

## **Supportive frameworks that increase mathematical knowledge and confidence in students enrolled in bridging mathematics courses.**

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### **Abstract**

Internationally, universities are changing the focus of their undergraduate degrees, increasing enrolments and broadening participation. As a result, non-traditional students who would once have been excluded from university studies are now being accepted. As expected, these changes are not without consequences, and one is left asking “How do we adequately prepare non-traditional students academically and increase their confidence enabling them to cope with undergraduate study?” Preparatory mathematics courses that follow adult learning principles can both provide content knowledge and increase confidence. A study conducted by CQUniversity Australia (CQU) examining students’ mathematical confidence prior to and after completing at least one Transition Mathematics course, found students reported a reduction in their fear of mathematics. Courses with supportive frameworks, containing formative assessment and prompt feedback, are essential for ensuring students are engaged and understand the course content. Course scaffolding and support also increase student confidence in mathematics which in turn benefits academic progression.

**Keywords:** Tablet PC, Bridging Mathematics, Mathematics Confidence, Preparatory Mathematics, Mathematics knowledge gaps

### **1. Introduction**

Equity, quality and efficiency are internationally considered to be essential measures of a higher education system and as such equity has become a focus for higher education policymakers (James, 2012). There is, therefore, a global trend toward increasing enrolment rates and broadening participation, especially for low socioeconomic status and mature aged students. Within Australia changes have resulted from the Review of Higher Education (Bradley Report) recommending “that the Australian Government set a national target of at least 40 per cent of 25 to 34 year-olds having attained a qualification at bachelor level or above by 2020” (Bradley, Noonan, Nugent, & Scales, 2008, p. xviii).

Sursock and Smidt (2011, p. 6) found higher education within Europe in the past decade had been affected by a number of changes, “including higher rates of participation, internationalisation, the growing importance of knowledge-led economies and increased global competition”. In response to these changes two key European policies: the Bologna Process and the Lisbon Strategy, including the Modernisation Agenda for Universities, have

been implemented. An increasing number of Higher Education Institutes in Europe are attracting and teaching a more diversified student body, and introducing more inclusive and responsive policies (Sursock and Smidt, 2011).

Berdahl, Altbach, and Gumport (2011), looking at the American higher education system in the twenty-first century, noted the change from an elite system to a mass system of education. In Egypt, Cupito and Langsten (2011) found that the number of females from poor families increased during the period from 1988 to 2005, though young adults from wealthier families still maintained the advantage when it came to obtaining higher education places, despite governmental efforts to improve inclusiveness.

The global trend to increase enrolments and accept a broader range of students is resulting in a “much greater diversity of numeracy, mathematical skills and knowledge backgrounds across tertiary cohorts” (MacGillivray, 2008, p. 15). The mathematics deficit exhibited by students entering university is “symptomatic of a general denial of mathematics for more than a decade, the consequences of which must now be acknowledged and faced by all types of universities” (MacGillivray, 2008, p. 27). Within Australia the demographic of university students is changing due to social and economic environment fluctuations, which resulted in the Australian Government developing a vision of a socially inclusive environment (Department of Education, Employment and Workplace Relations (DEEWR), 2010). This vision emphasises the importance of higher education and has resulted in a number of monetary incentives aimed at increasing the education participation rate of mature-aged students and students from low socio-economic backgrounds (Council of Australian Governments (COAG), 2009).

CQUniversity Australia (CQU) has been consistently recognised as having one of the highest low socio-economic participation rates amongst Australian universities (approximately 43%) and was awarded five stars for indigenous participation and cultural diversity of the student body (Good Universities Guide, 2011). In a 2011 ‘I’m all ears’ Student Forum, the CQU Vice Chancellor, Scott Bowman, acknowledged that opening the doors to more students must be accompanied by appropriate academic support (Bowman, 2011). To assist the transition of this ‘non-traditional’ demographic into university, CQU provides a single enabling programme Skills for Tertiary Education Preparatory Studies, (STEPS) to prepare students for entry into university, regardless of their former skills and educational achievements. This programme can be tailored to suit the student’s individual needs and desired undergraduate programme. This paper is primarily concerned with the mathematics component of the enabling programme.

## **2. Transition Mathematics Courses**

CQU offers three levels of Transition Mathematics courses to prepare students for their chosen undergraduate degree.

- Fundamental Mathematics for University (FMU) is a course in elementary mathematics, designed to have the student commence work on the foundation concepts, rules and methods of basic mathematics. The main aim of this course is to provide students with a refresher in the fundamentals of basic mathematics, which are necessary to develop

mathematics as a unified body of knowledge. Modules include: the study of mathematics; operations; percentages; introductory algebra; solving algebraic equations; introductory statistics; exponents; graphs and linear equations; and units and conversions.

