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Maybe we could just count the boxes of chocolates? Measuring the impact of Learning Development mathematics support for undergraduate students

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Abstract

Many students who are required to study mathematics as part of their undergraduate degree find the subject challenging. Support is offered for these students by Learning Development mathematics lecturers, mainly through individual or small-group consultations, workshops on specifically-requested concepts, or drop-in sessions. The effect of this support is difficult to determine, however; yet it is essential to demonstrate its success to the institution's management to ensure continued funding. Confidence in mathematics is a factor associated with a student's success in mathematics learning (Parsons, Croft & Harrison, 2009). This paper describes a project conducted at a large regional Australian university which compared the levels of students' mathematics confidence before and after support obtained through consultations. Different aspects of confidence, as suggested in the literature, were examined, and it was found that there was an increase in the levels of each of them. The paper presents an overview of both the advantages of the project and the problems faced in its implementation. Attitudes towards, and confidence in mathematics of potential primary school teachers are highlighted as it is recognised that these are a vital aspect of the success of their future mathematics teaching. A particularly important part of the project was to obtain students' comments at the end of the period of support; this is suggested as an essential requirement of reporting as not only is it beneficial for the lecturers' data collection, but as well, asking students to reflect on their latest feelings and attitudes towards mathematics may be considered an important step in their becoming self-directed learners.

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Many students who are required to study mathematics as part of their undergraduate degree find the subject challenging. Support is offered for these students by Learning Development mathematics lecturers, mainly through individual or small-group consultations, workshops on specifically-requested concepts, or drop-in sessions. The effect of this support is difficult to determine, however; yet it is essential to demonstrate its success to the institution's management to ensure continued funding.

Confidence in mathematics is a factor associated with a student's success in mathematics learning (Parsons, Croft & Harrison, 2009). This paper describes a project conducted at a large regional Australian university which compared the levels of students' mathematics confidence before and after support obtained through consultations. Different aspects of confidence, as suggested in the literature, were examined, and it was found that there was an increase in the levels of each of them.

The paper presents an overview of both the advantages of the project and the problems faced in its implementation. Attitudes towards, and confidence in mathematics of potential primary school teachers are highlighted as it is recognised that these are a vital aspect of the success of their future mathematics teaching. A particularly important part of the project was to obtain students' comments at the end of the period of support; this is suggested as an essential requirement of reporting as not only is it beneficial for the lecturers' data collection, but as well, asking students to reflect on their latest feelings and attitudes towards mathematics may be considered an important step in their becoming self-directed learners.

Key Words: Learning Development; mathematics support; mathematics confidence

1. Introduction

Many university undergraduate students are dismayed to discover they need to study some mathematics as part of their non-specialist mathematics courses. Some of these students seek assistance from Learning Development mathematics lecturers who offer support mainly through one-to-one or small group consultations, workshops on specific topics, or drop-in sessions for particular subject or faculty cohorts. However, the impact of such support is difficult to measure.

It has been recognised that a student's confidence in mathematics is related to their performance in mathematics (Parsons, Croft, & Harrison, 2009; Galligan, 2011; McNaught & Hoyne, 2011), and so a project designed to measure any changes in students' confidence after support from Learning Development was run at the University of Wollongong (UOW) during 2013 and 2014.

This paper outlines the rationale for the project, its results, and the benefits and problems associated with its implementation.

2. Background

The University of Wollongong (UOW) is a large Australian regional university with a diverse student cohort. Many students are from "non-traditional" backgrounds such as mature-aged, first in family, and Indigenous; students may also study via videoconference from smaller remote campuses. The Learning Development mathematics team (introduced in 2011) comprises one full-time lecturer at the main campus, with part-time lecturers at each of four smaller campuses and, from 2013, a part-time statistics specialist at the main campus. Lecturers see students from a large range of non-specialist mathematics courses; by far the majority are Australian domestic students in their first (or possibly second) course that requires mathematics, although not necessarily their first year at university, with most from Education, Science, Engineering, Finance, and Nursing. Attendance at Learning Development is voluntary; many students attend regularly throughout their course, while others only require a short amount of time and attend just one workshop or consultation. Consultations are limited to one hour per week. A variety of printed resources is available which is also accessible through Learning Development's website.

3. Literature review

Difficulties associated with measuring the effectiveness of Learning Development assistance for students have been discussed by several writers including MacGillivray (2009), MacGillivray and Croft (2011), and Cole (2011). In much of the literature relating to Learning Development in mathematics and statistics provision, however, students' confidence assumes at least some level of importance. By observation of the students who come to Learning Development, it was apparent that many of them had little confidence in their mathematics ability and it was thought that this lack of confidence affected their potential to succeed in their mathematics course and therefore, in the long term, their university degree. The idea of using any change in students' mathematics confidence after they had consulted Learning Development lecturers as an indicator of the effectiveness of these consultations was thus considered. To explore the validity of this idea, a literature review was carried out to investigate, firstly, mathematics support for undergraduate students through provision such as Learning Development and, secondly, students' mathematics confidence.

3.1. Learning Development – Mathematics

In their comprehensive investigation of the provision of mathematics support in Australian universities, MacGillivray and Wilson (2008) state: "There has always been, and always will be, need for reliable, supportive and expert learning support for students in numeracy, mathematics and statistics across a wide range of disciplines in universities" (p. 3). MacGillivray and Croft (2011) detail the history of mathematics and statistics support in Australia and emphasise the importance of this provision to be reported effectively. Cole (2011) however, suggests that it is a challenge for Learning Development lecturers to work out the best kinds of data that successfully illustrate their impact and convince appropriate people that they are an essential requirement of the university sector, while Myers (2013) points out that there is a danger that students are supported by institutions only "to produce desired outcomes for the institution" (p. 594), adding that this may not necessarily benefit students themselves.

Tinto (2005) distinguishes between "retention" and "persistence", suggesting that "retention as a goal reflects the interests of the institution, while persistence mirrors the desires of the student" (p. 89). Learning Development lecturers need to ensure both goals are reached and that "success" is achieved by both – but not only that, they also need to ensure that they successfully

report they have accomplished this. To assist with this necessary reporting, MacGillivray and Croft (2011) offer a “framework” for Learning Development lecturers and recommend that the aim of developing students’ confidence should be part of this framework.

The need for students to have confidence in their approach to mathematics has further been discussed by various writers, including Galligan (2011); Parsons, Croft and Harrison (2009); and Warwick (2008). In fact, Galligan (2011) suggests that “academic numeracy” consists of three components: “mathematical competence” in the learner’s chosen profession; a “critical awareness” both of the mathematics itself and of their own mathematical knowledge; and “confidence, highlighting its deeply affective nature” (p. 289).

3.2. Confidence as an indicator of competence in mathematics?

3.2.1. Interpretations of mathematics confidence

Pajares and Miller (1994) distinguish between a learner’s confidence that they will do well in a particular mathematics topic or task, termed “self-efficacy”, and their perception of their overall mathematical ability, or “self-concept” (Pajares & Miller, 1994, p. 193). Parsons, Croft, and Harrison (2009) add “applications confidence” to these, stating that levels of each may be different. They also suggest that a learner’s self-efficacy may be enhanced or diminished by a number of factors: success or failure in their performance; “vicarious experiences” such as comparing themselves with their peers or colleagues; “verbal persuasions”, for example feedback received from, or remarks made by teachers or others; and their physiological and affective states such as emotions felt while attempting mathematical tasks (p. 56). Writers such as Carmichael and Taylor (2005) however, argue that Pajares’ and Miller’s (1994) required distinction between self-efficacy and self-concept is “academic” and regard “mathematics confidence” as an adequate term to explain “student beliefs regarding their confidence to succeed in mathematics at both the general and the specific level” (p. 715). On the other hand, Warwick (2008) found from his research that “students are happy to make use of performance experience as a source of evidence for the self-efficacy judgements” (p. 7); he adds that this may be as a result of the emphasis placed on the value of assessment tasks.

