

For sustained commitment to engaging first year mathematics students through a supportive learning environment, the use of new technologies and community consultation

Overview of contribution and context

We teach a total of four first year mathematics subjects to classes of up to 300 students who have a diverse range of mathematical abilities. We influence, motivate and inspire students through a team approach to engagement via new technologies, building confidence and creating a learning environment where students feel safe in taking risks. Many first year students are ill prepared for tertiary mathematics and lack confidence in the basic mathematics skills. We feel that by engaging students through our own passion for mathematics, and maintaining strong alignment throughout our courses and between lecturers, we can build confidence and encourage students to become active participants in the learning process.

JCU is a regional university with a diverse student intake with many students being the first in their family to attend University, and who come from a variety of regional communities and schools. Hence it is difficult, but necessary, to cater for students of all abilities and prepare them for the many disciplines in which mathematics is a basic requirement. It is vital that the students obtain a firm grounding in the basics as well as obtaining the necessary skills to become good problem solvers. Our approaches and teaching techniques have been very successful in engaging and inspiring students, extending good students, as well as identifying and motivating "at risk" students and improving their overall learning experience. As JCU has a strong research profile it is very important that we inspire and motivate our gifted students to engage with the discipline, as these quality students are our potential researchers of the future. Also, with increasing participation rates over the last decade, there has been a steady but very significant decline in the average abilities of students entering first year mathematics. In response to this difficult challenge we have taken a **team approach** to all aspects of the teaching of first year mathematics, creating a central learning community with three key features: engagement through developing positive relationships with the students, engagement through technology and engagement with the wider community.

Criterion 1: Approaches to the support of learning and teaching that influence, motivate and inspire students to learn

We successfully engage the students through a mixture of sheer passion for mathematics, the creation of a supportive learning environment and the use of the latest technologies. Enthusiasm for the subject is infectious and has been our most powerful tool in motivating students to engage with the subject. This engagement is then enhanced through the inclusion of mathematics in topics which are relevant to them and through the use of media that they are familiar with.

Whole team approach to engagement

A team approach to the teaching of first year mathematics has been successful in creating a learning environment where the lecturers are approachable and students are made to feel part of a mathematics community of engaged and committed mathematics staff and students. This provides a very supportive environment underpinned by a genuine open door policy. Our team of lecturers are available for consultation on all first year subjects and attend as many tutorials as possible. This helps to develop a strong rapport with students and allows us to get to know them on an individual basis. Hence our group are all very familiar with all aspects of any first year subject and students feel comfortable in consulting any team member about any aspect. This technique has proven to be very successful as students no longer feel like another "face in the crowd" and are more likely to attend lectures.

We have successfully used team teaching and all lecturers have been active in the peer review process. The peer reviews conducted within the group have proved to be invaluable in maintaining quality and alignment between lecturers.

Our teaching techniques are heavily based on positive reinforcement and confidence building. If the students can achieve early success in the course, then they will be more likely to attend and engage in the learning process. All lecturers involved share an excellent rapport with their students and this is evidenced in student evaluations with up to 70% of students responding that "the teacher's ability to develop good rapport with the students" was outstanding.

The students require clear structure throughout the course and we are very careful that there is clear alignment between the lecture materials, the tutorial questions and the assessment. Our team approach to alignment has proven to be very successful with decisions made by the group, with all members very familiar with all the courses involved. Every member of the team is involved in the tutoring of the main stream first year subjects, as well as undertaking the entire exam marking for the main first year subjects. This is vital in maintaining consistency throughout the course and forms an integral part of our reflective practice for each subject. This approach has not only been important in maintaining alignment throughout the subject but also between lecturers. Alignment is also important between first year subjects where students progressing to another mathematics subject clearly know what is expected of them, and how to access

their support network. To achieve this we have created a central electronic library of materials for all first year subjects. These materials include lecture notes, tutorial questions, solutions, assignments and online quizzes which are all typeset to give uniformity throughout all first year subjects. Our team approach has been critical in maintaining consistency throughout all aspects of first year mathematics thus resulting in a smooth transition between subjects, minimising stress and enhancing their first year experience.

All assessment is returned quickly, with feedback heavily encouraged and the lines of communication clearly defined through email, discussion boards or staff/student meetings. As students have become familiar with the use of text messages and internet chat rooms, they have come to expect immediate responses to questions. Hence emails are checked regularly and responded to as quickly as possible. The team meet weekly to discuss issues and student feedback is taken very seriously and acted upon quickly to avoid any long term issues.

