

# MERGA36 - 2013



## Mathematics Education: Yesterday, Today and Tomorrow

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Mathematics Education Research Group of Australasia

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## **ROUND TABLE DISCUSSIONS - Abstract only**

### **Are We Bored Yet?: Raising Attainment And Maintaining Interest**

*Kim Beswick & Rhonda Faragher*

The Australian Curriculum: Mathematics (Australian Curriculum, Assessment and Reporting Authority, 2012), with its specification of content for year levels, represents a break from stage based curricula which have become the norm in Australian educational jurisdictions in recent decades. It thus provides an opportunity to rethink the appropriateness of developmental approaches to mathematics teaching and the concept of readiness that underpins the widely accepted tenet of teaching from where students are at (Anderson, 2010). Such an approach has the risk of students who fall behind their peers remaining behind even when they make progress (Capraro, Young, Lewis, Yetkiner, & Woods, 2009). This is exacerbated in mathematics because of a prevailing belief that mathematics, to a greater extent than other school subjects, is inherently hierarchical and hence must be taught in a linear fashion that precludes access to advanced content (e.g., algebra) until more basic topics (e.g., arithmetic) have been mastered. A year level based mathematics curriculum has the potential to contribute to solving at least two major problems that currently characterise mathematics learning particularly in the middle and secondary years of schooling. These are 1) persistent gaps in attainment between various disadvantaged groups and a majority of their year level peers, and 2) impoverished curriculum offerings for low attaining students who struggle to master 'basic' content.

This Roundtable will provide a forum for discussion of these propositions and the opportunity afforded by the implementation of the year level based Australian Curriculum: Mathematics. Stimulus in the form of evidence that challenges the hierarchical and linear nature of mathematics learning will be presented and ways that these ideas might contribute to closing attainment gaps discussed.

### **Assessment Standards In Undergraduate Mathematics**

*Carmel Coady, Deborah King & Cristina Varsavsky*

This roundtable will report and seek participants' feedback on progress towards the project Developing a shared understanding of assessment criteria and standards for undergraduate mathematics, funded by the Office of Learning and Teaching. The project seeks to engage the higher education mathematics community in a conversation around assessment standards which builds upon the Learning and Teaching Academic Standards project outcomes for the sciences (Yates, Jones & Kelder, 2011), and their contextualisation within the mathematics discipline. It aims to influence assessment practices in mathematics departments, to move away from idiosyncratic marking and grading approaches that favour procedural mastery towards practices that measure the quality of all aspects of student work against external anchors, ensuring comparability of standards within and across mathematics departments. The project will result in a reference framework and toolkit to support tertiary educators in the development of quality assessment standards and criteria. The project approach incorporates the four essential elements that, according to Sadler (2009), are required to convey and apply achievement standards: (i) exemplars of different levels of achievement invoking the criteria relevant to the judgment made, each of them with an (ii) explanation of how the judgment was made; a (iii) conversation about the exemplars and their corresponding judgments to establish a common vocabulary; and (iv) the sharing of what has been tacit knowledge within the discipline community.

## **Accelerated Learning in Mathematics**

*Fiona Fox & Komathi Kolandai-Matchett*

What is acceleration and how do we achieve it? Effective classroom pedagogy occurs in classrooms where the teacher has evidence of accelerating the progress of priority group learners. Accelerated Learning in Mathematics (ALiM) is a national intervention introduced in New Zealand in 2010 aimed at accelerating the learning of those students below and well-below national expectations. It focuses on the expertise within the school to evaluate the effectiveness of current practices that support accelerated mathematics learning and to closely monitor the impact of a 10 -15 week intervention for a small group of students. The attention is on supporting teachers and schools to inquire into how an effective teacher provides a short and intensive supplementary programme alongside their classroom programme to accelerate progress. The key themes for teaching are accelerated learning; pedagogical response to individual learning strengths and needs; carefully designed mathematics task in response to identity, language and culture; genuine engagement with parents and family; collaborative inquiry; and high levels of teacher reflective practice. In this round table presentation we will present findings from schools who participated in this intervention in 2012. We will examine the main focus for teaching these students and the impact this intervention had on the rest of the school. We will look at how these schools engaged the parent/family and what effect this had on the rate of acceleration. Finally we will analyse to what extent the teachers were engaged into inquiring into their own teaching practice and to what extent this impacted on the learning of the students.