- Intermediate Mathematics for University (IMU) is an intermediate preparatory course designed to follow on from FMU and is a pre-requisite for Technical Mathematics for University. IMU contains five core and four elective modules with the choice of electives governed by students' future study plans. Modules include: simultaneous equations; inequalities and absolute values; quadratics; logarithms; functions; geometry; trigonometry; series and sequences; variation, ratio and proportion; statistics and standard deviation; probability; finance; and annuities.
- Technical Mathematics for University (TMU) is a technical preparatory course designed to follow on from IMU. The combination of IMU and TMU provides a mathematical foundation similar to Queensland Mathematics B and satisfies the prerequisite requirements for engineering and applied science. Modules include: additional algebra; trigonometric functions, ratios and graphs; plane and analytical geometry; vectors; differentiation; and integration.

### **3. Distance Offerings of Transition Mathematics Courses**

Approximately 78% of students enrolled in the CQUniversity Transition Mathematics courses study by distance (externally). Following a similar trend to the rest of the university, pass rates for students in distance Transition Mathematics courses have experienced a slight rise over the past few years.

Harry (2003) notes that in many countries over the past thirty years, distance study has moved into the mainstream of higher education. According to MacKeogh and Fox (2009, p. 147) "one vision of the future of universities is that virtualisation and remote working technologies will enable us to study at any university in the world, from home". As universities are pressured to implement eLearning technologies into mainstream higher education, the Tablet PC provides the opportunity to achieve this.

The diverse mathematical backgrounds of students enrolled in Transition Mathematics courses pose difficulties for course developers. These difficulties are exacerbated when delivering programs externally, which was the mode of delivery for students in this study. Although students are provided with extensive resources in the form of Study Guides and detailed textbooks, it is extremely difficult for some students to learn from text-based materials, especially when their mathematical background is limited. Additionally, many bridging students struggle with learning mathematics by distance and miss having a teacher. "The nature of mathematical sciences dictates that students need to hear the instructor explain the concepts and ideas" (Amin & Li, 2010, p. 47).

In order to overcome known difficulties and provide a quality learning environment, Transition Mathematics' course developers are guided by the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamsen, 1987) that are endorsed by the

CQUniversity Academic Board. According to the Seven Principles, good practice in undergraduate education:

1. Encourages contact between students and staff
2. Develops reciprocity and cooperation among students
3. Encourages active learning
4. Gives prompt feedback
5. Emphasises time on task
6. Communicates high expectations
7. Respects diverse talents and ways of learning.

Through the use of discussion forums set up on the Learning Management System (LMS) and through regular email contact from markers and course coordinators, distance students are fully supported. FMU distance students often seek the support of fellow students and ask questions via discussion forums. The forums are also regularly monitored by Mathematics staff who answer queries and check that student responses, when provided, are correct.

The Mathematics staff adopt a constructivist approach, viewing the learner as the centre of knowledge creation, with knowledge being constructed through the learner's experiences, actions and activities (Hadjerrouit, 2007; Lee, 2009; Oliver, 2004). Electronic study guides (ESGs) provide direction for the learners and encourage them to engage with the content. Students are further driven by tasks and problems to engage with the content and discover things themselves. In the online environment, we have incorporated a number of innovations designed to provide the same kind of scaffolding that is available to students in face-to-face situations, including PowerPoints<sup>®</sup> or slides, discussion boards, readings and instructional videos. Students greatly appreciate the ease afforded by the ESG.

#### **4. Electronic Study Guide (ESG)**

The ESG contains the entire set of course resources and can be accessed through the Learning Management System (LMS - Moodle) and/or via CD/DVD. Hargreaves and Jarvis (1998, p. 200) explain learning as "a planned process to modify attitude, knowledge or skill behaviour through learning experience to achieve performance in an activity or range of activities". The ESG enables students to easily navigate their way through the course, all with the click of a mouse. It is designed to provide students with weekly tasks to keep them on track with their studies. As the student works through the week's instructions they are able to read the relevant sections of the textbook; watch instructional videos; complete and check textbook examples; and when they finish a module they can easily access a corresponding sample test (with worked solutions) before accessing, completing and submitting a formative test for marking and feedback. All of this is facilitated by hyperlinks within the week's instructions (see Figure 1).

Transition Mathematics 1 External

START

**START**

Welcome to the preparatory course Transition Mathematics 1 External A (TM1A) and Transition Mathematics 1 External B (TM1B). I hope that your studies are enjoyable and assist you in achieving your educational goals. I am the course co-ordinator for these courses and so will be marking your tests and generally providing any assistance you may require. However, if I am not available, other staff members at the Academic Learning Services will also provide assistance as needed. As you are working through the material provided, please do not hesitate to contact me at any time. Often one phone call or a quick note can save you lots of time and much frustration. Sometimes it is nice just to speak to someone about your work and how you are progressing. All the contact details are on the [Contact Information](#) page. Over the years, the Academic Learning Services has been assisting students at all levels so we are aware of many of the difficulties and problems that can arise. Our role is to help you overcome any obstacles you may encounter as you continue with your study of mathematics.