3.2.2. Measuring students’ mathematics confidence

It is difficult to determine just how to measure students’ mathematics confidence. Tapia and Marsh (2004) developed “a new instrument to measure students’ attitudes toward mathematics”, in which “items were constructed to assess confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations”; while Nielsen and Moore (2003) also developed a “maths self-efficacy scale” with which they looked at confidence levels within two different contexts: in the classroom and under examination conditions. Both of these methods were developed for high school students. Galligan (2011) developed a “Maths relationship scale” which asked first year undergraduate nursing students to rate their feelings about mathematics and to reflect on their mathematics experiences, and included questions looking at their confidence.

MacGillivray and Croft (2011) identify precisely the problems with obtaining data or measuring students’ success and its possible association with any input from Learning Development lecturers:

The essence of learning support is that it is not formal. It enables students to try to engage with mathematics or statistics in an environment with no formal expectations of them other than that they are there to try. Whilst this is strength in providing an environment for students to face their fears, conquer weaknesses and develop confidence and self-knowledge, it also brings challenges for measurement and analysis of its effects. (p. 196).

MacGillivray and Croft (2011) outline two types of data collection as appropriate to Learning Development: usage of the support and its effect. They suggest that each type may be represented by both qualitative and quantitative data, where qualitative data for “usage” of Learning Development might be obtained from student feedback, comments, interviews and observations. Qualitative data for “effect” would “enable links to be made between [Learning Support in Mathematics and Statistics] usage and students’ confidence, performance and

prevention of avoidable attrition” (p. 199). They emphasise the necessity for verbatim comments to be included in any measurement data, reasoning that students generally report positively regarding especially one-to-one Learning Development consultations and that the comments themselves therefore “provide insight into how and why the students feel as they do”. At UOW, unfortunately, attempts to collect students’ evaluations at the end of semesters have resulted in few being completed and returned. Quantitative data might be relatively straightforward to collect; in fact, since this project was implemented, a database for the Learning Development unit was introduced which records students using the service. Data may be produced that analyses usage according to gender; mature-age vs school-leavers; faculties/subjects; first-year students; campus, and so on.

3.3. Extra research needed

The literature reviewed, in the main, did not pertain to those students supported by extra assistance within a one-to-one Learning Development university environment. Several pieces related to pre-university training (Parsons, Croft, & Harrison, 2009; Bahr, 2008; Carmichael & Taylor, 2005) or school students (Tapia & Marsh, 2004; Nielsen & Moore, 2003). Most of those that did focus on university students looked at specific courses: Galligan (2011) studied nursing students while Holm and Kajander (2012) developed an optional extra mathematics course for Teacher Education students and, although confidence was investigated, the setting for this extra assistance was quite different from that provided by Learning Development.

4. The project

4.1. Overview

Learning Development mathematics provision at UOW is relatively new. As such, it was imperative that the service be shown to be valuable and, in fact, essential for the success and retention of many students; however, a means of evaluating the impact of Learning Development is difficult to determine. University subjects require their students to undergo some sort of assessment program, but Learning Development lecturers are confined to dealing with students for one hour per week only. This is insufficient to suggest that students perform a pre- and post-assessment of their competencies. Moreover, students are required to do many assessment tasks within their courses and suggesting to them that they need to complete an extra one for Learning Development would hinder many of them from approaching the unit in the first place. The majority of students who seek assistance seem to have limited confidence in their mathematical ability and, from their point of view, they certainly do not want a person from whom they are seeking extra support to tell them that their mathematical ability is poor – they already think that! Thus, Learning Development lecturers are obliged to “assess” their students either by more subtle means (observation, for example) or by asking them about their confidence as an indicator of potential success in their mathematics course. Using the reviewed literature as a starting point, a project was set up to determine the levels of confidence in mathematics overall, and in individual mathematics topics, of students who approach Learning Development for support in mathematics.

4.2. Methodology

The literature indicated that several issues needed investigation:

1. is there any difference in students’ levels of confidence in a mathematics topic before and immediately after a consultation?
2. is there any difference in students’ confidence in mathematics (in general) when comparing those levels of confidence before and after they receive help, over a period of time?
3. is there any relationship between their confidence in mathematics overall and their confidence in being able to apply it in their chosen profession (both measured after a period of support)?

4. is there any difference between students' levels of confidence in mathematics overall and their levels of confidence in each specific topic for which they have received support?
5. are mathematics confidence levels independent of gender, faculty and subject? and
6. are students' levels of confidence in mathematics independent of their subject results?

The project was begun at the commencement of Autumn Semester, 2013. To avoid the potential bias if Learning Development lecturers themselves asked questions before and after a consultation, students were asked to complete their ratings by an independent person – the Administration Assistant of Learning Development – at the main campus. This luxury was not available at the remote campuses however, and so lecturers themselves collected the information from students.

At their first visit for a consultation, students were asked if they were willing to participate in the research project; those who agreed were given an Information sheet and a Consent form together with “Form A”, which asked for some generic information as well as their overall confidence rating in mathematics and “Form B” which asked what specific topic they were seeking help for that session and their level of confidence in that topic. Levels of confidence were indicated on a 1-5 Likert-type scale, with 1 = *Zero confidence*; 2 = *A little confident*; 3 = *Neutral*; 4 = *Fairly confident* and 5 = *Absolutely confident*. At the end of the session they were presented with “Form C” which gauged their post-support confidence in the specific topic. (The Information sheet, consent form and Forms A, B, and C are all attached in Appendix B). And yes, some students did complain about the paperwork! Students were also required to submit Forms B and C before and after each subsequent Learning Development consultation. Once forms were received, random numbers were allocated to each student's set of information and data coded appropriately.

At the end of the semester, students were also supposed to receive Form D (see Appendix B) which asked them to rate their overall confidence in mathematics, especially after they had received their results. Form D proved difficult to administer as most students did not return to Learning Development after examinations. A blind copy email was sent using the Administrative Assistant's email, together with a letter signed by the Head of Learning Development. Disappointingly, however, even two emails – spaced apart by approximately 3 weeks – were insufficient to attract more than 12 replies from the 83 participants and at the end of the semester, only 15 responses had been received. Ethics approval was obtained to telephone participants and an independent, non-Learning Development person was employed to do this. She asked the same questions as comprised Form D, including inviting students' comments. The timing of this process itself could have been a problem, however, as it was then quite some time since students had finished the mathematics subject they were studying with many no longer needing to pursue further mathematics courses, while others could have begun a subsequent, more difficult course and perhaps may have forgotten their level of confidence at the end of the previous one.

4.3. The Project: “Part 2” – Education students only (Autumn 2014)

The cohort comprising students surveyed during 2013 disappointingly contained fewer than normal Primary Education students; in fact, because of course restructures, no Primary Education students at all were seen at the main campus. Therefore, with ethics approval, the project was repeated in 2014 for Primary Education students only. Administration of the project was carried out using the same methods as in 2013, with two exceptions: firstly, it was confined to the main campus and only one remote campus; secondly, because the same problems were encountered regarding collection of Form D, a *SurveyMonkey* questionnaire was developed, copied directly from Form D, including space for students' comments, and the link emailed to students. Nevertheless, again very few responses were obtained. Eventually it was decided to analyse the nineteen responses obtained as it was realised that even with repeated reminders, students just would not respond!

