First-year undergraduate business students’ choice of different sources of learning support for assumed math skills

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Abstract: This paper explores the choice of math skills learning support by an undergraduate student cohort of Commerce and Business students at Flinders University, Adelaide, Australia. A survey methodology was used to determine the support students sought for the assumed math skills for a mandatory first-year microeconomics subject. The majority of respondents (71%; 120 of n = 169) sought support outside of class for their math skills during the semester. The major source of support was from informal networks of friends and family (62% of respondents), with 40% of respondents seeking help from only this source. University support services from the centrally provided learning center and individual tutoring at course and subject level, were used by 31.4% of respondents, with a minority (8.9%) of respondents utilizing only University support. Students who only used their informal networks for math learning support were more likely to have a recent high school graduate profile, and students using university learning support services were more likely to fit a more diverse entry pathway profile. Recommendations for math skills support include the communication of assumed skills

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PUBLIC INTEREST STATEMENT
The relaxation in math prerequisites to allow for greater diversity of student backgrounds to access higher education has led to widespread concern that commencing students may be underprepared in these skills. This may contribute to student failure to perform in science and non-science subjects where basic math skills are assumed.

This study found 21% of students surveyed accessed maths learning support during the semester, with 62.1% turning to family and friends for support. Students whose characteristics pointed to a more diverse entry path were more likely to access university learning support services, and students whose characteristics more closely resembled traditional high school graduates were more likely to only use their family and friends. The results show that formal university support services play an important role but widening student access to good, knowledgeable peers, and support through online resources, may have the greatest impact on student access of math learning support.
explicitly, early self-assessment of assumed skills through diagnostic tests, the institution of a peer learning strategy and the creation of online learning resources.

**Subjects:** Microeconomics; Accounting Education; Teaching & Learning; Study Skills

**Keywords:** assumed skills; math skills; learning support services; academic skills support; support-seeking behavior; help seeking behaviour

1. **Introduction**

Over the past four decades, a key objective of higher education policy in Australia has been to expand access to students from a greater range of socio-economic, cultural and linguistic backgrounds (Bradley, Noonan, Nugent, & Scales, 2008; Devlin, 2010, 2013; Gale & Parker, 2013, 2014). For domestic students, changes have occurred in the number and variety of pathways that a student can take to enter tertiary education. In part because of government funding constraints, this period has also seen the growth of the number of fee-paying international students (Choudaha & Chang, 2012; Marginson, 2015, 2014; Ziguras, 2011). Universities now service a student community that has a broader range of culturally and linguistically diverse backgrounds, socio-economic class, and possess different levels of preparation for university study (Baik, Naylor, Arkoudis, & Dabrowski, 2017; Gale & Parker, 2013).

The increased diversity in student backgrounds and the relaxation of math prerequisite entry requirements (Bamforth, Robinson, Croft, & Crawford, 2007; Galligan & Hobohm, 2015; King & Cattlin, 2015) have led to concern about the lack of math skills in many commencing students and therefore, understandable concern for student preparedness for university math or science courses both in Australia and internationally (Bamforth et al., 2007; Gill & O’Donoghue, 2007; King & Cattlin, 2015; MacGillivray & Croft, 2011; Pell & Croft, 2008; Rylands & Coady, 2009; Varsavsky, 2010; Wilson & MacGillivray, 2007). Math skills are also an integral part of success in many non-maths and science courses, and the lack of adequate math skills of commencing students has been discussed in a range of disciplines such as Nursing, Education, and Business (Croft, Harrison, & Robinson, 2009; Galligan, 2013; Galligan & Hobohm, 2015; MacGillivray, 2009; McClure & Sircar, 2008). Specifically of concern to us is that basic high school math skills are assumed knowledge for undergraduate students commencing their study in tertiary Business and Accounting courses (Ballard & Johnson, 2004; Galligan & Hobohm, 2015).

Assumed knowledge, or assumed skills, are those not taught in class but used in the explanation of new concepts in the subject. Unlike prerequisite subjects, assumed knowledge entry standards are not enforced, with most students able to enroll online without fulfilling specific requirements for them (King & Cattlin, 2015). If the new learning students are expected to achieve builds on a level of assumed knowledge that students do not have, students may struggle to understand a subject (Sargent, 2013). Such a lack of math skills may contribute to student failure to perform, or leave the course, or the university if it contributes significantly to a difficult transition to university (Arnold & Rowaan, 2014; Croft et al., 2009; King & Cattlin, 2015; McInnis, James, & McNaught, 1995; Varsavsky, 2010). For Business and Commerce students in particular, stronger math skills have often been linked to better student performance (M. Y. Koh & Koh, 1999; Wong & Chia, 1996).

Despite the importance of assumed math skills to many university courses, they are not taught within the course content for two principal reasons. Firstly, it would cut into the technical content of the course being taught (King & Cattlin, 2015) and secondly, many of the students in the subject already have the necessary skills, and this would waste their time and threaten their engagement.