I look forward to hearing from you and receiving your first End of Module test. For quickest 'turnaround' you may [fax or email](#) it to the Rockhampton Campus. Meanwhile, I wish you every success with your studies.

To start Transition Mathematics 1 External A (TM1A) press [TM1A](#)

To start Transition Mathematics 1 External B (TM1B) press [TM1B](#)

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Transition Mathematics 1 External

TM1A - Week 1

**TM1A, Week 1**

Tasks	Task Description
One	Read Course Profile Transition Mathematics 1 External A.
Two	Take a look at the course CD and Online Course web site: ( <a href="http://e-courses.cqu.edu.au/">http://e-courses.cqu.edu.au/</a> ) <ul style="list-style-type: none"> <li>The CD has a <a href="#">video presentation of the Course Profile</a></li> <li>The CD contains this <a href="#">Study Guide</a>, video presentations, sample tests and solutions and <i>Transition Mathematics 1 - Introductory Mathematics</i> textbook.</li> </ul>
Three	Scan through this CD and the Study Guide.
Four	Read sections A, B, C, D, E and F from STMA Module. <ul style="list-style-type: none"> <li>These sections discuss study tips for learning mathematics.</li> </ul>
Five	Complete sections G, H, I, J, K, L and M from STMA Module. <ul style="list-style-type: none"> <li>Read sections G, H, I, J, K, L and M from STMA Module.</li> <li>Watch video presentations on sections A to G, H, I, J and K for STMA (Week 1, Study Materials).</li> </ul>

Transition Mathematics 1 External

Example 1: Solve for  $x$ , the equation  $\frac{x-3}{6} + \frac{x-1}{3} = \frac{1}{2}$  (6 marks)

$$2(x-3) + 2(x-1) = 6 \times \frac{1}{2}$$

$$2x - 6 + 2x - 2 = 3$$

$$4x - 8 = 3$$

$$4x = 11$$

$$x = \frac{11}{4}$$

Transition Mathematics 1 External

Example: Solving Algebraic Equations - Fractions

$$\frac{x+3}{2} = \frac{3x-1}{4} \quad \text{c.o. 4}$$

$$2(x+3) = \frac{3x-1}{1}$$

$$2(x+3) = 3x-1$$

$$2x = 3x-1$$

$$-x = -1$$

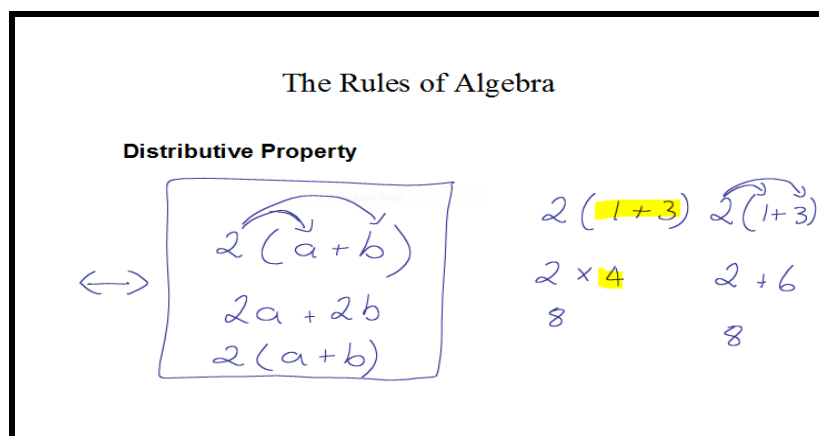
$$x = 1$$

**Figure 1:** Electronic Study Guide (ESG)

4.1. Videos

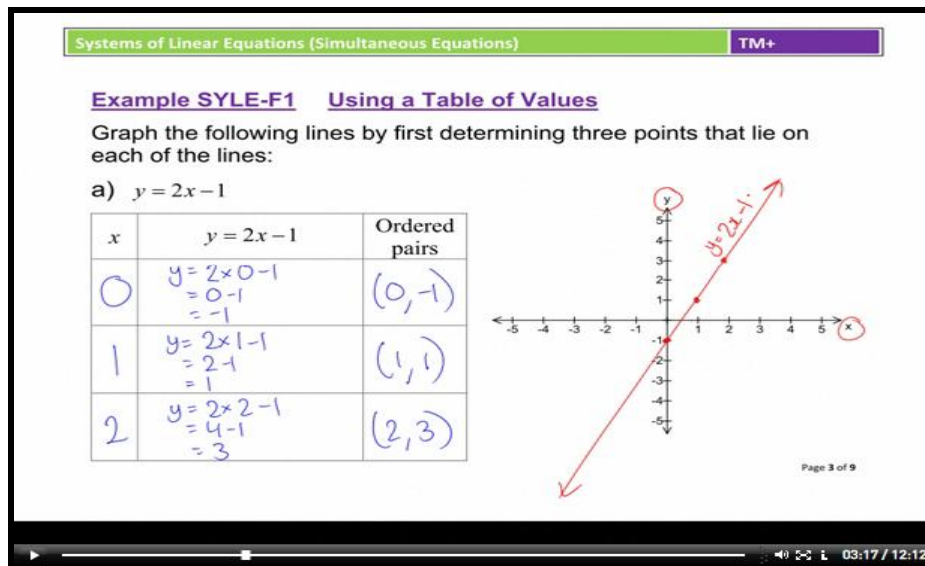
Mathematical videos enable the student to hear and see the mathematics unfold, providing instruction similar to that given in a class situation. The lecturer not only explains the concepts and ideas but also the mental processes involved in problem solving. Robson, Abell, and Boustead (2009) highlight the importance of students being able to mentally plan a sequence of strategic decisions when forming a strategy for solving equations.