## **Teacher Judgements in Mathematics**

*Christine Hardie*

National Standards, introduced into New Zealand schools in 2010, require teachers in years one to eight to make overall teacher judgments in mathematics. This new assessment policy asks teachers to use the standards and exemplars to make defensible and dependable holistic judgments about whether a student is above, at, below or well below their year standard. The centrality, complexity and nature of teacher judgment practice in mathematics in such a policy context need to be understood. My study drew from principals' and teachers' perspectives about how teachers approach and make overall teacher judgments in mathematics and was gathered using semi-structured interviews and from document analysis. Participants included four principals and seven teachers of students in years three to six. A range of approaches to judgment making emerged from exploring the beliefs, understandings and judgment practices teachers adopted. Teachers utilised both explicit and tacit knowledge in the decision making process and valued their relationship with and knowledge of their students, giving attention to features other than those specified in the mathematics standards. This round table forum will begin with a short presentation of findings to initiate discussion regarding influences that could be considered to ensure teacher judgments in mathematics are dependable and whether exemplars and standards are sufficient to inform professional judgments in mathematics.

## **Students' Transition From Number To Algebra**

*Christina Lee & Christine Ormond*

In the 21st century algebra continues to be seen as a "gatekeeper course" for mathematics (Rand Mathematics Study Panel, 2003). Many future career opportunities are lost to students who do not have a good understanding of algebra at some level. The Australian Curriculum, in its strand Number and algebra, introduces formal algebra to students at an earlier stage than has been the case in most Australian states in the past. In this round table presentation we will firstly examine some aspects of what the curriculum says about early algebraic ideas and reasoning. We will then examine three lesson plans designed to introduce students to foundational algebraic concepts, also

discussing some current doctoral research. This research asks: What strategies do teachers use when teaching algebra in the transition years, and how do these choices reflect their beliefs about mathematics teaching and learning? Participants will have the opportunity to discuss the results of some current research on teachers' beliefs and practices in this area of teaching. They will also review some research findings in current literature, and what this says about the teaching and learning of early algebraic concepts.

### **National Testing: Is it valid**

*Fiona McDiarmid & Deb Gibbs*

The recent publication of the Trends in International Mathematics and Science Study (TIMSS) 2011, has raised much debate in the public and political arena in New Zealand. Analysis of the data indicates that New Zealand students performed less well than most developed countries, and performance of ten year olds has declined since 2001. The question being asked is, 'Why are New Zealand's ten year olds not performing as well as those in other developed countries?' In 2010, New Zealand introduced National Standards in mathematics, reading and writing. The mathematics standards rely on teachers making judgments about a student's overall learning from a wide range of relevant evidence. Other countries such as Australia, England and the United States of America have introduced national testing. The notion that New Zealand students aren't practised in taking tests in this manner has been offered as an explanation for the decline. How does a student's prior test-taking skills and experience impact on results in such a high stakes activity? Do international tests like TIMSS provide an accurate measurement of a student's mathematical understanding and ability to solve complex problems? Should teachers be investing some time in practising the techniques for tests of this type?

This round table forum presents a small-scale study investigating the impact of practiced skills involved in test taking in relation to mathematics standard data. Discussion will focus on high stakes testing versus overall teacher judgments in assessing mathematical competence.

## **SHORT COMMUNICATIONS - Abstract only**

### **Student Engagement in Mathematics: Switching Students On to Mathematics**

*Janette Bobis, Jenni Way, Judy Anderson & Maryam Khosronejad*

Research indicates that students are 'switching-off' mathematics from as early as Year 5. This presentation reports on an intervention study aimed at improving middle year students' engagement in mathematics. Twenty middle year teachers and their students (N=339) from seven schools were involved in a year-long professional development program. Student motivation and engagement levels in mathematics were assessed prior to and at the completion of the intervention. Comparison of student data with those from a similar cohort not involved in the intervention indicates that it is possible to reduce, and even reverse, the downward shift in student engagement levels in mathematics.