Typical comments include:

- *The lecturer had an open door policy for assisting students. i.e. help and encouragement freely given. Has ensured I will continue to do more mathematics subjects. (2003)*
- *Excellent staff. If you have a problem basically anyone in the maths department will go out of their way to help you. It really is appreciated (2003)*
- *The lecturer is a wonder. I wish I had him at high school. It would have made such a difference. He is the best teacher I have ever had. I wish I could offer strong enough praise. Lock up this guy, don't let him get away." (2001)*
- *I've already won because I'm not afraid any more. Thank you for your understanding and support. (Student Letter)*
- *Your fantastic assistance had me achieving results that I never dreamed possible. (2006)*
- *The lecturer's infectious enthusiasm for this subject made for an enjoyable and productive learning experience. (2007)*
- *I feel much more confident about maths not only in this class but across my other classes – and the lecturer's enthusiasm and positive attitude contributed greatly towards that. (2006)*

Before we can truly engage the students we must understand their strengths and weaknesses, so diagnostic tests are carried out at the start of all first year mathematics courses. These tests are vital in gauging any deficiencies that may exist within our class and provide a useful guide when determining which areas require more emphasis or deeper explanation. A similar test is also given at the end of the course to gauge how successful our teaching techniques have been. These techniques have been productive as the average over all student evaluations for the category "explanations by staff in this subject" was 4.4 out of 5.0, well above the university average of 3.6.

Engagement through technology

As students learn in different ways, it is important to engage students by presenting materials in a number of forms and through media that they are familiar with. At JCU, 72% of students are involved in either part time or full time work (First Year Experience questionnaire, 2006), hence flexibility is paramount as students are finding it increasingly difficult to physically attend all lectures and tutorials. In order to achieve the best outcomes for the students the team has embraced the latest technologies and devoted an enormous amount of time into making all of our courses flexible and accessible via the internet. We have all used Blackboard since its inception at JCU, and all of our course materials have been in electronic form for at least seven years. As 95% of JCU students access Blackboard frequently, all course materials are supplied electronically in advance as well as notes being explained on the board, via PowerPoint or through the use of a tablet PC. We firmly believe that it is important to include a variety of techniques whilst still maintaining a strong structure throughout our courses.

The vast majority of first year students are very comfortable with new technologies and it is vital to communicate with the students through media that they commonly use. Hence materials developed are suitable for use via the internet, mobile phone or iPod. The use of the internet to supply materials to students has been very well received and, as well as supplying all subject materials online, we have created a pool of hundreds of online quizzes as part of our assessment. These have been very popular with students who are able to access these quizzes over the internet at any time, have multiple attempts and receive immediate feedback including the correct answers as well as concise explanations. All team members have been involved in the creation of these materials and they have become one of our most valuable resources.

Over the last year we have extended our online assistance to include screencasts as a supplement to our lectures. This has been made possible through a successful screencasting grant application for \$30,000 which was used to purchase hardware for all members of the team. These screencasts involve the screen capture of handwritten explanations or powerpoint presentations using a tablet or tablet PC with further explanations given by an audio voiceover. These screencasts can also be edited to include music or video clips and are proving to be very valuable in engaging students

online. This exciting advance has been well received by the students who are now able to download the screencasts to their personal computers, mobile phones and iPods. This allows enormous flexibility as students can access their lectures on their laptop or iPod at any time from anywhere on campus. The screencasts can be paused, rewound and watched as many times as the student requires and are proving to be an important asset to our electronic library.

The team has also been involved in collaboration through an ALTC project aimed at developing and sharing mathematics learning resources. This collaboration ensures that the team maintains an awareness of developing technologies that will further enhance delivery of content. For example we are currently purchasing the "Elluminate" range of software which provides an interactive tool where a lecture or tutorial is given live over the internet with the student and lecturer communicating vocally or via writing on a common webpage. This is a very exciting tool and will add more flexibility for students who may not be able to physically attend all lectures or tutorials.

Student comments include

- *Online quizzes - great way to aid learning and brilliant for revision purposes. (2006)*
- *The use of learnJCU (Blackboard) was outstanding, made life a lot easier. (2005)*
- *Online quizzes were great. Lecturer was excellent. Very well structured lectures and course. (2003)*
- *I think screencasts are a great and exciting tool.(2006)*
- *Excellent use of workbook and IT. (2008)*

Engaging with the wider community

It is very difficult as an individual to have a genuine impact on the teaching of mathematics. Far greater progress can be achieved with a team approach and we have had real success in engaging with high school students, teachers, educationalists and potential mathematics teachers. In order to achieve this, we have been very proactive in the local region over the last eight years. We have been heavily involved with the Townsville branch of QAMT (Queensland Association of Mathematics Teachers) through meetings, speaking at their mathematics camps and presenting at their annual conference. The team has also instigated very successful talks between the local high school teachers, JCU mathematicians and JCU educationalists in an effort to bridge the perceived gap between secondary and tertiary mathematics. In 2004 we reached out further into the schools when we combined with Saint Margaret Mary's College to create a program involving the teaching of first year mathematics to grade 12 students. This was the first time any JCU subject had been delivered to secondary school students anywhere. The program has run very successfully for the last five years and has been implemented in five local high schools. The success rate of these students has been exceptional with 95% of these students successfully completing the course. By travelling to the schools and engaging with the students we have been successful in attracting 93% of these students to commence studies at JCU. Numerous schools have now requested to join our program and this highly successful pilot study has now become the template for the University with other JCU subjects now being offered to secondary students.