2. **Learning support resources**

Many universities have responded to the lack of math skills in commencing students by providing learning support resources additional to course instruction. These resources may be provided by
central university learning support centres for students to seek help as they require, such as the dedicated mathematics learning support centres described in Adams, Hayes, Dekkers, Elliott, and Atherton (2012), Berry, Mac An Bhaird, and O’Shea (2015), MacGillivray (2009), MacGillivray and Croft (2011) and Solomon, Croft, and Lawson (2010). Faculty, school or course level programs may also provide additional learning support, such as the pre-sessional course for students commencing Engineering described in Bamforth et al. (2007) and the supplemental instruction (peer-assisted) study sessions introduced by a Business School described in Dancer, Morrison, and Tarr (2015), by an Engineering School described by Malm, Bryngfors, and Mörner (2012), and initially in Chemistry and later across 55 courses as described in Balzer, Carr & London (2017). Students may also make use of their own informal learning support resources of family, friends and fellow students, such as the social learning described in Solomon et al. (2010), the unstructured peer mentoring program described in Collings, Swanson, and Watkins (2016) and the use of other students, family and friends described in Pillai (2010).

Studies have shown that some students use learning support resources and improve their math skills and/or their understanding of the course content. Improved outcomes for students who accessed learning support from dedicated Mathematics Learning Centres were reported in Adams et al. (2012), Berry et al. (2015), Croft et al. (2009), Mac An Bhaird, Fitzmaurice, Ni Fhloinn, and O’Sullivan (2013), Mac An Bhaird, Morgan, and O’Shea (2009), Pell and Croft (2008) and MacGillivray (2009). Formal peer learning programs implemented by the university were found to have positive results on performance in Balzer Carr and London (2016), Dancer et al. (2015) and Malm et al. (2012). Other programs at the course or School level also reported improvements in student performance, as reported for the diagnostic tests for assumed math skills with online remedial resources in Galligan and Hobohm (2015) and pre-sessional residential math workshops discussed in Bamforth et al. (2007).

These studies focus on the evaluation of the learning support resource, but do not investigate whether students have sought other sources of math learning support during the course. The concern over the level of math skill of students is a widely perceived problem, and learning support can be offered at different levels of the University. Even if the university only offers formal learning support for general math skills through the learning support under discussion in the study, students always have the option of turning to their informal networks of family and friends for learning support.

Although many papers discuss the decline in math skills and attribute this to the increasing diversity of the student cohort, few papers include an objective measure of the level of math skill of the commencing students or include data to indicate how diverse the background of the student cohort is. Studies that have included a measure of the math skill of the students include Malm et al. (2012) which used the high school mathematics score and Berry et al. (2015) and Mac An Bhaird et al. (2009) that each used the level of mathematics passed in high school plus a diagnostic test for the assumed math skills at course commencement. Their purpose was to separate students into low and high math skills groups to evaluate the differential effect of the learning support on the performance of students in the two groups. Only Bamforth et al. (2007) looks at the diversity of student entry into the course through their categorization of “non-traditional” students, being those with their highest mathematics qualification at lower than a low grade in A Levels math, compared to “traditional” students with higher A Levels math passes. Their purpose is to evaluate the impact of their learning support intervention for students with non-traditional mathematics backgrounds commencing Engineering. Only Balzer Carr and London (2016) include a wider range of student characteristics that indicate a diversity of student backgrounds, but their focus is the different utilization of learning support by race and socioeconomic status rather than the diversity of entry pathways to university admission.

Different types of math learning support may be more suitable for students with different characteristics. The “traditional” student entering a Business course in Australia in the past
would be a student between the ages of 17 and 20, who had recently graduated high school in Australia with a pass in a specified, prerequisite level of Year 12 math. The greater diversity of student background has been a result of opening access to university to students who have qualified outside of Australia for admission, who have returned to study after a significant break and to those who have entered from a vocational post-secondary pathway (referred to here as “TAFE”, which stands for Technical and Further Education). Further, a wider range of acceptable subjects taken at high school and a reduced number of prerequisites for admission has also increased the diversity of students’ backgrounds.

While the literature makes it clear that the various learning support resources improve outcomes for students, they are not mandatory and some students do not choose to use them. Some studies report on the percentage of the student cohort who use the learning support, such as Balzer Carr and London (2016), Berry et al. (2015), Dancer et al. (2015), Mac An Bhaird et al. (2013), Mac An Bhaird et al. (2009), MacGillivray (2009) and Malm et al. (2012), but most did not investigate student characteristics and the choice to use the learning support, or the reasons why they did not use it. The exceptions were Balzer Carr and London (2016) which focused on the intensity of usage of the learning support by race and socioeconomic status, and Mac An Bhaird et al. (2013) which asked students why they chose not to use the mathematics learning support center.

In the present study, a cohort of first-year Business and Commerce students were surveyed to explore their choice of different sources of learning support for the assumed math skills in a mandatory introductory microeconomics course. We seek to understand the extent to which students sought support for their assumed maths skills and their choice between the different sources of university resources available and their own informal networks for support. We further attempt to identify the student characteristics that influence whether a student will seek learning support and the type of learning support they seek. Finally, we seek to understand why students do not seek learning support from the university learning support resources made available. Our aim is to contribute to improved learning support for students through a greater awareness of student needs and choices. The research questions investigated in this paper are:

RQ1. To what extent do students use the different sources of support available to them for the assumed math skills?