Videos to support the content covered in Transition Mathematics textbooks are supplied to all distance students. FMU and IMU students are provided with full video support while TMU offers partial video support with staff currently working toward increasing this. Microsoft PowerPoint® or Microsoft Word® are used to create the video slides. Although some researchers believe it is more authentic to have handwritten slides (Harrison, Pidcock, & Ward, 2009), it is less time consuming to use the textbook files to create the outline of the slides. This also provides a connection to the textbook for students. The staff member then converts these slides to an Adobe® PDF document and inks directly onto the slides (using PDF Annotator® or Adobe Acrobat Pro®) whilst recording the screen using Camtasia®. An example of a slide template with annotations is provided in Figure 2.



**Figure 2:** An example of a Microsoft PowerPoint® slide, with annotations, prepared for FMU (2007).

Whereas some staff choose to record the sound simultaneously, others add the sound as a narration after the video has been created. Once the video has been created, any necessary editing is conducted and the video is rendered as a Flash® or Windows Media Player® file. These videos are provided to students as part of the ESG via the LMS or on a CD/DVD. One added benefit of creating slides using Microsoft PowerPoint® or Microsoft Word® is that they can be used for face-to-face lectures as well. Additionally, using a program such as Microsoft Word® to create the slides provides the capability to make slides visually stimulating, whilst also allowing for the creation of a theme for the different modules (through the use of headers, footers and colour). A Microsoft Word® slide with annotations is provided in Figure 3 and can be compared with a previous version in Figure 2.

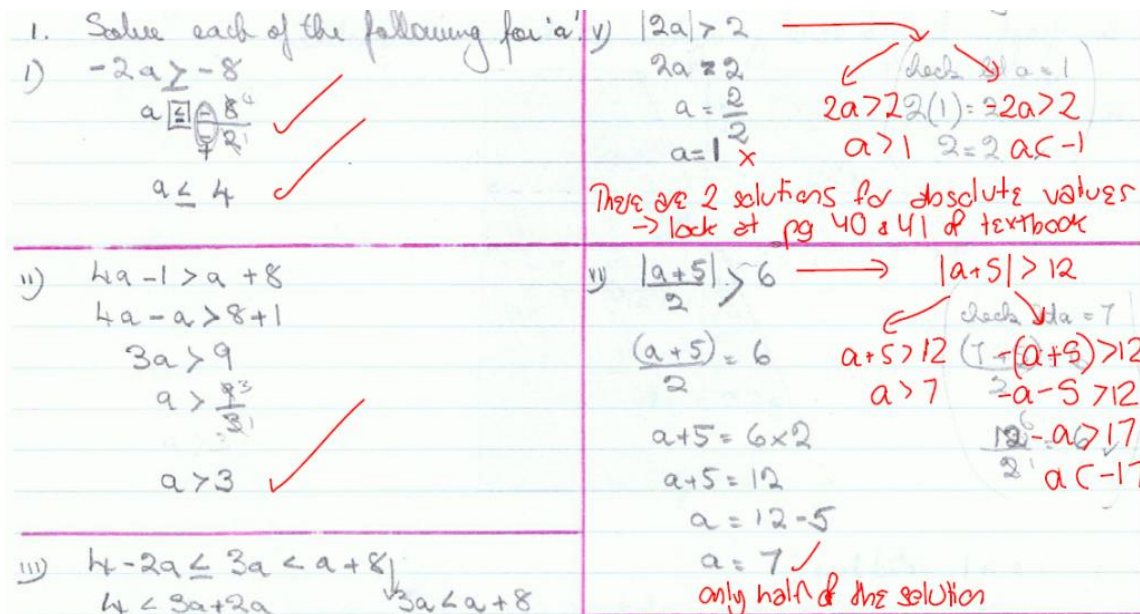


**Figure 3:** An example of a Microsoft Word® slide, with annotations, prepared for IMU (2010). Having the videos embedded into the ESG guides students through the course content in a similar manner to attending lectures or tutorials, with the added benefit of being able to revisit, replay and pause the instruction. Additionally, as well as being embedded into the ESG, there is a separate link to the videos which enables the student to view selected ones again without the need to remember the week of study in which they occurred.