4.4. Results (Part 1 of the project – Autumn 2013)

Data was analysed using *Excel* and *SPSS*, with mainly t-tests used to compare pre- and post-means and medians, and Pearson's correlation where appropriate. In all, 83 students participated, with 62 (75%) from the main campus and 21 from the other campuses. (Because of the methods of data collection, it may have been useful to compare results from each campus, but unfortunately sample sizes were too small for meaningful analysis.) Twenty-eight (34%) participants were male, and 53 (64%) female, (2 unstated). Ages ranged from 17 to 61, (mean age 28.9; median 24). Twenty-one subjects within 5 faculties were represented. Although the Commerce Faculty had most students attending, this was for several subjects, whereas the largest subject representation (19%) was Science Faculty students studying that faculty's compulsory mathematics unit¹ – their majors could be, for example, geology, chemistry, biology. A bar chart showing the faculties represented is shown in Figure 1.

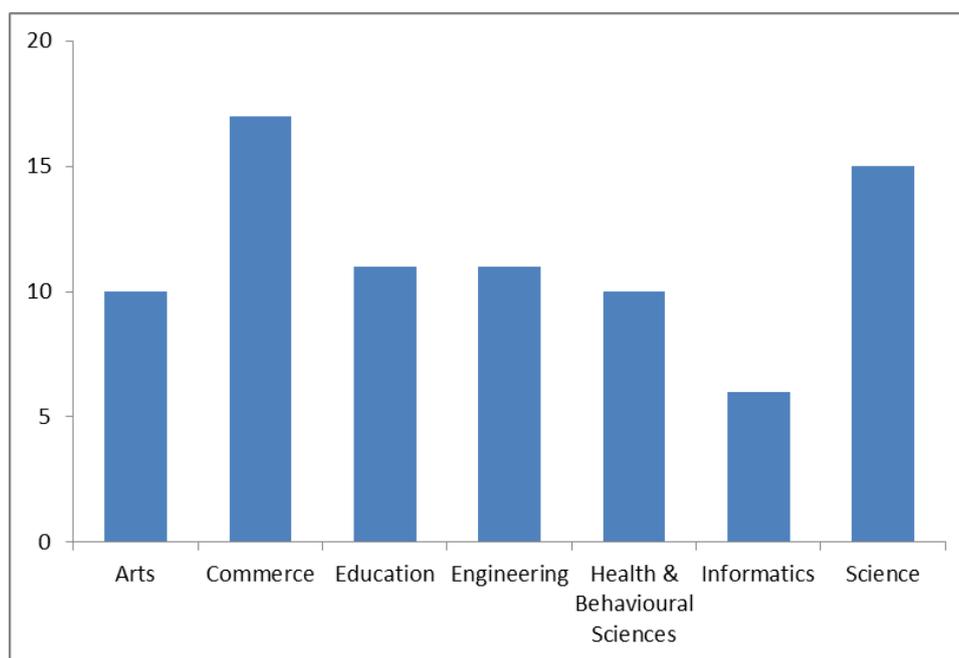


Figure 1. Student numbers by faculty (Autumn 2013). While the number of Education students does appear relatively large, they were actually extremely low compared to other years and the project was repeated for students from this subject alone in 2014.

Unfortunately, the questions asking for students' years since school or since they last studied any mathematics and ATAR/HSC² results were poorly answered and analysis was not possible. Several students, particularly those at the remote campuses, preferred to have consultations in small groups, mainly of 2 or 3, but often up to 9 were involved. Because one student's data was incomplete, 82 students' data was used to analyse the Topic Confidence, but even after two full mornings' phone calls, only 65 complete responses were available for the Overall Confidence analysis.

¹ Students are exempt if they meet "minimum mathematics requirements" such as HSC Mathematics Band 4 or Mathematics Extension 1.

² "The Higher School Certificate (HSC) is the highest award in secondary education in New South Wales" (Board of Studies Teaching & Educational Standards, 2015), while the Australian Tertiary Admission Rank (ATAR) "is a rank that allows students who have completed different combinations of HSC courses to be compared" for university admissions purposes (Universities Admissions Centre, 2015).

4.4.1. Topic/Session confidence

Students come to Learning Development on a voluntary ad hoc basis and so the number of times they attended during the semester varied greatly. In fact, there was a range of from 1 to 11 consultations given to each student. As well, often a variety of topics was discussed throughout each session, and so the variable *Topic Confidence* was replaced by *Session Confidence* (that is, confidence before and after each Learning Development consultation or “session”), as it was not possible to code all topics discussed, nor to separate these by any meaningful unit such as time. This was a little disappointing as it had been hoped to identify those topics with which the students seemed to have most difficulty.

Both the means and medians resulting from each student’s set of pre-support and post-support session data were calculated and paired sample t-tests applied. The results indicated there was a significant difference in these levels ($p < 0.001$, $\alpha = 0.05$), with the mean of pre-session confidence 2.32 and of post-session confidence 3.55, and the mean of their differences 1.23; the medians gave similar results, with the mean of their differences 1.196. The greatest difference in the medians was from 1 to 4 while the only decrease was from 3 to 2.5. These results are summarised in Figure 2 and Table 1:

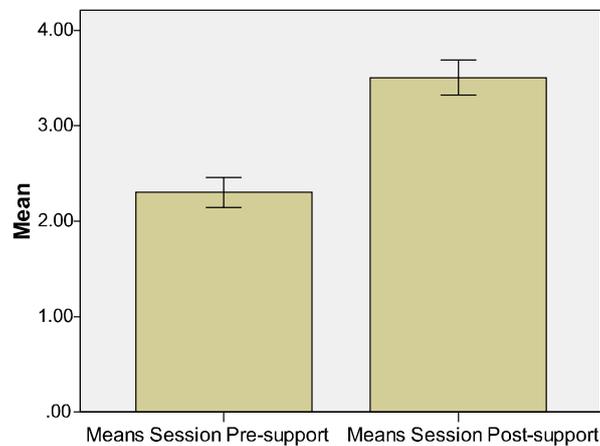


Figure 2. Means of session confidence pre-support and immediately post-support (Error Bars 95% CI). (1 = Zero confidence; 2 = A little confident; 3 = Neutral; 4 = Fairly confident and 5 = Absolutely confident.)

Table 1. Session confidence medians using the same scale as given in Figure 2 ($N = 82$).

Medians	Pre-support session confidence	Post-support session confidence
Minimum	1	1.5
Maximum	4	5
Median	2.38	3.57

Of course it could be argued that students *would* feel more confident immediately after receiving assistance, but this may not always be the case as sometimes a student may still feel confused about a certain aspect of a concept. Moreover, especially if they were due to face a forthcoming assessment task, there could still be some nervous apprehension which may outweigh any perceived short-term gain in confidence.

4.4.2. Overall mathematics confidence

Because the number of students who initially responded to the investigation into their overall mathematics confidence after receiving the support was small, it was decided to include all data

received, no matter the timing or method of collection. Analyses of all cohorts' data were compared to ensure consistency between results obtained from each data collection method. Sixty-five students' information was included in this analysis.

The mean of pre-support overall confidence levels was 2.54 (i.e. between *a little confident* and *neutral*) and of post-support confidence was 3.54 (i.e. between *neutral* and *fairly confident*), with the mean difference being 0.997. Paired-samples t-tests indicated a significant increase in students' overall confidence ($p < 0.001$, $\alpha = 0.05$). The largest increases were from 1 to 4 and 2 to 5; notably there were three decreases. Many factors may influence changes in students' confidence, and it is impossible to determine the extent to which Learning Development's support in particular might have contributed to these increases. Nevertheless, the qualitative feedback (included as Appendix A) suggests that it could have had a positive impact in many instances, and the improved confidence is indeed encouraging.