RQ2. Do student characteristics influence the likelihood of a student seeking support and the type of math support they access?

RQ3. Do students perceive a benefit from the different sources of math learning support?

RQ4. What are the most important reasons given by students for not accessing University provided math learning support services?

RQ5: What feelings do students express about the maths skills required for the subject and their use of math learning support?

3. Assumed math skills and academic support services at Flinders Business School

Flinders Business School is an Australian business school of approximately 1,100 full-time equivalent students, offering a Commerce course stream focusing on accounting and finance, and a Business course stream focused on marketing, human resources, and other business disciplines. The first year introductory microeconomics subject is a first semester subject mandatory for all undergraduate Commerce and Business degrees, in addition to a handful of courses offered by other Schools. There are no formal math pre-requisites for these degrees or this subject, with the level of assumed maths skills in this topic at an Australian secondary school Year 10 level. The specific maths skills assumed have not been specified to students, and students have not been pre-tested for them prior to enrolment. With this level of math a prescribed minimum in the
Australian high school sector, the implicit assumption is that students entering university have these math skills. However, experience has shown us that not all students are suitably proficient in all of these skills, and formal university learning support resources have been put in place for students to seek help outside of class instruction time to gain proficiency as needed.

There are four types of outside-of-class academic skills support where students can access face-to-face math skills learning support at Flinders University, offered by two different levels of the University:

The Student Learning Centre (SLC) is a centrally provided university learning resource that provides to all students at the University:

- formal group instruction (SLC classes) on academic skills, and
- individual coaching (SLC student consultations)

Additionally, at school level, Flinders Business School provides:

- the “Steps to Success” program in which students access individual coaching on academic skills which are more tailored to the Business School curriculum.
- weekly consultation times during the semester when students can receive individual learning support from subject tutors.

Students may also seek learning support from their own informal networks of family and friends. Our interest in this study is to gain a better understanding of the extent to which students seek learning support for the assumed math skills in the subject, and some of the issues around their choices between seeking learning support from University sources (“formal University maths skills support”), seeking learning support from their informal networks (“informal maths skills support”) and not seeking any learning support.

4. Method

Our first step was to review the course material to ensure we understood exactly which math skills we were assuming in the introductory microeconomics subject. These were categorized as follows:

- (1) arithmetic manipulations of decimals, fractions, and percentages;
- (2) slope, intercept and the formula for straight line graphs;
- (3) simple algebraic manipulations;
- (4) recognizing simple increasing/decreasing relationships on graphs of non-linear functions.

Participants were recruited from the cohort of students studying the first year introductory microeconomics subject at Flinders University, which is mandatory for all Commerce and Business courses. Participation involved completion of an initial demographic survey, as well as a follow-up survey at the conclusion of the semester. All participants were informed that engagement with the project was voluntary and would have no impact on their grading for the subject. The present study was performed under the approval of the Flinders University Social and Behavioural Research Ethics Committee, project number 6015.

Students were advised in the first lecture that the mathematical skills detailed above were assumed skills in the subject, and students would find it easier to understand the subject if they had these skills. The first survey was administered to students in the lecture, asking them demographic information, information about the highest level of maths they had previously studied, how long ago that was and how comfortable they felt about their math skills. A short test including questions on each of the four types of math skills detailed was administered in order to allow
students to assess their abilities in those skills at the beginning of the semester and allow them to address the specific skills they may need to improve upon, in a manner that was timely and appropriate for them.

Details of how students could access sources of formal University maths skills learning support were discussed in the first lecture and tutorial of the subject, provided to students in a handout with their marked and returned test, and displayed prominently at the top of the subject’s learning management system for the duration of the semester.

The follow-up survey was administered in the last two weeks of the semester, in which participants were asked which specific sources of support for math skills they had accessed during the semester. This included the four types of formal University sources of maths skills support as well as informal maths skills support from their networks of family and friends. Participants were also asked to describe their experience with the math skills required in the subject. Survey responses were entered into the SPSS statistics package version 22, and data matched between participants using student ID numbers.

Data from participants who completed the initial demographic survey but did not complete the follow-up survey were discarded. Where participants did not complete the initial demographic survey but answered the follow-up survey, these data were included using data matching with other University records to complete omitted demographic answers where possible. Where students omitted answers to specific questions within either survey, these answers were omitted as necessary from the results shown.

5. Results and discussion

Of the 314 students enrolled in the topic at the end of the semester, 169 students (53.8%) completed the follow-up survey. The responses to the initial survey about demographic characteristics and previous maths experience are shown in Table 1 for the 169 students. The demographics of gender, age, the location of most recent qualification and most recent study experience of the survey group resemble the university’s demographic statistics for the total commencing students for this subject.

The demographic responses to this survey paint a picture of a cohort with the majority student characteristics resembling traditional recent high school graduates, who would be expected to be competent at the math skills required for the subject. Most students were in the youngest age group (66.3% were 20 years old or younger), had left high school less than two years ago (62.8%) and had done Year 12 math (20.4% at highest level maths and another 49.6% at a lower level). Although the traditional high school graduate entering university of a couple of decades ago may have had a higher level of math at Year 12, the math assumed in the subject has declined in sophistication since then, so any Year 12 math pass should certify adequate math skills for the subject. Most respondents passed their highest level math either less than one year (32.8%) or 1 to 2 years ago (24.1%). When asked at the beginning of the semester about their level of comfort with their math skills, the most common response was neutrality—students thought they would be OK when they got into it (48.9%), with 38% of valid responses expressing they were comfortable or very comfortable with their maths skills.