To ensure that the videos actively engage the student and conform to the adult learning principles employed by the MLC, every video contains activities for the student to do. The general format of each video is for the instructor to explain a concept, demonstrate an example and then provide an exercise for the student to complete. Answers to the video exercises are provided through the ESG.

### 5. Formative assessment and feedback

All of the End-of-Module tests for each of the Transition Mathematics courses are formative. This allows the student to learn from mistakes and reinforces correct working prior to the submission of summative assessment. “The importance of feedback provided through formative assessment is not only an important part of the learning process but is also reciprocal” (Dekkers, Adams, & Elliott, 2011). The student provides feedback to the lecturer on their progress and possible need for extra assistance through the submission of the assessment. The lecturer then provides feedback to the student through marking and annotation. Mistakes are highlighted and the problem reworked (Figure 4), thus allowing the student to see their mistake and the correct working.



**Figure 4:** Extract of an annotated IMU test

Feedback on formative assessment is not only beneficial to the individual student but the entire distance cohort as it offers the lecturer an indication of the general understanding of the mathematical content, thus allowing shortcomings in the course content to be addressed.

All assessment within the Transition Mathematics courses is marked with the Tablet PC and returned via email. French (2007) explains how the Tablet PC can be used by the instructor when marking assignments to annotate and save Microsoft Word® documents which can then be viewed on any LMS by the student. The Tablet PC enables teachers to send students an electronic copy of feedback which contains hand-written annotations (Neal & Davidson, 2008). Another benefit of 'e-marking' as seen by Chester (2008) is the reduction in the amount of paper required to be handled when evaluating students. In fact some courses at CQUniversity are completely paperless. All teaching resources, assessments, course profiles, student submissions and feedback are contained in a LMS. The information is stored electronically and at the completion of the course, the entire course can be compressed onto a single CD.

In a discussion on creating a paperless course, Hayes and Adams (2009) question how, in a society that demands instant gratification, assessment turn-around time of several weeks can still exist? The electronic marking system adopted by the mathematics staff is quick and virtually paperless. The choice of submission method (mail, email, fax), ensures that no student is disadvantaged due to the requirement of expensive equipment. All assessment items are converted to PDF and placed in the student's folder for marking. Through the use of a shared drive; these files are immediately available to the marker for marking with the Tablet PC. As the Tablet PC allows the lecturer to write on the student's test, personalised handwritten feedback (Figure 4) can be provided promptly, ensuring students receive feedback whilst the concepts covered are still fresh. The fact that all tests are returned to



the student's university email ensures the fastest turnaround. Additionally, as tests are stored electronically on a shared drive, staff have access to a copy of the marked test and annotations, should the student have any enquiries.

Whereas some scholars such as Hume (2001) find the writing surface of the Tablet PC produces poor quality writing and has the effect of making bad writing worse, anecdotal evidence suggests that students prefer handwritten solutions over typed. Additionally, according to Harrison, Pidcock, and Ward (2009) handwritten feedback is not only more authentic, but also provides guidance as to the correct setting out for a solution. For this reason handwritten feedback is preferable to computer generated marking and comments.

It was noted by Siozos, Palaigeorgiou, Triantafyllakos, and Despotakis (2009), in a discussion on computer based assessment (CBA), that feedback is an important element of the learning process and regardless of the sophistication of the feedback system, CBA is unable to replace a teacher's comprehensive ability to provide personalised feedback. Those in favour of CBA believe in its pedagogical nature, claiming that it provides immediate detailed feedback, increases the breadth of assessment and encourages regular study and autonomous learning though Siozos et al. (2008), found these tests to be objective and, as such, more beneficial to the teachers. Smith and Kimball (2010) found that not only does feedback work as an error correction mechanism but timely feedback can reinforce correct responses and promote long-term retention.