4.4.3. Confidence in applying mathematics in the chosen profession

Students were also asked, at the end of the semester, to rate their confidence in applying mathematics in their future profession. Although no significant relationship was found between confidence levels and subjects, the moderate correlation (0.61) between students' overall confidence (post support) and confidence in applying mathematics in their chosen profession was significant at the 0.01 level. This is illustrated in Figure 3.

4.4.4. Post support confidence, overall and by topic/session

A weak correlation of 0.36 was found between the post-support levels of confidence overall and by session (significant at the 0.01 level) – see Figure 4. Further investigation could perhaps be done by looking more specifically at individual topics rather than at whole sessions.

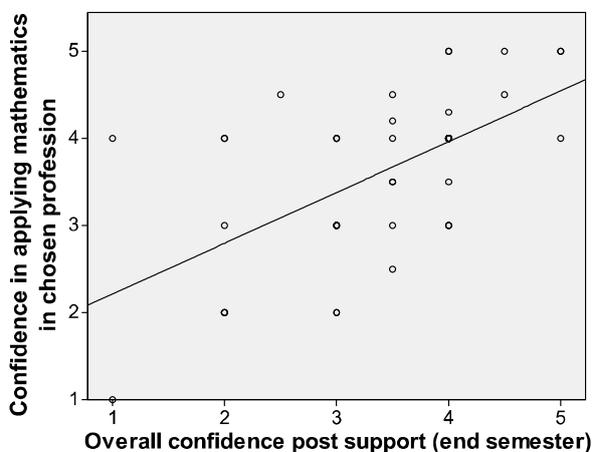


Figure 3. The relationship between students' overall confidence post-support (end semester) and confidence in applying mathematics in their chosen profession. (Because of low numbers of responses to this question, $N = 54$.)

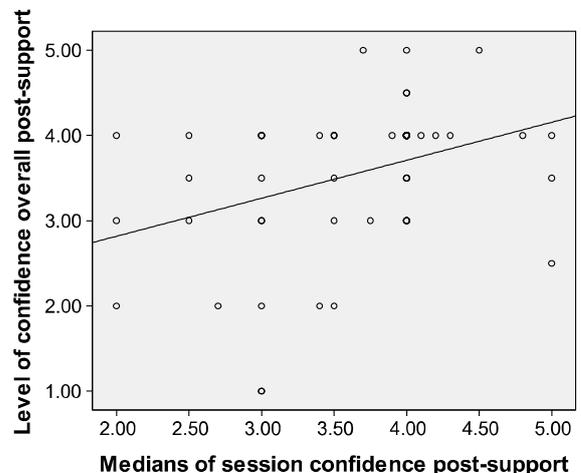


Figure 4. The overall mathematics confidence post-support compared to the medians of each post-support session confidence ($N = 64$).

4.4.5. Post-support overall mathematics confidence and faculty, subject, and gender

No significant relationships were found between overall confidence and faculty or between overall confidence and subject at the beginning or end of the semester. There was also no significant relationship between overall confidence and gender at the beginning of the semester; however, a Mann-Whitney analysis did show a significant difference between male and female students in their confidence at the end of the semester ($p = 0.024$, $\alpha = 0.05$), with males (mean 3.8) showing higher confidence than females (mean 3.37).

4.4.6. Mathematics confidence and Examination/Semester Results

Again, low numbers of students responded to the question about results and only 54 students' data was available for this analysis. Interestingly, no significant correlation was obtained between either students' overall confidence in mathematics at the end of the semester and their subject results, or their confidence in applying mathematics in their chosen profession and their subject results.

4.5. Results "Part 2" – Autumn 2014 (Primary Education students only)

Tests administered were identical to 2013. The results very much mirror those of "Part 1" in all respects and are presented as Appendix C.

5. Discussion

5.1. Problems found with the project

1. It was both unusual and disappointing that Primary Education student numbers were so low in 2013. However, it was essential to include these students in the project as it is well-documented in the literature that teachers, especially at the Primary Education level, who have little confidence in their own ability with mathematics are likely to pass this on to their students (Bibby, 2002; Hodgen & Askew, 2007), thus possibly perpetuating the cycle of poor confidence in mathematics in general.
2. The problem in obtaining data for the overall confidence level at the end of both semesters has been discussed above. Moreover, the process of emailing students (in 2013) itself had issues of privacy, breaches of which may have been perceived by students; responses may not have been as impromptu as if students were handed a form immediately by the Administrative Assistant; and there could have been some difficulty in actually completing the form online (a *Word* document). Some students do not regularly read their university email (anecdotal evidence) and several students who returned for support in Spring semester confessed they had ignored the emails sent by Learning Development. The person who eventually telephoned students needed two full mornings (separated by a week) on which to gather most of the information. She did report, however, that the response from students was positive, that most students were happy to talk about their support and were very forthcoming with comments.
3. The subjective nature of the Likert scale may generate a different interpretation by each participant. Many students ranked their confidence with the integer values on the scale but several chose somewhere vague in between. A small error was also noticed when coding the data: "1" had been used as the lowest value but had been termed *Zero confident*. This may have led to students who recorded this level of confidence regarding it as '0' and thus possibly distinguishing the levels incorrectly. Some students also used a range to illustrate their confidence level; for analysis purposes, it was determined to code these as the highest value of that range.
4. Analysing the differences in confidence levels only may not be an effective indicator of the improvement (or decline) in a student's confidence. For example if a level rose from 1 to 2, is that as powerful as, or less/more powerful than an increase from 4 to 5, say? And how does a student rate their confidence anyway? They had just received a session of tutoring in concepts in which they had not been confident and in which they had sought assistance. But they had not been formally assessed and so both their pre- and post-support levels of confidence may have been a vague feeling only rather than a considered response.
5. There were some administration problems where forms were not completed each session and there was often a 'pre' without a 'post' or vice versa so that the session could not be counted. The Administration Assistant also reported that sometimes students grew tired of completing the forms for each session and their answers possibly were unrealistic on those occasions. There was also one questionnaire (SurveyMonkey) completed by a student who had not actually participated in the project!

6. The personality and/or attitude of students could have played a part. The data collection was supposed to be unbiased, especially in its administration, but even with this care taken, still some students told their lecturer, for example: ‘Don’t worry ..., we’ll give you a good report’. More than once an explanation of the importance of their own true opinion was necessary!
7. Form D, the telephone enquiry and the 2014 SurveyMonkey questionnaire gave students the opportunity to comment on any aspect of the support they had received. Unfortunately, some students talked about the course (and course lecturers!) instead. However, this is the qualitative data that the project organisers were hoping for and all the comments received are included as Appendix A. Most were extremely positive and praising of the support; only one negative comment was received from all 65 students, but this post-graduate student had most likely been misinformed about the level of support offered through Learning Development and during the consultation the lecturer had re-directed him/her to the more appropriate Statistical Consultancy service which is available to both staff and post-graduate research students.
8. Of course, those students who did not respond either to emails or phone calls may have had decidedly different comments from those collected and overall levels of confidence that differed from those used in the analysis. To avoid potential bias, it may have been appropriate to try to reach these students by other means, such as ‘snail mail’ (S. Laursen, conversation, November 25, 2013; unreferenced). Although the analysis was carried out using 64 out of a possible 83 students (77%) in the first instance, this is still a limitation of the study, especially for the 2014 data which used only 17 responses out of 45 participants (37%).
9. A particular disadvantage of the makeup of a Learning Development support session, for this project, was the virtual impossibility of discerning each student’s change in levels of confidence in a specific topic. In fact, the topic for which a student had indicated they were seeking support in a particular session may not even have been covered during that session – the nature of mathematics being sequential, prior topics may have taken up the whole hour. Further, the student’s interpretation of ‘topic’ was often very broad, ranging, in some instances, from ‘maths’ to the name of their mathematics subject! Often the ‘topic’ was a specific question on a tutorial or workshop sheet which was made up of several components representing different ‘topics’. The recent introduction of Learning Development’s database in which lecturers are able to code topics covered during each session has been beneficial in reporting to course lecturers any concepts students misunderstand; however it is still very difficult to isolate students’ confidence in each distinct topic area.
10. The question also needs to be asked about transfer of confidence from one topic to the next (S. Worsley, conversation, November 25, 2013; unreferenced). Can we be sure that once a student gains confidence in a certain topic this confidence will be retained, and does that confidence in turn affect the level of confidence for a topic yet to be studied? However, this information would be difficult to collect. A Learning Development session really needs to flow for the student and the necessity to answer questions about confidence in each topic would be too disruptive.