### **What Does Numeracy Mean to Teachers of Subjects Other Than Mathematics?**

*Elizabeth Ferme*

Although there has been considerable research into the importance of teaching numeracy and being numerate, little is reported on how numeracy is regarded in the secondary school setting by non-mathematics teachers. This paper reports on a preliminary study into the prominence of numeracy in Australian curriculum documentation and teacher perceptions of numeracy in their daily practice. Results indicate that secondary teachers have a narrow view of numeracy and have limited access to professional learning in that area.

## **How Is 'Teaching As Inquiry' Impacted By Cross-Grouping In Mathematics?**

*Rosemary Golds*

The New Zealand Curriculum advocates a reflective strategy termed 'teaching as inquiry', which encourages teachers to plan for their learners, then continually reflect and respond to their learners' needs (Ministry of Education, 2007). The February 2013 ERO report, *Mathematics in Years 4 to 8: Developing a Responsive Curriculum* (Education Review Office, 2013), has questioned the ability of some schools to be able to provide a responsive mathematics curriculum, particularly for students who are under-achieving. One of the factors which may be having a negative impact on teacher ability to foster 'teaching as inquiry' is the practice of streaming which has become quite common in recent years in New Zealand primary school mathematics (Years 1-8). This paper looks at the background of streaming in classrooms, and explores the connections that can be made with current research in regards to effective classroom practice for all learners of mathematics.

## **"Am I a Maths Type of Person": Responses of Top Stream Year 8 Students**

*Gavin Little*

As part of a longitudinal study on mathematics identity formation and senior subject selection, responses from five top streamed classes of Year 8 students, to the open-ended question "Am I a maths type of person?" have been thematically analysed through examination of key words. Consideration is given to the type of mathematical identity these top streamed students are constructing and how this is related to their intended mathematics pathway in Years 11 and 12.

## **Narrative Inquiry and the Formation of Mathematics Identity**

*Gavin Little*

Mathematics identity, as a specific type of identity, may be considered through a variety of paradigms. If identity is defined as a narrative, analysis of the formation of mathematics identity may be undertaken through narrative inquiry. A narrative approach allows the researcher to consider both personal understandings and meanings relating to mathematics identity, in the participants' spatial and temporal location. Narrative inquiry allows the consideration of the "why" behind participants' statements and actions, within their particular context, over a period of time.

## **Utilizing Open-Source Dynamic Mathematics Software in Teaching Geometry: an**

*Mailizar*

This paper discusses the differences of students' achievement between using open-source dynamic mathematics software (GeoGebra) and Geometer's Sketchpad in learning geometry. There were 43 participants taken from two secondary school classes in Indonesia. The GeoGebra group consists of 21 students, and the Geometer's Sketchpad group consists of 22 students. The findings show that the use dynamic mathematics software can have positive effect on students' achievement. However, findings do not show any significant difference between the two groups.

## **Impact on Identity and Self-Efficacy of Primary Pre-Service Teachers: Experiences In the Mathematics Practicum Classroom**

*Karen McDaid*

Developing quality teachers of mathematics is a global concern and research into mathematics teaching, early career primary teacher identity and teacher self-efficacy often focused on teachers' beliefs and the relationship between beliefs and teaching practice. While some studies have looked at early career teachers and mathematics, none have focused solely on pre-service teacher beliefs about their teaching identity as teachers of primary mathematics as it is constructed over the duration of the practicum. The proposed longitudinal case study aims to track the impact on self-efficacy and identity of pre-service

primary teachers as they participate in their practice teaching.