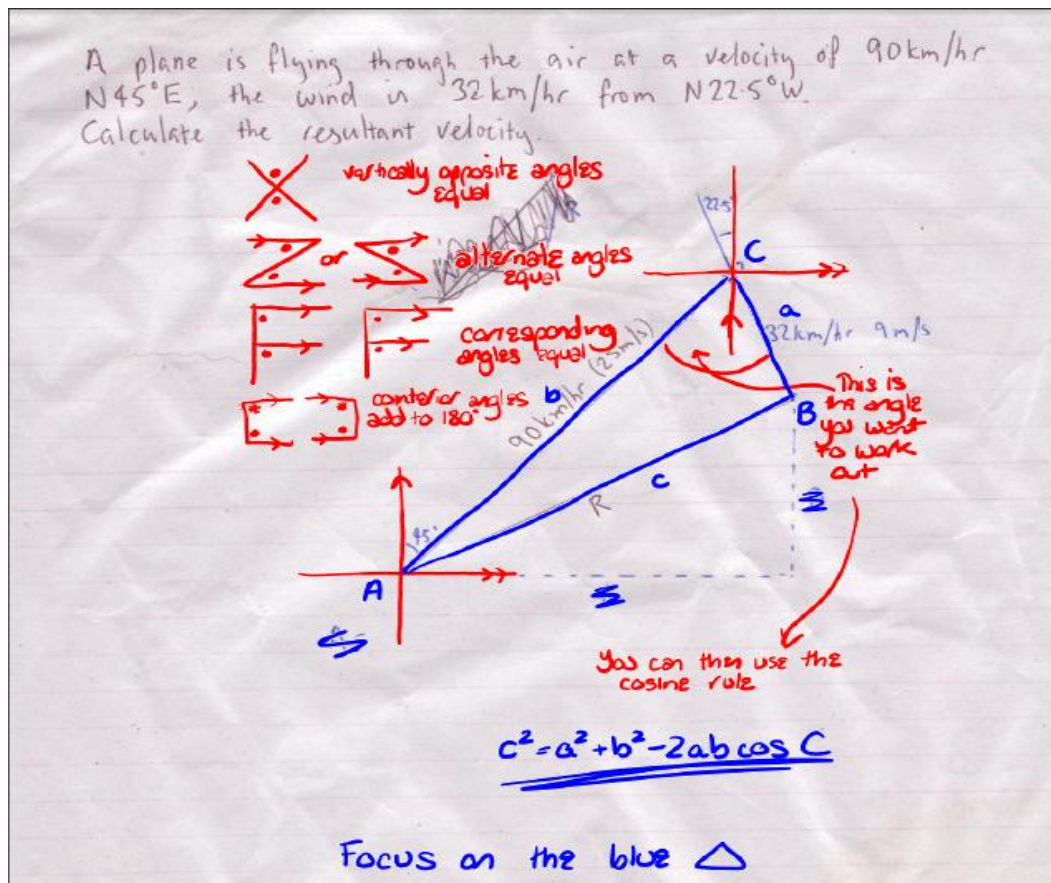
## **6. Support**

Many students seeking extra assistance do so by email. One method of assisting a student via email is to provide annotated solutions to the student's problem, especially as mathematics can be difficult and time consuming to type. When distance students email staff with a mathematics problem they are either unable to perform or which requires further explanation, if the problem is not too involved, staff will use their Tablet PCs to write the solution, complete with annotations, as shown in Figure 5. Different colours are used to aid readability. Regardless of the program used to create the document (usually Windows Journal<sup>®</sup>) we have found it is always advisable to convert it to a PDF before emailing the student. For more complex questions videos are more appropriate.

Quick videos to address student questions as they arise are often created when a problem cannot be easily explained using annotations alone. The staff member will often use Windows Journal<sup>®</sup> and Camtasia<sup>®</sup> to create a video that will walk the student through the solution to the problem in question. Windows Journal<sup>®</sup> allows the staff member to annotate directly on the screen. Camtasia<sup>®</sup> is used to record the screen and sound as the staff member writes and explains the solution (for the base document staff have also experimented with using Microsoft Word<sup>®</sup> and its built-in annotating functions or converting the students email to PDF). Once the video has been recorded it is rendered as a Flash<sup>®</sup> or Windows Media Player<sup>®</sup> file and emailed to the student.

These videos are relatively quick and easy to make as they require virtually no preparation, rarely require editing and can be emailed directly to the student, thus enabling external

students to be provided with help within a very short time. Additionally, these videos are created not only for external Transition Mathematics students but also for undergraduate students experiencing problems with a mathematical component of their program. Therefore, as the number of distance students at Universities across the world increases, this capability has extensive benefits not only in mathematics but also in other disciplines.



**Figure 5:** Student enquiry and annotated solution

## 7. Aim

The aim of the research was to discover if Transition Mathematics courses with supportive frameworks increase the mathematical knowledge and confidence of distance students. Anecdotal evidence had led the mathematics staff to believe that many students entered the courses with a fear of mathematics and this fear was often reduced during the course. There was also the belief that the resources supplied with the course and the formative assessment and feedback were a vital part of increasing confidence and success.

## 8. Methodology

CQUniversity students who had been or were enrolled in any of the Transition Mathematics courses as a distance student during 2010 or 2011 were invited to partake in the study. Participants were requested to complete a 5-10 minute online survey.

A portion of this study surveyed students regarding their mathematical confidence prior to and after completing one or several of the Transition Mathematics courses. Students were also questioned on the usefulness of extra study resources and support supplied with the course. As all students were studying in distance mode it was vitally important that they engaged with the material and did not feel isolated. The relationship between age and mathematical confidence; and the provision of mathematical videos and mathematical confidence were also examined.

## **9. Results and discussion**

One hundred and forty distance Transition Mathematics students completed the online survey. This included 99 females and 41 males. There was a relatively even spread of age groups with the 30-34 age group having the largest representation at 22%. The lowest level of education amongst the participants was grade nine (3%). 18% of students had only completed year 10 (Junior Certificate) while 22% and 26% respectively had completed either year 12 or TAFE (Institute of Technical and Further Education). Of those students completing the survey, 93% had completed or were completing FMU.