5.2. Benefits achieved by the project

5.2.1. Student comments

At the time the project was implemented, Learning Development had limited means of collecting suitable data to be used for demonstrating its impact for students. Thus the comments obtained from students alone were extremely valuable (please see Appendix A). In the two implementations of the project, only one negative comment was received, out of a total of 87 (65 in 2013, 12 in 2014). This is very useful in reporting as it demonstrates, from the students’ points of view, just how Learning Development has helped them. Comments also vary in their content; some look at the student’s understanding of the subject while others concentrate on assessment results. Many students noted a gain in confidence and others that their understanding had im-

proved. The comments are, in the main, very positive about the support received, with several students bemoaning the availability of only one hour per week.

Because comments are “officially” recorded, they are easier to present as data than an email here or a “thankyou card” there! They may also help overcome the difficulty of inferring that Learning Development has helped improve students’ confidence or even results. According to MacGillivray and Croft (2011), “causality does not need to be claimed for improvement in performance data to have impact, particularly as readers will tend to infer causality based on context, even when the results are presented in neutral ways” (p. 201).

5.2.2. Education students’ confidence in applying mathematics within their profession

By far the majority of Primary Education students who completed the last part of the data collection chose “4” (*Fairly confident*) as their confidence level for applying mathematics in their chosen profession (10 students) with two students choosing “5” (*Absolutely confident*) and no students choosing “1” (*Zero confidence*); the median was also 4 and the mean 3.69. Only 6 students recorded no change in their confidence levels (and one of these students’ pre-support levels was already 4). This may illustrate that all these respondents had at least begun the journey of thinking of mathematics in a more positive light. Of course these numbers are small; however the results are encouraging for the students’ further development. As Hodgen and Askew (2007) state: “for many primary teachers, their relationship with mathematics is fraught with anxiety and emotion, much of it relating to their negative experiences of school mathematics” (p. 469). Perhaps the first step for these potential teachers was to seek help through Learning Development – they had realised that they had little confidence in the subject and may feel ashamed when faced with teaching content of which they had little understanding themselves (Bibby, 2002).

6. General discussion

Taylor and Galligan (2006) recommend that students be encouraged to reflect on their attitudes towards mathematics. This is especially important for teachers whose teaching methods need to be attractive for their own students; they need to “create a positive classroom environment that encourages students to have a go without fear” (Buckley, 2011, p. 3). The project may have been beneficial in this regard as it may have alerted students to think about their attitudes.

It is interesting to speculate whether confidence can be used as an indicator of success in other disciplines. Is mathematics isolated in being the only subject which has such emotional issues for students? It certainly is often openly acknowledged by many as having negative associations; in fact, it can be thought to be “socially acceptable” to admit to not liking or being “good at” mathematics (Ramagge, 2010; Galligan, Wandel, Pigozzo, Frederiks, Robinson, Abdulla, & Dalby, 2013).

Can confidence necessarily be linked to “success”? This may depend on the definition one chooses to use of “success”: for the student, it may be as simple as being able to apply a mathematical concept with understanding, although of course in general most would probably acknowledge that their aim is to pass their course! For the university administration, “success” probably means that a student will eventually graduate – and become a “success statistic”. For the mathematics support lecturer, it can be the emotion felt on seeing that a student understands, retains that understanding of, and can apply, a concept about which they had asked for help. The words “now I see!” said by an individual student have more meaning than any set of crunched numbers! The problem is, of course, that for the mathematics lecturers’ positions to be maintained (especially those who are part-time casual), evidence which *proves* – or at least *implies* – “success” must be produced.

Further, does a student’s confidence necessarily mean that they fully understand the mathematics they have been studying and, for potential teachers, are able to competently transfer this knowledge to their students? There may be cases where confidence and results simply do not line up – over-confidence/under-performance or under-confidence/over-performance. On the other hand, those with more self-confidence may have a better attitude towards persevering with

a problem: Parsons, Croft, and Harrison (2009, p. 65) cite Warwick (2008), stating: “increasing student self-efficacy in itself improves student engagement in mathematics”, and surely those who have more self-confidence will be better able to become more independent learners.

Problems associated with the practical implementation of the project have been discussed. It is also worth pointing out the necessity for either the researcher themselves to have expertise in statistical analysis and statistical computing packages, or to have access to professional guidance in order to competently analyse the data obtained.

7. Conclusion

The paper has discussed why it is necessary for assistance to be available to students who have difficulty with mathematics needed for their undergraduate course. The method behind a project introduced to measure the impact of such assistance, together with results obtained, have been described and its benefits and challenges outlined. It appears that most students who participated in the project perceived a gain in mathematics confidence immediately after a consultation. There was also a perceived gain in confidence overall in mathematics. As well, students seen by Learning Development appeared, by the end of their support, confident in their ability to apply mathematics in their chosen profession. This confidence was independent of subject, faculty, and results. As “confidence in learning mathematics ... is a significant factor in shaping attitudes and achievement, and predicting performance” (Matthews, Hodgson, & Varsavsky, p.791), these are seen as favourable results from the project.

Students seek assistance from Learning Development for a variety of reasons. They also have their own ways of acknowledging the impact of this support. As a measure of the impact made by Learning Development lecturers, the success of the project may actually depend on those who it is imperative to convince of the worth of Learning Development’s support. It is impossible to measure accurately the part Learning Development lecturers play in the university retaining students, or even the grades obtained by the students themselves, as so many other factors come into play in students’ lives. It is vital, however, for students, especially those who are about to pursue a career in educating primary school children, to exhibit and maintain a high level of confidence in mathematics so that attitudes towards mathematics within society become more positive – as mathematics knowledge is essential for all “in their personal, work and civic life” (Australian Curriculum, 2014).

Graduates of any university should surely exhibit an understanding of fundamental mathematics concepts and be confident using mathematics as part of their everyday living as well as their future profession. If Learning Development lecturers have assisted this to become a reality then they have fulfilled the aim of the unit. From the results of this project it has been relatively simple to determine the trend of a rise in confidence in mathematics both overall and immediately after individual consultations with Learning Development. The project may have been even more simple, however, if, instead of painstakingly surveying students, lecturers were able to record students’ impromptu comments and to count the thankyou cards and boxes of chocolates received from them after a period of support – these statistics would surely be an accurate measure of the impact of Learning Development!

