using a formula)

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Advanced Algebra (e.g. rearranging equations, factorising)

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Statistics

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Trigonometry (e.g. sine, cosine and tangent)

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Calculus (e.g. basic differentiation and integration)

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

Problem solving (e.g. interpreting and solving word problems)

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

***Other maths topic*_____**

Well prepared	Prepared	Poorly prepared	Very poorly prepared	Not applicable

7. Overall, my mathematics preparation was adequate for this first year course that I studied.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

8. a) Are there any other courses that you wish to comment on with regard to your mathematics preparation?

   b) Do you have any comments?

9. Please briefly express your views on how the University could better prepare students for the mathematics they will see in first year.

10. Are you willing to help us by allowing us to interview you? We wish to try to obtain more detailed information about your experiences. Yes / No

    If yes, please supply your email address.