### **9.1. Instructional videos**

Moyle (2008) noted that between 2002 and 2008 very little Australian research had been published which listened to students regarding their opinion of learning with technologies. Previous feedback from students and anecdotal evidence had shown that instructional videos improved the learning outcomes for distance students. From this study it was discovered that 93% of the survey participants enrolled in the FMU course reported having access to instructional videos. Of these students 80% watched the videos. Of the students that watched the videos 89% found them beneficial to their understanding of the mathematical concepts. Even though 83% of students felt that the videos explained mathematical concepts clearly only 73% felt that the videos were able to adequately replace face-to-face teaching. Some comments received from students relating to the videos included:

*The videos demonstrated clear methods of solving math problems.*

*Learning maths via videos was excellent. I was able to go over a few times if I didn't understand it. A very good learning tool. I think I would of not found it as easy learning without this.*

*I love maths and please supply videos with all the maths courses as I had some bother with some and videos would have helped to understand the concepts.*

There appears to be an age bias for students not finding the videos a viable substitute for face-to-face teaching. It was noted that 15% of the over 35s, with a representation of 48%, preferred face-to-face while only 6% of the under 35s were not satisfied with video substitution.

Amongst the IMU students 69% had access to video support, of which 73% watched the videos. Of the IMU students watching the videos 100% believed the videos benefited their understanding of the mathematical concepts being taught. This group displayed no age bias

in their opinion regarding the videos being the good substitute for face-to-face teaching. 61% of the IMU students felt the videos were a good substitute for face-to-face teaching. Only one of the nine TMU students was able to access the video support. Since the video support for this course is not as comprehensive as the other two courses, students were not questioned regarding the videos being a good substitute for face-to-face teaching. We believe that the trend of an increasing desire for face-to-face teaching would increase as the course increases in mathematical complexity. It was interesting to note that 80% of the FMU students that did not find the videos a reasonable replacement for face-to-face teaching also had no improvement in their mathematical confidence; likewise with 100% of the TMU students.

## **9.2. Feedback**

Given that formative assessment and feedback are viewed as an important component of the learning process, students were questioned with regards to the promptness of feedback. The majority of students, across all three courses, had feedback returned within two to four days. They were also requested to provide information on whether or not they found the feedback beneficial. Approximately 90% of the students surveyed found the feedback beneficial to their learning. Students submitting their assessments via email generally received tests and feedback in the fastest time and were the most satisfied with the turnaround time. Some student comments relating to feedback included:

*I appreciate how fast the marked assignments are returned and understand how busy the markers are. Sometimes the comments can be a little hard to read though because of the handwriting.*

*Marks were received quickly and always an encouraging message along with the result.*

## **9.3. Support**

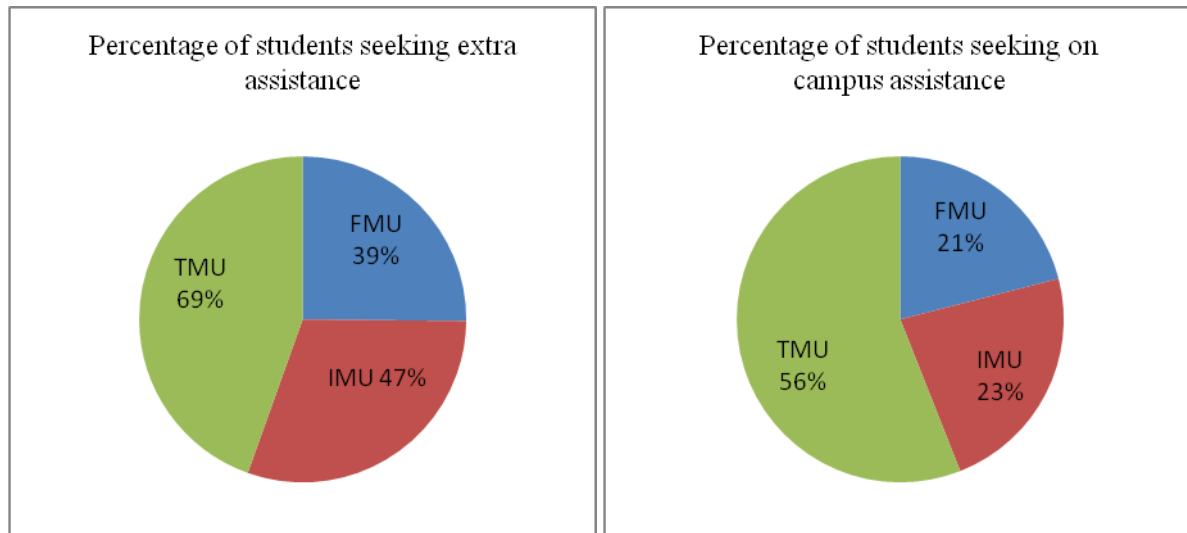
It is important that support is available for students enrolled in Transition Mathematics courses should they need it. 39% of FMU students sort extra support and from these 48% gained support from the course coordinator. 47% of IMU students sort extra support and from these 61% from the course coordinator. 69% of TMU students sort extra assistance and of these 36% contacted the course coordinator. 70% and 69% of FMU and IMU students respectfully sort extra assistance via email. While only 44% of the TMU students sort extra assistance through email. 21% and 23% of FMU and IMU students respectfully sort on campus assistance, while only 56% of TMU students sort assistance on campus, either from the course coordinator or through the MLC. 45% of TMU students attained their extra assistance from the MLC on campus. It can be concluded that as mathematics courses become increasingly more difficult a greater percentage of students require extra assistance (see Figure 6). While email support was sort by the majority of FMU and IMU students, TMU students preferred face-to-face support. This could be because this course is not as supported as the other two courses or those students experiencing difficulties in higher

