

It's part of my life: Engaging University and community to enhance mathematics education: the USQ experience

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This paper outlines the USQ's involvement in the OLT project "It's part of my life". We plan to improve teacher knowledge by linking pre-service teachers with the university's applied mathematicians and specialist educators to develop pre-service teachers' understanding of mathematics modelling through the context of everyday life in the Toowoomba region. Pre-service teachers will teach into our already successful Maths Enrichment Program for year 9 and 10 students. Here students from the community come to USQ and engage in interactive sessions run by local mathematicians. Proposed topics include: Are more dentists needed in Toowoomba?; Modelling Dust on the Darling Downs; UV radiation modelling for surfers at Fraser Coast; and, Detention basins for flood mitigation.

An Office of Learning and Teaching project, "It's part of my life", is designed to improve pre-service teacher training at the university level by investigating the effect of giving pre-service teachers pedagogy, discipline competence, and confidence while planning mathematics and science mini-lessons to teach to school students. The project involves a series of iterated trials to develop and gauge the effectiveness of enhancement and feedback modules to ensure that they are suitable for embedding within teacher education and other university curriculum. More specifically, the project aims to:

- strengthen pre-service teachers' competence and confidence in teaching mathematics and science;
- engage pre-service teachers with the mathematics and science that underpins everyday life in Australian regional communities and incorporate this into teaching practice;
- foster collaborative networking between university scientists, mathematicians, educators and pre service teachers within and across a Regional Universities Network (RUN) institutions; and,
- provide a sustainable and scalable approach for enhancement of pre-service teacher education curriculum for adoption in a range of regional, remote and indigenous contexts.

This paper concentrates on the mathematics curriculum and the trials are situated in the Darling Downs and Brisbane West region of Queensland with the support of the University of Southern Queensland. The trials are based within a Year 9 and 10 mathematics classroom with groups of preservice teachers teaching iterations of mathematics lessons with the guidance and support of mathematicians and mathematics educators.

Methodology and Instruments

There are two main approaches to the overall research project: A complexity study and a psychology study.

Complexity Study: Research is based in complexity studies (Davis & Renert, 2014) and documentation and analysis will use network representation (Hanneman & Riddle, 2006;

Newman, Barabási, & Watts, 2006). Iterations will be examined using design research methodologies (Collins, Joseph, & Bielaczyc, 2004) and approaches from Japanese Lesson Study (Shimuzu, 2013). Data collection will include video recording and surveys of pre-service teachers (PSTs) and participants in the interactions. Specifically, the study examines how “mathematical thinking” (e.g., pattern and generalisation, linear thinking, modelling) can be developed within lessons, in place of a focus on content – this is where the contribution of mathematics researchers is most important. ‘Portable’ teaching skills (e.g., Niss & Højgaard, 2011) are an integral part of this process.

Psychology Study: Pre-service teachers (PSTs) will learn to self-evaluate their performance to determine the effect of competence on their confidence. Analysis of critical moments in their teaching, and classroom student responses will be used to determine how to make future lessons more effective through improvements in pre service teachers’ confidence that are related to student engagement (pedagogy) or subject competence (research input). Details of the instruments are detailed in Table 1.

Table 1. Instruments and Analysis

Participants	Instruments
Teaching PST	Video and audio of PST Confidence survey (CCC pre) Confidence survey (CCC post) Pre-Test PANAS* survey Post-Test PANAS* survey
Observing PSTs	Observation CCC Checklist
All PSTs	Emotional Diary Complexity questions (survey)
Classroom students	Video of body language Survey statements

*PANAS: Positive and Negative Affect Schedule

PSTs presenting a lesson, just before and after each of the classroom lessons, they will complete a PANAS to record their overall emotional state (Crawford & Henry, 2004) PANAS is a valid and reliable measure to assess different feelings we experience. Teacher observers will be using competence/confidence checklists (CCCs) during the lesson using the same items on which the student ranked their confidence. Those in the Group not receiving the enhancement and feedback will still have an observer completing competence checklists during their lessons, and they will also be asked to complete a PANAS before and after the lesson. Classroom students in all teaching lessons (enhancement or not) be asked to complete an emotion diary and rate their interest in the teaching PST’s lesson. The analysis of the data obtained from the instruments will be used to determine:

- Links between positive emotional correlates and PST confidence
- Links between PST confidence and subject competence
- Links between PST confidence and student engagement or attention
- Links between the mathematics integration and PST competence
- Using such links to validate measurement of correlates used

The overall framework is outlined in Table 2.

Table 2. Training Session for Feedback and Reflection and approach to mathematical modelling

GROUP A	GROUP B
<i>Enhancement & feedback/ reflection (also with PANAS, CCC & Student data)</i>	<i>No enhancement & no feedback/ reflection (but with PANAS, CCC & Student data)</i>
Enhancement Session 1: PST & real world math	
Teaching Session 1	
(A1)	(B1)
Feedback and reflection 1 Assessing confidence through competence	
Enhancement Session 2 PST & real world maths	
Teaching Session 2	
(A2)	(B2)
Feedback and reflection 2 Assessing confidence through competence	
Enhancement Session 3 PST & real world maths	
Teaching Session 3	
(A3)	(B3)
Feedback and reflection 3 Assessing confidence through competence	
Final reflection – members of both Groups	

There will be two groups (A and B) together in each of two trials

Group A:

- Three Pre-service teachers (PST) plan three lessons (A1, A2 and A3) each and teach one each (with specialised assistance as per trial process) and observe two others
- These same three PSTs then plan and teach one lesson each (without specialised assistance) although they have already been through the specialised process

Group B

- Three Pre-service teachers (PST) plan and teach one lesson each (without specialised assistance) (B1, B2, B3)
- These same three PSTs then plan three lessons each and teach one each (with specialised assistance as per trial process) and observe two others

For USQ (2015 and 2016)

To highlight the mathematics that surrounds the everyday life of students in the Darling Downs and Brisbane West region, the focus of the Trials will be on mathematical modelling as real world problem solving (Galbraith, 2011) with examples tailored to the region and linked to the applied mathematics researched at USQ.

- How many dentists are needed in Toowoomba?
- How much dust is lost in a dust storm?
- Random Walks
- How much sun is needed for your Vitamin D requirements?
- Medical statistics
- Detention basins for flood mitigation

Modelling was chosen as it is an excellent way to illustrate how an applied mathematician thinks and works. In addition there are many examples of mathematical modelling at the elementary level that can be replicated. The trials will be undertaken at USQ in the already developed Maths Enrichment program for year 9 and 10 students. Here students from the local region come to the USQ campuses in Toowoomba (Semester 1) and Springfield (Semester 2). There are 6 lessons (3 weeks apart) and about 30-40 students. We will divide the students into two groups (for Group A and Group B). Each Mathematics Enrichment Session is 2 hours, allowing for the first half an hour for informal chat and refreshment. PSTs then teach most of the lesson (with the assistance of experts) based on one modelling example.

Permission for Year 9 and 10 students to be part of the research will be obtained from the parents (as has happened in the past). We will also get permission from parents to film students.

Sustainability and scalability through Trial modules become embedded in course structures. A bank of podcasts from mathematicians and statisticians will be developed to make this sustainable and scalable. Hence, Trial 3 is an Embedding Trial where we plan to embed the approach into a course (MAC1901 – Maths for Teachers in S2 2015)

References

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