Acknowledgements

Grateful thanks to Mrs Leanne Emmett, because of whose efforts potential bias was avoided (at the main campus) as she instructed students in completing all the relevant paperwork which she also later collated. To Dr Kim Draisma, (former) Head, Learning Development, thanks for encouragement, support and ideas for the project. Thanks to Mrs Susan Dennett, Mrs Alison Sandwith and Mrs Kay Walters, Lecturers, Learning Development, UOW remote campuses, who contributed by both collecting data and with enthusiastic ideas and support. I express special thanks to Mrs Susan Dennett for her contributions. The assistance of Dr Marijka Batterham, University of Wollongong’s Statistical Consultant was also invaluable. To Mrs Julie Allan, thanks for her patient telephoning and success in obtaining a huge amount of data without which the project could not have been completed.

Appendix A. Student comments

2013 data

The following comments are published verbatim (with the exception of some criticism about the course itself). They have been left in random order to emphasise their spontaneity.

It was really useful because when I started Education I had really low confidence in Maths, but I still need to keep working on it.

I recommended [Learning Development Lecturer] to 2 or 3 people, one of whom got a D in ECON309 which I dropped out of. I think [Learning Development Lecturer] is really good. I understand limited resources but would have liked to have come more than once per week - it can be hard to build on skills. LD should target subjects with a high failure rate and ask lecturers for exercises so that students who come to LD could work on those.

Overall really beneficial - confirmed I was doing it right. But times when I was taken back to basics - sometimes I needed this to refresh knowledge, but sometimes it didn't need it and it wasted time - the hour went so quickly. Maybe there needs to be a prior assessment of the student's skills so tutor knows where student is at.

It was beneficial due to the one on one instruction which enabled me to go through it at my level.

Worthwhile

After seeing Learning Development about math tutoring after struggling with the business math subject. I feel much more confident with facing the subject now. I am currently studying a previously attempted math subject so I haven't got a result yet...

Staff were very helpful - helped me get over the line.

I have taken leave and will change degrees. Though LD help was quite good - just wasn't enough to get me through semester but no fault of theirs.

Really helpful - only regret was just having one session per week - could have come more. Unfortunately I rolled my ankle the week before exam and didn't do as well as I had expected.

It was good but would like to have been able to come more than once a week.

It was excellent. I didn't come many times but I think I did well because of it. I came with a friend and we felt very comfortable with [Learning Development Lecturer] - it just boosted our confidence to be able to talk about maths.

Even though my Major is not connected with Mathematics, still I will try to attend classes, they are very helpful.

I think it was a great opportunity - it put me at ease - before it was just too stressful. That extra one on one support made a huge difference.

The experience was good - it was a good team. I could have used more time there - felt a bit rushed and walked out door not totally grasping everything, but overall it was good.

Very helpful - they were good.

[Learning Development Lecturer] was fantastic - she made everything much easier to understand. When I tried to apply stuff from lectures by myself I was confused but she helped me really understand it

[Learning Development Lecturer] was really good - at the beginning I nearly dropped out but she helped a lot.

Due to illness I was unable to attend the final exam or last few weeks lectures which resulted in my TF however I felt much more confident in mathematics solely due to the assistance I received at Learning Development.

If I hadn't gone to LD I wouldn't have turned up for my exam. I felt stupid, but the help from LD showed me the learning material that I needed to know.

I found LD so helpful. The set up was perfect for me, having an hour one on one, and I've recommended it to several people.

It was quite good . It was basic stuff that I wanted to know and it has certainly helped me with calculations.

It was a good service - it was free and I could make appointment when I needed help.

The support that I have received from the Learning Development tutor has been a tremendous help in being able to grasp all of the areas that I was struggling with. I would not have achieved these results had it not been for her help. Thank you.

It's really good but you can only do it once a week - more often would be good.

[Learning Development Lecturer] is the only reason I passed my maths class, it was the best resource the uni could have offered

It would be good if they could have Maths support at [remote] campus.

I had [Learning Development Lecturer] and she was really good.

MATH151 has been deferred to Summer Session 2014/2015. Math support will continue thought the next three sessions until then. The Math support at L&D is highly recommended.

It was good - I went to LD and was helped.

It was only advertised once in MATH141 lectures but there is a high failure rate so it should be advertised more often.

Pretty helpful - helped cement my understanding.

Grateful for all help provided; helped to clarify issues that were covered at fast pace; easy to understand my tutor.

If I had started at LD earlier I would have got a better mark - the help I received really helped me to get the mark I got. I still have the knowledge I received and this has given me confidence for my future studies.

It does help.

Sought help in preparation for doing MATH142 in Spring semester - I thought LD was really good.

It helped clear things up.

Definitely helped with my hand in assignments, but I had severe test anxiety so the exam didn't work well for me.

I went to LD for help in understanding statistical methods for my PhD research . It was good - it helped to put me in the picture.

I'm confident in basic Maths but it is different to statistics. I've decided to change degrees to avoid having to do stats.

It was very, very helpful. I didn't go to LD at the beginning but it was a good opportunity to re-visit basic maths foundations.

I attended 2 times and I was not happy with the service because the consultant I saw said they were not at the level to help PhD students, she could only help undergraduates. I have since been getting help in Building 39.

Learning and Development offered a service that was VERY helpful for my statistics unit, only I believe I found the assistance too late, and was ill toward the end of semester and fell behind further than what I originally thought. This contributed to my overall end result. This semester I

have re enrolled in the unit whilst it is still fresh, so as to hopefully remember the work a little and know what is expected. (Went on to criticise the course.)

I used both LD and PASS and this enabled me to get such a good mark. [Learning Development Lecturer], who had also taught me at WCA, has a relaxed style and she taught me to explain each term and to work methodically, so that I know now how to solve difficult problems by breaking them into little pieces.

The LD help was good.

It was really helpful - without this help I wouldn't have got these marks and I wouldn't have understood the concepts as well as I did.

It was really good and helpful - I probably would not have passed without this help. I need the steps to be broken down and had failed EDKM102 in my first year.

I was happy with my result as I expected to fail. I had a lot of difficulties with my maths last semester and the support kept me going through a difficult start. I feel much more able to tackle the next maths module for next year.

For me Maths is always a challenge. LD assists me with self confidence, but I need more of [Learning Development Lecturer]'s help and will continue to see her through next semester. Without this help I wouldn't complete Nursing.

[Learning Development Lecturer] was a fantastic tutor, more than helpful and goes out of her way to make sure that everyone in the class gets the help they need. I really enjoy her tutes.

It is very useful.

Learning development has been essential for me to get the best mark I can. Although I may not have distinctions, the speed at which we are required to learn, and the fact that there are quite some gaps needed filling from many years of not practicing anything but basic maths. I am very appreciative of any help. I strongly weight my pass on the fact that I attended learning development. Without that help I would not have passed. I also have the opportunity to do a supplementary exam for another maths subject and I am very excited about that a because the topic for me was extremely difficult and the fact that I got so close to passing and will have the opportunity to resit is exciting for me, I still have the chance of a supplementary pass and with some more time I will be very good at this subject

I will continue to use this service and I expect over the comming months my confidence will increase dramatically,

It was very helpful for my computer skills

I think it is very good to have it available, especially at a small campus like [remote campus]. It was a small group and that was really important in the uni experience.

The LD help was fine. My regret was that there wasn't a designated Maths subject offered for-Commerce students like the Arts students have. That subject's timetable clashed with mine so I couldn't take it.

It was pretty good - really helpful.

It helped me gain a lot of confidence.

It was great - I got a bit out of it, really helpful.

I have loved seeing [Learning Development Lecturer] for maths support. She is friendly, warm, non-judgemental and supportive. She explains maths well, breaks down into an easy understandable way. I have learn't so much from [], I would recommend her to anyone.

I think the department is brilliant and without the assistance of the dept I would not have achieved the result I did.

It has been very helpful, I feel much more confident after my sessions with [Learning Development Lecturer]. The oncampus learning development is essential, lectures and a one hour tutorial is not enough.