level mathematics courses require more personalised assistance. Some student comments relating to support included:

*Support from MLC Mackay was excellent and with out it I would not have completed the course.*

*Support was only an email or phone call away.*

*Support is excellent, marking was very easy to understand with a great turn around.*



**Figure 6:** Percentage of students seeking extra assistance and on campus assistance

#### 9.4. Mathematical confidence

Graven (2004, p. 177) describes “confidence as both a product and a process of learning”. As part of the study we looked at mathematical confidence. We were interested in what effect gender and age had on mathematic confidence. We found that less than 10% of males found mathematics frightening prior to commencing the course whilst 46% of the females did. As Liu and Wilson (2009) found that males had a slight but consistent advantage over females in mathematics testing, we wonder if this could be due to greater confidence displayed by males. 17% of males admitted to being confused by mathematics prior to the course with 52% of the females confessing to the same. Upon completion of the course(s) 5% of the males and 11% of females remained frightened by mathematics. This reduction adds weight to Graven’s statement. After completion of the course(s) 5% of males and 14% of females continued to be confused by mathematics. It was the under 25 age group that entered a course with the greatest mathematical fear and confusion. All age groups showed a significant reduction in mathematical fear and confusion upon completion of one or more Transition Mathematics courses. We did not find age a significant factor affecting mathematical confidence. The learning process and the scaffolding and support provided with the course appeared to increase student confidence. This is an important aspect of the course as Parsons, Croft, and Harrison (2009, p. 53) concluded that “students’ confidence in

their ability in mathematics does matter” and that courses should be structured to increase mathematical confidence. In their study Parsons, Croft, and Harrison (2009) found that as confidence increased so did the student’s grade. Students were asked to provide further comments relating to their mathematical confidence, which included:

*I always disliked mathematics at school, but I find that I like the STEPS programs way of teaching and it helps me understand better.*

*Having completed Mathematics I now have more confidence dealing with mathematical problems.*

*I am currently undertaking FMU. Before I began I thought I was crazy to undertake mathematics as a subject because I had such a bad learning experience in high school. However I have now come to the understanding that I am just as smart as the average person when it comes to maths, and I look forward to sitting down and doing the work each day. I am confident that I will be able to complete each task successfully, where as I never used to be.*

*Before starting this course, I was terrified of maths, but I now feel more confident and am actually enjoying the challenge.*

## **10. Conclusion**

As universities throughout the world increase their student numbers and accept students with a broader level of mathematics there is an increasing need for preparatory mathematics courses with supportive frameworks to foster students transitioning into undergraduate degrees. Through the implementation of scaffolding these courses are able to improve both mathematical knowledge and confidence of the students.

The Standards of Excellence in Teaching Mathematics in Australian Schools states that excellent teachers of mathematics need to “establish an environment that maximises students’ learning opportunities”, empowering them “to become independent learners” by modelling “mathematical thinking and reasoning” and providing “purposeful and timely feedback” (The Australian Association of Mathematics Teachers Inc., 2006, Sec 3). The capability of video creation has enabled the Transition Mathematics staff to actively engage distance students, providing them with the opportunity to see and hear the logical progression of mathematical solutions. The majority of students surveyed found their understanding of the mathematics being taught was enhanced by the addition of video support and timely and comprehensive feedback. We found that as the mathematics became increasingly difficult students displayed a greater desire for face-to-face teaching and the need for extra assistance increased.

There was a far higher incidence of fear of mathematics entering Transition Mathematics courses amongst women than men. Upon completion of the course(s) this gap had substantially closed. Results were repeated for mathematical confusion. The majority of students found they had increased mathematical confidence after the course(s).

It is concluded that a course with supported frameworks containing instructional videos, formative assessment and prompt feedback is essential for ensuring distance students are

engaged and understand the course content. Course scaffolding and support also increase student confidence in mathematics which in turn benefits academic progression.

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