- *"The course has been very successful with many positive outcomes. One of these outcomes is the interaction with JCU staff ... this relationship removes the preconceived idea, held by many high school students, that Uni staff are remote and unapproachable." Leonie Meehan, MA1000 teacher, Ryan School*

Over the last five years we have taken a strong interest in mathematics education research and over that time we have published our findings in the literature, participated in numerous mathematics education conferences and collaborated on a number of large studies into the teaching of first year mathematics and the preparation of secondary students for tertiary study in mathematics. These collaborations between team members and the wider mathematics community are vital if we are to have any significant impact on the teaching of mathematics at a national level.

Our teaching has also been recognised outside of our institution with an American publishing company recently inviting us to publish a mathematics textbook in the "Eureka" series to be used by potential mathematicians and engineers.

- *He recommended you highly for your "outstanding teaching" skills and someone with the ability to author a very useful and successful book on mathematics for engineers and scientists. (Email)*

Contribution to student learning

Over the last eight years the team has received excellent student survey results across all first year subjects. The students participate in two formal surveys and the results of all first year mathematics subjects from 2001 to 2008 are given below. The table lists the percentage of students who replied that the staff member involved was in the "Outstanding" category for that question. As each subject may have been taught by different lecturers during this time period, we are very pleased with these results, as they show a consistent set of very high scores for four different lecturers, received over a long period of time for a wide range of subjects.

Citation for Outstanding Contributions to Student Learning 2009

Dr Shaun Belward, Dr Ronald White, Patrick Higgins and Dr D'Arcy Mullamphy (James Cook University)

Question	MA1000	MA1020	MA1721	MA1003	AVERAGE	JCU AV.
"Quality of the staff member's teaching"	56.4%	65.2%	42.5%	43.5%	55.5%	26.1%
"Interest in assisting students to learn"	56.3%	60.9%	50.6%	46.5%	55.8%	28.3%
"Availability to the students"	46.3%	33.4%	54.5%	41.7%	45.7%	20.1%

On the second set of student evaluations the group obtained an outstanding average across all subjects of 4.5 (out of 5) for the category *"Interest in assisting students to learn"* with scores as high as 4.8, as well as averaging 4.4 (out of 5) for *"Explanations by staff in this subject"* with scores as high as 4.9 and class sizes of up to 300 students. A student evaluation score in excess of 4.0 is considered excellent in our faculty and, over all years, our average is in excess of 4.0 over all questions. Once again this is an excellent result as it involves all lecturers, across many subjects over a very long period of time. Our strongest evidence, however, lies in the enormous number of very positive student comments received over the last eight years. The comments regularly contain words such as "enthusiastic, exciting, inspiring, engaging, invigorating" and some typical comments are given below.

- *The lecturer's ability to keep students' attention is outstanding ... makes learning a pleasure. (2005)*
- *The lecturers were so helpful. Explanations were awesome. They provided great understanding. (2007)*
- *The lecturer made a hard and quite boring subject into a challenging and exciting experience. (2001)*
- *I can honestly say that I am overwhelmed with the lecturer's teaching abilities.... Thank you James Cook University for supplying first class lecturers".(2000)*
- *My lecturer for this subject was outstanding. He made himself available for consultation and I felt he truly cares about people 'getting it' a wonderful down to earth attitude which broke down barriers. (2007)*
- *I always dreamed of finding someone who could teach maths to me in a way where learning is fun, enjoyable and entertaining, he has opened my mind to understanding in a deep and wonderful way. (2006)*
- *The maths department and lecturers are the most helpful I have come across! (2005)*
- *Awe inspiring to learn from a professional. (2006)*
- *For you are the reason why people become such a success in their future careers. (2000)*
- *Will benefit me in future life greatly. Thank you for taking the time to care about my academic future. (2005)*

Conclusion

Over the last decade we have addressed a changing student demographic by using a team approach in all aspects of the teaching of first mathematics. This approach has proven to be extremely successful and this is evidenced by the consistently very high student evaluations and excellent student comments we have obtained over many years. Over the last five years alone the group has received fifteen letters from the PVC of the Faculty for outstanding student survey results. Our team approach has allowed us to obtain excellent alignment within and between first year subjects, which would have been difficult to achieve without a united approach. Our success has been recognised by our peers and this is evidenced by awards at School, Faculty and National level as well as one group member being appointed to the position of Faculty Scholar for teaching and learning. Our team approach has also allowed us to instigate talks between local high school teachers, JCU mathematicians and educationalists in an effort to bridge the perceived gap between secondary and tertiary mathematics. We liaise regularly with the schools through QAMT meetings and since 2004, we have run an extremely successful program where first year mathematics is taught into local high schools. In 2007, our work in "screencasting" was recognised by JCU with a \$30,000 internal grant. We have a genuine interest in addressing the perceived decline in the mathematical abilities of entering first year students and we have given conference talks on these issues at local and national level. We have also published our findings in the literature and collaborated on several large scale studies.

Through a unified attitude towards engagement and the creation of a central learning community we have been able to achieve outstanding learning outcomes for our students which would not have otherwise been possible. Our joint approach has been critical in successfully achieving strong alignment throughout first year mathematics and the strength in numbers has enabled us to have genuine impact at both the local level and with the wider mathematics community.