I didn't finish exam so didn't do as well as expected but I felt I knew the work really well at the end of semester.

it's just helpful - [Learning Development Lecturer] is really good.

It's pretty good.

[Learning Development Lecturer] at [remote] campus is absolutely excellent - took me from where I was at to much more confidence.

2014 Data – Primary Education students only

it was extremely helpful. It simplified things I knew but showed me a new way of doing them

very helpful since I am from Germany and a mature student so I needed some support, thanks!

[Learning Development Lecturer] is a fantastic tutor and incredibly helpful

It was really useful to go to Learning Development to improve both my skills and my confidence in this subject. Thank you

I have never really been very confident in my maths skills and I have always had to work hard to be good at it. I found the Learning Development maths support worked very well for me, what I had found confusing at the beginning of the session was clear to me at the end of it. Everything was explained in easy, everyday language in a supportive environment. Thanks very much for your help!

The assistance provided by [Learning Development Lecturer] has been wonderful - nothing is ever too much trouble!

Really appreciate the individual tutoring provided to help support students. I was hesitant about returning to mathematics as this is my 6th year since studying it. Out of all subjects I was most nervous about teaching mathematics, particularly to higher years, but now feel very confident and numeracy was my best subject!

[Learning Development Lecturer] was incredibly helpful with the topics we covered last semester. Maths ended up being one of my highest marks so I was very pleased. I will definitely be seeking her help again this semester where needed. Thank you [Learning Development Lecturer]!!

It was helpful that you explained the concept from the beginning because I hadn't realised that I hadn't understood the underlying concept. Thank you!

The 1:1 support was really helpful. Being able to take things back to basics and have things explained simply, in a number of ways, helped me to feel more confident regarding primary maths I had forgotten and also was a good model for how to teach children maths. Thank you.

The session I attended was fantastic. It is a massive shame that we could only attend once a week I think it was, this shouldn't be the case. The other feedback I could provide is that although I came to the session with specific questions about mathematical processes and how to do the actual 'maths' in regards to this subject, that is only half the subject. The learning development would be even better if it catered for the educational theoretical side the numeracy subject as well as the actual mathematical processes. There was a lot to learn about this theory and

this help would have been quite useful

An excellent resource that provides hands on learning at your own pace. Personalised tuition.

APPENDIX B Survey Forms

University of Wollongong



PARTICIPATION INFORMATION SHEET FOR LEARNING DEVELOPMENT STUDENTS (MATHEMATICS)

Determining the levels of mathematics confidence in students who seek assistance through Learning Development at the University of Wollongong.

This is an invitation to participate in a study conducted by researchers at the University of Wollongong. The purpose of the research is to investigate the level of confidence in mathematics of students who seek support in mathematics topics.

If you choose to participate in the study we will ask you to rate your confidence before and after you receive support in a particular topic. You will also be asked to rate your confidence at the beginning of the semester and at the end of the semester after you have received your results.

Participation in the study is voluntary and you can withdraw your consent at any time in the project by contacting Lesley Wilkins (contact details below) or Leanne Emmett, Learning Development (42213977).

This study is supported by the University of Wollongong's Learning Development unit. The research will be used to inform and improve the quality of support provided in mathematics by the unit. The results of the project will also be published or presented in academic journals or conferences. Confidentiality is assured and you will not be identified in any part of the research.

This study has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the University of Wollongong Ethics Officer on (02) 4221 4457.

If you have any further questions regarding the study please feel free to call or email the following researcher:

INVESTIGATOR

Ms Lesley Wilkins

Learning Development

Room 207, Level 3, Building 11

University of Wollongong NSW 2500

02 4221 5523

lwilkins@uow.edu.au

Thank you for your interest in this study. Please sign the consent form (over) to indicate that you agree to participate in the research project.

University of Wollongong



CONSENT FORM FOR STUDENTS SEEKING SUPPORT IN MATHEMATICS THROUGH LEARNING DEVELOPMENT

Determining the levels of mathematics confidence in students who seek assistance through Learning Development at the University of Wollongong.

This is an invitation to participate in a study conducted by researchers at the University of Wollongong. The purpose of the research is to investigate the level of confidence in mathematics of students who seek support in mathematics topics.

If you choose to participate in the study we will ask you to rate your confidence before and after you receive support in a particular topic. You will also be asked to rate your confidence in mathematics both at the beginning of your support and at the end of the semester after you have received your results.

I _____ (please print your name) have read through the information provided by the researchers regarding this project and agree for the researchers to include my survey responses in the above-mentioned research project conducted by the University of Wollongong. I am also willing for data such as my age, gender and background level of mathematics to be used in this research.

I understand that this data will not identify me personally. I understand that I can withdraw this consent at any time throughout the study.

Signed: _____

Date: _____

PART A

Please do not proceed unless you have read the Participation Information Sheet and signed the Consent Form.

Please complete the following information:

Campus: _____ Date: _____

Student number: _____ (This will not be used to identify you)

Faculty: _____

Mathematics subject (eg MATH151; EDGD815) _____

Age: _____

Gender: M

F

If this is the first year you are studying a mathematics subject at the University of Wollongong, how many years is it since you studied maths at school? _____

Final level of mathematics studied at school: _____

Result: _____

ATAR or equivalent score: _____

How confident are you overall in mathematics?



1

2

3

4

5

Zero

A little

Neutral

Fairly

Absolutely

confident

confident

confident

confident

PART B

Please do not proceed unless you have read the Participation Information Sheet, signed the Consent Form and completed PART A.

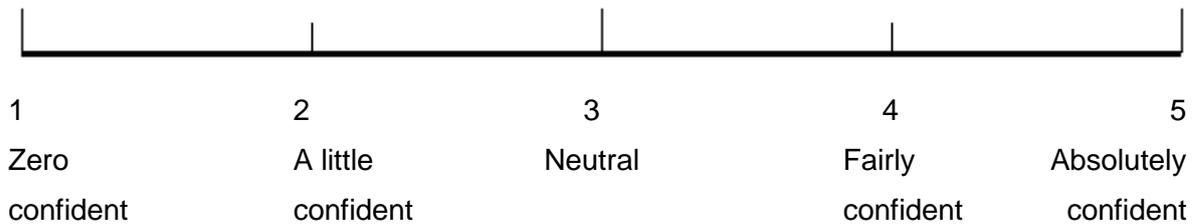
Campus: _____ Date: _____

Student number: _____ (This will not be used to identify you)

If this is not a one-to-one session, please write the number of students: _____

What topic are you looking for help in at this Learning Development mathematics support session? (If more than one, please list the main one.)

How confident are you in this topic?



PART C

You have just completed your Learning Development mathematics support session.

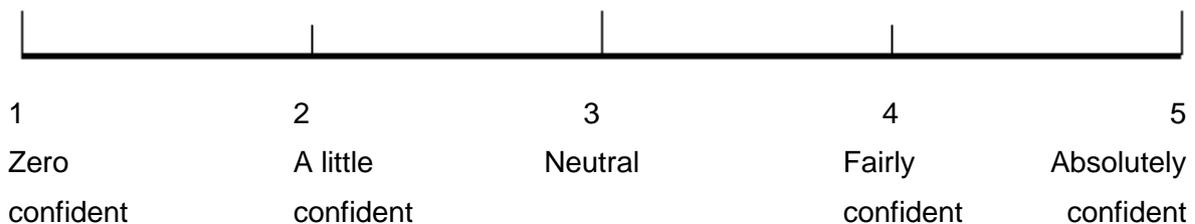
Campus: _____ Date: _____

Student number: _____ (This will not be used to identify you)

If this was not a one-to-one session, please write the number of students: _____

What topic were you looking for help in at this Learning Development mathematics support session?