Although the most common student profile is consistent with a traditional recent school graduate, there were students with a range of ages (33.7% were 21 years or older and 4.2% were 31 years or older), most recent formal educational experience (21.9% entered through the TAFE pathway and 10.2% had last formally studied more than 2 years ago), formal maths educational standards (29.9% had not done Year 12 maths) and time since they had completed their highest maths qualification (43.1% more than 2 years ago and 23.4% more than 3 years ago). This is the expression of the diversity in student admissions that has been referred to in the
literature, where approximately one-third of the students have a background different to that for a traditional recent high school graduate on at least one of the characteristics.

Although the student body may show greater diversity it does not necessarily mean their basic math skills are lacking. Students have entered from TAFE pathways and from working lives where basic math skills may be often used. Of the respondents, only 13.2% stated they felt uncomfortable with their math skills, and this was the group that we would expect to seek learning support for their assumed math skills. Given the lack of explicit discomfort expressed, we expected that math learning support would rarely be required for those who answered comfort or neutrality with their math skills, especially given the demographic profile of the majority of respondents.

Table 1. Demographic data for students who responded to Survey 2 (n = 169)

|                              | No. of students | % of student responses |
|------------------------------|-----------------|------------------------|
| Gender                       |                 |                        |
| Male                         | 97              | 58.4%                  |
| Female                       | 69              | 41.6%                  |
| Age group                    |                 |                        |
| 20 or younger                | 110             | 66.3%                  |
| 21–30                        | 49              | 29.5%                  |
| 31–40                        | 4               | 2.4%                   |
| 40 or over                   | 3               | 1.8%                   |
| Location where completed most recent qualification |     |                        |
| In Australia                 | 142             | 91.6%                  |
| Outside Australia            | 13              | 8.4%                   |
| Most recent, previous study experience | |                        |
| Undergraduate last or previous year | 7           | 5.1%                   |
| TAFE last or previous year   | 30              | 21.9%                  |
| High school last or previous year | 86          | 62.8%                  |
| More than 2 to 10 years ago  | 13              | 9.5%                   |
| More than 10 years ago       | 1               | 0.7%                   |
| Studied economics before?    |                 |                        |
| Yes                          | 34              | 24.8%                  |
| No                           | 103             | 75.2%                  |
| Highest level of math previously passed | |                        |
| Year 12 highest level        | 28              | 20.4%                  |
| Year 12 lower level (applied/business) | 68      | 49.6%                  |
| High school, not Year 12     | 40              | 29.2%                  |
| Primary school               | 1               | 0.7%                   |
| Time since highest level of math passed | |                        |
| Less than 1 year             | 45              | 32.8%                  |
| 1–2 years                    | 33              | 24.1%                  |
| 2–3 years                    | 27              | 19.7%                  |
| More than 3 years            | 32              | 23.4%                  |
| How comfortable are you with basic math? | |                        |
| Very comfortable             | 22              | 16.1%                  |
| Comfortable                  | 30              | 21.9%                  |
| Neutral—be OK when do it     | 67              | 48.9%                  |
| Uncomfortable                | 16              | 11.7%                  |
| Very uncomfortable           | 2               | 1.5%                   |

Omitted responses have been left out; percentages are of valid responses.
The remainder of this section discusses the results of the follow-up survey and how students sought learning support for their assumed math skills, against the five research questions.

RQ1. To what extent do students use the different sources of support available to them for the assumed math skills?

Table 2 contains the reported use of the learning support service as a proportion of the total respondents to the survey. Most of the respondents (71%) sought some maths learning support during the semester, even though the math skills required in the subject did not exceed the Australian secondary school Year 10 level. Students turned to their informal networks of friends and family (62.1%) more than they turned to formal University learning support services, with 31.4% of students utilizing at least one of the different types of university-provided learning support services. More students who attended individual learning support during the semester accessed the support at the School level (21.9%) than at the centrally provided SLC level (7.7%). This result has some consistency with Pillai (2010) who found that, other than asking their course tutor, students most commonly turned to informal sources of other students, friends and family for academic support rather than formal university support services.

Only 29.0% of respondents from our survey reported they had not sought any support for their math skills during the semester. This was contrary to our expectations, given the nature of the math skills required, that approximately two-thirds of our students had characteristics resembling a traditional recent high school graduate profile and only 13.2% of students had expressed a lack of comfort with their basic math skills.

Table 3 shows the number of students who accessed single and multiple sources of learning support, both as a percentage of the number of respondents who had accessed some support and as a percentage of the total number of valid responses. The most frequent scenario was that students accessed learning support only from their own informal networks, which comprised 55.8% of all students who sought any learning support, and 39.6% of total respondents. Only 12.5% of respondents who sought help turned only to formal University learning support services.

| Table 2. Use of learning support (n = 169) |
|------------------------------------------|
|                                          |
| **Formal SLC classes run at the beginning of the semester** | No. of students | % of student responses |
| Total students who attended at least one class | 30 | 17.9% |
| **University personal learning support services during the semester** | | |
| SLC drop-in semester | 13 | 7.7% |
| Tutors semester | 20 | 11.8% |
| Steps to success semester | 17 | 10.1% |
| Total students who used at least one semester service | 33 | 19.5% |
| Total students who used some University learning support | 53 | 31.4% |
| Total students who used informal networks | 105 | 62.1% |
| Total students who used some math learning support (University and/or informal networks) | 120 | 71.0% |
| No help sought of any type | 49 | 29.0% |
Table 3. Students who sought single and multiple sources of help, as a percentage of those who sought help (n = 120) and total student respondents (n = 169)

| Source of Support                                      | No. of students | % of student n = 120 | % of students N = 169 |
|--------------------------------------------------------|-----------------|-----------------------|------------------------|
| One source of support only                             |                 |                       |                        |
| SLC classes                                            | 8               | 6.7%                  | 4.7%                   |
| University semester                                    | 4               | 3.3%                  | 2.4%                   |
| Informal networks only                                 | 67              | 55.8%                 | 39.6%                  |
| Two different sources of support                       |                 |                       |                        |
| SLC classes & University semester                      | 3               | 2.5%                  | 1.8%                   |
| SLC classes & informal networks                        | 12              | 10.0%                 | 7.1%                   |
| University semester & informal networks                | 18              | 15.0%                 | 10.7%                  |
| Three different sources of support                     |                 |                       |                        |
| SLC classes, University semester & informal networks   | 7               | 5.8%                  | 4.1%                   |
| Students who accessed only university learning support | 15              | 12.5%                 | 8.9%                   |
| Students who accessed any university learning support  | 53              | 44.2%                 | 31.4%                  |
| Students who accessed informal networks only           | 67              | 55.8%                 | 39.6%                  |
| Students who accessed no learning support              | 49              |                       | 29.0%                  |

(R.9% when counted as a percentage of respondents), but when adding on students who may also have turned to their informal networks for learning support, 44.2% of those who sought some support accessed University learning support sources (31.4% of total respondents).

RQ2. Do student characteristics influence the likelihood of a student seeking support and the type of math support they access?

To determine possible associations between student characteristics and their likelihood of using University sourced learning support, their own informal networks or no learning support at all, a Chi-squared test for independence was performed between the categorical independent demographic variables and the type of learning support used. A significance level of $p < 0.05$ is used throughout, without adjustment for multiple comparisons, following Rothman (1990). The strength of the association between the characteristic and the learning support used was measured by the Phi value for all the student characteristics except for the comfort with the basic math skills, where Cramer’s V was used. Those strengths are shown for the significant results at the $p < 0.05$ and for results with $p < .10$ levels.

Many of the demographic variables shown in Table 1 were collapsed into two categories to reflect student characteristics that would resemble a traditional recent high school graduate profile compared to a student profile more likely to be associated with a “diverse entry path” into the subject. Table 4 lists the student characteristics, the percentages of students with that characteristic who accessed the type of learning support shown, and the two-tailed probability that there is no significant association between the student characteristic and the type of learning support accessed.
Students who used university learning support services were significantly more likely to be female, to be over 21 years old, have recently left TAFE or been more than 2 years since their most recent study experience, and were less comfortable with their basic math skills at the commencement of the semester, which had the strongest association. The probability of respondents not having passed Year

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Table 4. Student characteristics and use of learning support

|                                | University support services | Informal networks only | No help |
|--------------------------------|----------------------------|------------------------|--------|
|                                | 53 students                | 67 students            | 49 students |
| Sex—M                          | 24.7%                      | 36.1%                  | 39.2%  |
| F                              | 42.0%                      | 44.9%                  | 13.0%  |
| p                              | .019**                     | .251                   | .001** |
| Phi strength                   | weak                       |                        | Moderately strong |
| Age—under 21                   | 25.5%                      | 50.0%                  | 24.5%  |
| 21 and over                    | 49.0%                      | 17.6%                  | 33.3%  |
| p                              | .004**                     | .013**                 | .830   |
| Phi strength                   | moderate                   |                        | strong |
| Most recent study last or previous year |                          |                        |        |
| High school                    | 23.3%                      | 50.0%                  | 26.7%  |
| - TAFE OR more than 2 years ago | 48.8%                      | 27.3%                  | 25.0%  |
| p                              | .004**                     | .013**                 | .830   |
| Phi strength                   | moderately strong          |                        | moderate |
| Studied economics before       |                            |                        |        |
| - Yes                          | 23.5%                      | 35.3%                  | 41.2%  |
| - No                           | 35.9%                      | 42.7%                  | 21.4%  |
| p                              | .182                       | .445                   | .023** |
| Phi strength                   |                            |                        | Weak   |
| Highest math previously passed |                            |                        |        |
| —Any Yr 12                     | 28.1%                      | 40.6%                  | 31.3%  |
| —Lower than Yr 12              | 43.9%                      | 41.5%                  | 14.6%  |
| p                              | .072*                      | .927                   | .043** |
| Phi strength                   | Weak                       |                        | Weak   |
| Time since highest level of math studied |                        |                        |        |
| —Two years or less             | 25.6%                      | 47.4%                  | 26.9%  |
| —More than two years           | 42.4%                      | 32.2%                  | 25.4%  |
| p                              | .039**                     | .073*                  | .843   |
| Phi strength                   | Weak                       |                        | Weak   |
| How comfortable with basic math? |                            |                        |        |
| —Comfortable                   | 19.2%                      | 34.6%                  | 46.2%  |
| —Neutral                       | 37.3%                      | 49.3%                  | 13.4%  |
| —Uncomfortable                 | 55.6%                      | 27.8%                  | 16.7%  |
| p                              | .010**                     | .131                   | .001** |
| Cramer’s V strength            | Moderately strong          |                        | Very strong |