How confident are you in this topic now?



THANK YOU!

PART D

End of semester

Campus: _____ Date: _____

Student number: _____ (This will not be used to identify you)

You have just completed your semester and received your results. Please list your Mathematics mark/result: _____

How confident are you overall in mathematics?



1	2	3	4	5
Zero	A little	Neutral	Fairly	Absolutely
confident	confident		confident	confident

How confident are you about applying mathematics in your chosen profession?



1	2	3	4	5
Zero	A little	Neutral	Fairly	Absolutely
confident	confident		confident	confident

Would you like to make any comments about Learning Development mathematics support?

THANK YOU!

APPENDIX C Data analysis

Part 2 Autumn 2014

Data was analysed using *Excel* and *SPSS*. Forty-six students participated in all, comprising the following: main campus: 44 students (approximately 75%); other campuses: 2. All except 3 participants were female, however none of the male students returned the final survey and so their results have been discarded for that part of the analysis. Ages ranged from 17 to 53, (mean age 26.7; median 24). Three subjects were represented: 14 students were studying the compulsory mathematics course for Primary Education students who had not the required level of mathematics from HSC or equivalent entry, while the remainder of the students were doing a subject from the Graduate Diploma of Education.

Again the question asking for students' years since school or since they last studied any form of mathematics was poorly answered, as was the ATAR/HSC result and it was not possible to analyse this data. A total of 19 responses only were received for the required final data collection (overall confidence and confidence in applying mathematics in the future profession) of which 2 had to be discarded because of incomplete data and therefore only 17 responses could be analysed for the Overall confidence results.

Topic/Session confidence

Many of the students attended during this semester in small groups rather than individually. This was probably because the Graduate Diploma subjects were delivered intensively, with students completing the subject in a matter of weeks, full-time, rather than the subject spread out over the semester. Group dynamics were, in the main, excellent, as students worked with each other and the Learning Development lecturer acted more as a facilitator. However, as Learning Development sessions are restricted to an hour per week, regardless of whether that hour is as an individual consultation or as a group, students' numbers of sessions attended were necessarily reduced. Many students only attended one or two sessions; the maximum was 7.

Again, the term *Topic Confidence* will be replaced by *Session Confidence* (that is, confidence before and after each Learning Development consultation or "session").

Both the means and the medians resulting from each of the 44 students' set of pre-support session and post-support session data were calculated; both the means and the medians in each student's levels of confidence pre- and post-session were then looked at and paired sample t-tests applied. The results obtained indicated that there was a significant difference in these levels ($p < 0.001$, $\alpha = 0.05$), with the mean of pre-session confidence 2.47 and of post-session confidence 3.69, and the mean of their differences 1.21; the medians gave similar results, with the mean of their differences being 1.17. These results are summarised below.

Table 2. Session confidence medians (Autumn 2014, Primary Education students, $N = 44$).

Medians	Pre-support session confidence	Post-support session confidence
Minimum	1	2
Maximum	4	5
Median	2.5	4

Overall confidence

Seventeen students' information was used for this analysis. For overall confidence, the mean of pre-support confidence levels was 2.5 and of post-support confidence was 3.35, with the mean difference being 0.853. Paired-samples t-tests indicated a significant increase in students' overall confidence ($p < 0.001$, $\alpha = 0.05$). The largest increases were from 2 to 4 and there were no decreases.

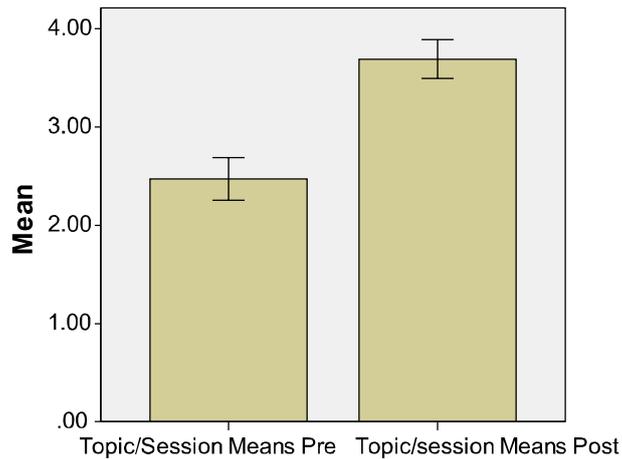


Figure 5. Means of Topic/session confidence pre- and post-support sessions on a five point scale (1 = zero confidence, 3 = neutral, 5 = absolutely confident), Primary Education students, Autumn 2014 (Error bars 95% CI).

Confidence in applying mathematics in the chosen profession

The moderate correlation (0.65) between students' overall confidence (post support) and confidence in applying mathematics in their chosen profession was significant at the 0.01 level.

The fact that both the median and the mode of students' confidence in applying mathematics in their chosen profession of Primary School teaching was 4 (i.e. *fairly confident*), with no student admitting "Zero confidence" could indicate that these students will approach their mathematics teaching with positivity.

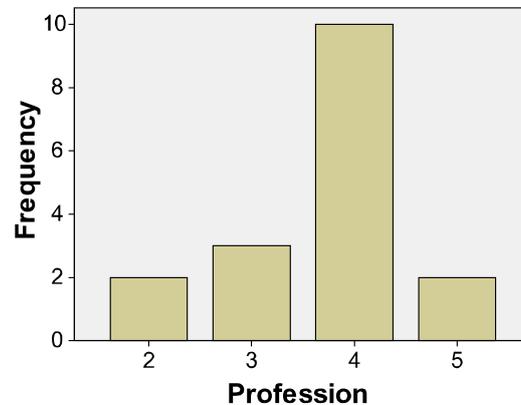


Figure 6. Primary Education students' confidence in applying mathematics in their chosen profession. (1 = Zero confidence; 2 = A little confident; 3 = Neutral; 4 = Fairly confident and 5 = Absolutely confident.)

Post support confidence, overall and by topic

Sixteen students' data were used in this analysis as there was data missing from one student's values. A weak correlation of 0.34 was found between the post-support levels of confidence overall and by session but this was not significant.

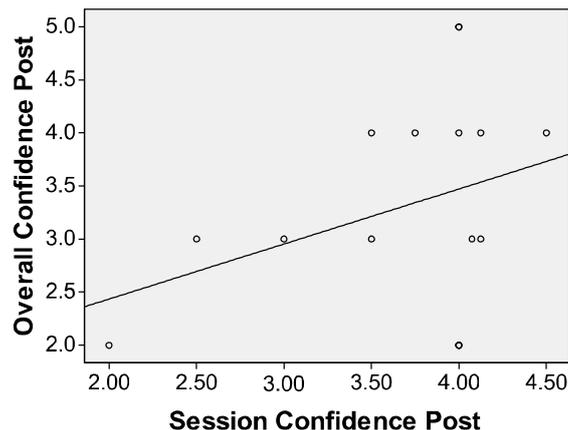


Figure 7. Scatterplot overall confidence post-support vs Session confidence post-support (N=16).

Confidence and Examination/Semester Results

Only 15 students' data was available for this analysis as one student withdrew before the final examination. In addition, some students reported grades rather than marks which were included by using the lowest possible mark for that grade. Interestingly, although no significant correlation was obtained between students' examination results and their overall confidence with the 2013 cohort, there was a significant correlation for the Primary Education students of 0.68 ($\alpha = 0.01$).

Confidence and Number of Sessions Attended

There was no correlation between either students' overall confidence or post-session confidence and the number of sessions of support students attended. This is perhaps disappointing from the point of view of reporting Learning Development's impact.

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