Note: Cell percentages are the percentages of that demographic characteristic who used that type of learning support.
12 maths was not significant at the 5% level but was at 10% and there was no significant difference whether they had studied economics before. In general, these students had a “more diverse entry” profile than students in the other learning support categories.

Students who only used their informal networks for maths learning support were significantly more likely to be aged under 21 years and have studied at high school, within the last two years. Those who had studied their highest level of maths within the past two years was not significant at the 5% level but was at 10%. There was no association between gender, whether students had studied economics before, whether students had passed Year 12 maths previously or with expressed comfort with their maths skills at the beginning of the semester. The strongest association with using informal networks only was being in the youngest age group.

Males were significantly more likely not to seek any math learning support (39.2%) than females (13.0%) and the association was moderately strong. This is consistent with Hoyne and McNaught (2013) who found males less likely than females to seek support for gaps in literacy skills. Other significant characteristics of those who did not seek any learning support for their math was to have studied economics before, to have previously passed Year 12 maths and to have expressed comfort with their maths skills at the beginning of the semester, which had a very strong association. Being older or younger than 21, whether their most recent study experience was at high school, TAFE or more than 2 years ago and time since the highest math studied did not show as significant in the decision not to seek any math help. This result is quite consistent with these students not needing help with their math skills, and quite consistent with some types of diverse entry path for students.

**RQ3: Determine whether students perceive a benefit from the different sources of math learning support.**

Table 5 shows the results of students’ ratings of how helpful they found each of the different types of learning support they accessed. Numbers differ between Tables 4 and 5 due to differences in the number of valid rating responses, and because students who accessed multiple sources of help have rated each type.

In general, students found all types of University provided learning support services and learning support from their informal networks to be helpful. Of the 10 students who found a University provided learning support unhelpful, only two students did not try another type of learning support and only one student tried another type of learning support and also found it unhelpful. The reverse situation was true for the students who found learning support from their informal networks unhelpful—only one student tried an alternative source of learning support, and that was the same student mentioned above, who found the university learning support service unhelpful.

This aligns with the many studies which have reported qualitative and quantitative evidence of the helpfulness of university-provided academic support services (Adams et al., 2012; Balzer Carr & London, 2016; Pell & Croft, 2008 amongst many others). Clearly, the University learning support resources are performing a very valuable service to students, and these may be students with the most need for improved math skill or reassurance, given students who use these sources of learning support are from a more “diverse entry path” as discussed above. The students’ informal networks are also performing a valuable service to students, given these reports of helpfulness. This result aligns with many studies that have reported the benefits of peer learning (Boud, Cohen, & Sampson, 1999; Fox & Stevenson, 2006 as examples).

**RQ4: What are the most important reasons given by students for not accessing math learning support services?**
Students who did not use any of the different types of University learning support resources available were given a list of possible reasons as shown in Table 6 and asked to nominate the most important reason why they did not. We looked at students who had sought learning support only from their informal networks and those who had not sought any support at all, and the two groups combined.

Students nominating the reason that they didn’t need help because their skills were good enough was the second most nominated reason for students who accessed no help, and the third most nominated for students who used their informal networks only, and the two groups combined. These are valid reasons for not seeking help or simply turning to informal networks for reassurance if the student has judged this correctly. This result has some similarities to the finding...

### Table 5. Ratings of the learning support used

| Learning Support                                      | Number that accessed this type of help | Very unhelpful | Unhelpful | Helpful | Very helpful |
|-------------------------------------------------------|----------------------------------------|----------------|-----------|---------|-------------|
| **Formal classes run by the SLC at the beginning of the semester** | Total valid responses: 50 | 0              | 6 (12%)   | 25 (50%)| 19 (38%)   |
| **University learning support for one-on-one consultation throughout the semester** | Total valid responses: 44 | 2 (4.5%)       | 2 (4.5%) | 18 (41%)| 22 (50%)   |
| **Informal networks used for learning support**        | Total valid responses: 91 | 6 (7%)          | 0 (0%)    | 62 (68%)| 23 (25%)   |

*Note: Students may have accessed more than one type of help.*

### Table 6. Most important reason for not taking up University sources of help offered

| Reason                                      | Informal networks only | No help sought | All students who did not use University support services |
|---------------------------------------------|------------------------|----------------|--------------------------------------------------------|
| Knew could work it out for myself           | 28 (41.8%)             | 22 (44.9%)     | 50 (43.1%)                                             |
| Always busy when help available             | 21 (31.3%)             | 11 (22.4%)     | 32 (27.6%)                                             |
| Didn’t need help—skills good enough         | 2 (3.0%)               | 13 (26.5%)     | 15 (12.9%)                                             |
| Other                                       | 6 (9.0%)               | 0 (0%)         | 6 (5.2%)                                               |
| Didn’t know where or when the help available| 4 (6.0%)               | 1 (2.0%)       | 5 (4.3%)                                               |
| Not confident could communicate with/understand the help staff | 2 (3.0%) | 0 (0%) | 2 (1.7%) |
| Felt would be judged not good enough for Uni or the subject | 2 (3.0%) | 1 (2.0%) | 3 (2.6%) |
| My family and I do not ask for help         | 1 (1.5%)               | 0 (0%)         | 1 (0.9%)                                               |

*Items are paraphrased from the questions posed in Question 2 of the survey. Respondents were asked to select the most important reason they did not access university learning support services. The percentages are the percentages of valid student responders in the help category who nominated this reason.*
in Mac An Bhaird et al., were the most common reason (48.8%) for not seeking Mathematics Learning Centre support was “Do not need support” (2013, p. 195) but it is not directly comparable.

The most nominated reason was a shade less assured about their math skills, with students not using University learning support resources because they knew they could work it out for themselves. There was little difference whether students sought help from their informal networks, or did not seek any math help at all. These could be students whose math skills range from good and needed no help, to those with good skills who needed a little reassurance from their informal networks. However, there could also be students who really needed much greater support but who did not want to seek formal support, perhaps from a need for self-autonomy (Hoyne & McNaught, 2013) or from uncertainty as to the appropriateness of them needing support in their studies (Pillai, 2010).

More concerning was the second most nominated reason for students who used their informal networks only and for the group overall, but third most nominated for students who did not seek help, was that the student was “always busy when the support was available”. It implies the student would have liked or could have used some help from this source but found it inaccessible. Students do have significant study and work demands on their time, and the university offers a limited working day and very limited after-hours learning support. However, the three different types of university semester learning support services are scheduled over a range of different times and days, and the School offers scheduled appointments for students if they cannot make advertised times. It may indicate a lack of prioritizing seeking support in their studies, which could potentially jeopardize success in which, for most respondents, is supposed to be their most important, full-time endeavor. “Times do not suit” also ranked second in Mac An Bhaird et al. (2013), where 28.8% of students gave this reason for not attending maths learning center support.

The fourth most nominated (4.3%) reason given was that students did not know where or when the support was available. Much effort was given to communication of these details, but it is always hard to ensure everyone is aware of the message, and what the message means. This played a slightly larger role in the Mac An Bhaird et al. (2013) study where 18.1% said they did not know where the maths learning center was, and 8.5% that they had never heard of it.

The most troubling reasons given for not attending formal university support were the reasons based on a lack of confidence or fear. “Not confident could communicate with/understand the support staff” and “Felt would be judged nor good enough for University or the subject” were reasons given by a small percentage of the students combined student group (1.7% and 2.6% of students, respectively). It is good that these are the least frequent of the specified reasons, but having any students answer this way is not what is wanted: this is a learning community, and we want no learner to lack confidence or feel fear in seeking learning. It also seems likely these could be students vulnerable to failing, especially given Grehan, Mac An Bhaird, and O’Shea (2011) who interviewed seven students repeating a first-year mathematics module and found fear a driving force behind their lack of engagement with the maths learning center support. Again, our findings were similar to the Mac An Bhaird et al. (2013) study, where “Embarrassed or afraid to go” was their least common reason specified reason for not attending the maths learning center (counting the “Never heard of the MLC” answer with the “Did not know where it was” category combined above).

In the “Other” category, respondents responses stated they didn’t seek support from formal university sources because they had other sources of help, such as family and friends and one student nominated they could use the Khan Academy resources to brush up their skills. Another student said he could not be bothered going and was not sure it would help, and one student said he’d talked to others who had been to the University formal support and did not find it helpful as the reason he did not attend.
RQ5: What feelings do students express about the maths skills required for the subject and their use of math learning support?

To determine whether there were any associations between the way students expressed their feelings about their experience with the math skills required in the subject and the learning support option they chose, a Chi-squared test for independence was performed between respondents’ agreement with the five statements summarised in Table 7 and the type of learning support used. The four-value Likert scale of 1 = Strongly Disagree to 4 = Strongly Agree was collapsed into two categories of “Agree” and “Disagree”. Table 7 shows the total percentage of all respondents who Agreed with the statement, with the cells containing the percentages of students who accessed that learning support type and Agreed. The significant results show the two-tailed probability that students who accessed that learning support option agreed in the same proportions as all respondents did for that statement. As done in Table 4, there was no adjustment for multiple comparisons (Rothman, 1990), and Fisher’s exact

| Table 7. Feelings about the maths skills required in the subject and learning support option sought | University support services | Informal networks only | No help sought |
|-----------------------------------------------------------------------------------------------|-----------------------------|------------------------|----------------|
| **Easy enough to work through the semester & gain the skills** | 53 students | 67 students | 49 students |
| - Agree (90.3%) | 79.5% | 93.4% | 97.5% |
| Valid responses | n = 44 | n = 61 | n = 40 |
| Phi | moderate |
| **Maths in the subject pretty easy** | | | |
| - Agree (76.6%) | 68.2% | 72.9% | 90.5% |
| Valid responses | n = 44 | n = 59 | n = 42 |
| Phi | Moderate |
| **Better maths skills would have improved their understanding of subject** | | | |
| - Agree (43.2%) | 64.3% | 40.0% | 24.3% |
| Valid responses | n = 42 | n = 60 | n = 37 |
| Phi | Moderately strong |
| **Usually ask for help when don’t understand** | | | |
| - Agree (81.1%) | 91.3% | 78.6% | 73.2% |
| Valid responses | n = 46 | n = 56 | n = 41 |
| Phi | Weak |
| **Wish I had sought more help** | | | |
| - Agree (37.7%) | 54.8% | 38.7% | 19.0% |
| Valid responses | n = 42 | n = 62 | n = 42 |
| Phi | Moderate |

1. Fisher’s exact test used due to cells in the test with an expected value of less than 5 with the lowest = 4.25.
test was used for two circumstances (one significant and one not) where the expected cell count was less than 5. The strength of the association was measured by the Phi value as discussed for Table 4, and are shown for the significant results.

Students who accessed different learning support categories in Table 7 mostly answered the survey questions very differently. Students who accessed university support services were significantly less likely to answer most of these questions positively, as they were less likely to agree the maths in the subject was easy enough to work through the semester to gain the skills and were more likely to agree that better maths skills would have improved their understanding of the subject, that they would ask for help when they did not understand anything and also to wish they had sought more help for their maths skills. Students who did not seek any help with their maths skills, in general, took the opposite positions—they were more likely to agree the maths in the subject was pretty easy, less likely to agree that better maths skills would have improved their understanding in the subject or that they wished they had sought more help. Students who accessed their informal networks only in general took a middle ground between these two positions. This may indicate that students with the greater need for maths support to turn to the university support services; those with a lesser need turn to their informal networks and those who don’t need help have generally made the right decision. However, it is concerning that whatever the help category, quite large percentages of students thought better maths skills would have helped them improve their understanding of the subject (24.3% of those who did not seek help) and wish they had sought more help (19.0% of those who sought no help).

6. Conclusion
We surveyed students in a mandatory first-year undergraduate introductory microeconomics course about the type of learning support they used, if any, for their mathematical skills during the semester. We found the concerns expressed in the literature about the lack of math skills of commencing students was demonstrated in our study, as the majority of respondents (71%) sought some amount of help with their assumed math skills during the semester.

Our research demonstrated that most students (62.1%) turn to their informal networks for maths learning support and 39.6% of respondents only use this kind of learning support. These results highlight, in the first instance, the importance of peer learning as a means to target math skills support. We suggest a program that helps to widen student access to good, knowledgeable peers may have the greatest impact. This could be achieved through a variety of different methods, and the literature on different types of peer learning programs is vast and well established. In addition, quality online learning support for math skills may further enable both individual and peer or family learning support. This may particularly suit the younger age group who were more likely to turn to informal networks, help those students who found their own informal networks unhelpful, and those who found it difficult to schedule attendance at a university support service. Nevertheless, it was the students who had the most concern about their math abilities who had a greater tendency to seek formal university provided support. These students generally found University support to be helpful, and it is likely the students who attend these formal sources have the largest skill gaps and may benefit more from the specialist skills of these service providers.

It is not surprising that students from pathways more diverse than the traditional recent high school graduate might need help with these math skills. However, faculty need to be aware that even though students may have a demographic profile they would expect to have no difficulty with the assumed math skills, students can still struggle with these skills as they may have “forgotten the underlying math, been underconfident, have not understood it or have not transferred the math to the higher education discipline context” (Galligan & Hobohm, 2015, p. 132).

The fact that some math skills are assumed does not mean they should be implicit. We recommend the specific math skills are articulated to students at the beginning of their studies.
for the subject. A suitable diagnostic test should be made available for them to self-diagnose the extent to which they have these skills. Effective diagnostic testing would also enable course coordinators to target scarce resources to where they will be of most benefit. This testing should occur early in the semester, with clear communication of both the skills needed and the mathematical skills support available to students.

As we did not have a wide range of demographic data available, our division of “recent high school graduate” and “more diverse pathway” students was quite crude and we were not able to specifically explore choices made by non-traditional pathway students, domestic students from culturally and linguistically diverse backgrounds, or the perceptions of international students. Another limitation of our study was that the survey occurred at the end of the semester, and students who had withdrawn or “given up” in the subject were not represented. These students may have reacted that way as a consequence of their poor math skills, or of their inability to get satisfactory help for them. Further limitations of our study were that we did not address the intensity of usage of the different help types, nor specifically address the use of online resources.

An important area for future research is to further investigate the reasons why students do not seek help when they are experiencing difficulties in their course. The costs of providing support pale in comparison to the costs of student attrition and failure, and a greater understanding of the obstacles that prevent students from seeking help from the most suitable resources that can help them would be beneficial to students and higher education institutions.

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