### **Worksheets vs. Practical Activities in Mathematics in the Primary Classroom**

*Bilinda Offen*

As a teacher educator in primary mathematics, I am intrigued by the number of 'worksheets' used; this is the antithesis of my philosophy of how primary mathematics should be implemented. My proposed research is informed by a study by Marcia L. Tate (2009). My study will compare the engagement of students, concept retention and practical application of numeracy skills of children using worksheets to those involved in practical hands on activities.

The children will be taught using a range of activities. Their learning behaviours will be monitored, they will be interviewed regarding their attitudes and formative assessment will be administered.

### **The Implementation of the Patterns and Early Algebra Preschool (PEAP) Professional Development (PD) Program in Indigenous Communities across New South Wales**

*Marina Papic, Kate Highfield, Joanne Mulligan, Judith McKay-Tempest, Deborah Garret, Monique Mandarakas, & Elizabeth Granite*

This short communication outlines a three-year study with 15 Aboriginal Community Children's Services across New South Wales and the Australian Capital Territory. The project engaged more than 60 early childhood educators and approximately 240 children aged 4 to 5 years. Following an Early Mathematical Patterning Assessment (Papic, in press; Papic, Mulligan, & Mitchelmore, 2011) the project implemented an early patterning framework that developed young children's mathematical thinking and problem-solving skills. Follow up interviews with kindergarten teachers, supported by data from Best Start assessments (NSW Department of Education & Training, 2009), provides evidence of the potential impact of this program on children's mathematics learning. A key finding is the increased confidence and pedagogical content knowledge of early childhood educators.

### **"Teacher's Dilemma" In Using The Internet As A Mathematical Resource In Multilingual Settings**

*Sitti Maesuri Patahuddin*

Indonesian government policy stipulating English as the language of mathematics instruction has created dilemmas for mathematics teachers since they are themselves not proficient in English communication, or with the English mathematics register. The question thus arose as to how mathematics online learning resources (in English) could support the development of learners' "English Maths" proficiency. Would the language in which mathematical ideas are communicated deny learners' access to mathematics learning and constrain teachers' capacity to develop rich mathematical talk? Both questions will be discussed through critical incidents from video data analysis of one teacher, teaching fractions in a secondary school.

### **Mentoring Undergraduate Primary Education Students In The Mathematics Classroom ? The Development Of A New Model To Help Reduce Mathematics Anxiety**

*Timothy Perkins*

Increasing numbers of students enrolled in primary pre-service teacher Education degrees in Australia enter university with insufficient mathematical content knowledge (Livy & Vale, 2011) and low confidence levels about their ability to teach and do the mathematics required for their intended role as classroom teachers (Wilson, 2009). Teachers need to have the knowledge and teaching skills to improve student outcomes in the mathematics field (Beswick, 2012). This research project explores the development of a mentoring model aimed at increasing the confidence and competence of pre-service primary teachers by matching them with well trained, highly capable, confident and supportive primary mathematics teachers as mentors.

## **Students' Preferences When Learning How To Use Advanced Calculators To Solve Mathematics Problems**

*Hazel Tan*

In this presentation findings from part of a PhD study on students' learning preferences and their use of advanced calculators such as graphics calculators and CAS calculators will be shared. Students' responses to a question asking for their preferred method of learning how to use the calculators to solve mathematics problems will be shared. Amongst the different methods, the highest percentage of students indicated that they most preferred to try out the calculator steps while receiving instructions such as observing a demonstration, listening to an explanation, or reading the instructions. The implications of the findings will be discussed.

## **POSTERS – Abstract only**

### **Investigating the effect of the second-order use of context on Mathematics literacy tasks**

*Felipe Almuna-Salgado & Caroline Bardini*

The incorporation of contextualised tasks has been highly recommended by reform documents and curricula. Nevertheless, the role that task context plays in assessments is an unsolved matter because there are arguments relate to whether it makes a task easier or harder for students. This study represents an attempt to scrutinise to what extent the nature of demand of the second-order use of context may affect students' performance on literacy tasks. It is anticipated that this study can provide a deeper understanding of how task context impacts students' performance, thereby contributing to the improvement of contextualised assessments among teachers, policy makers, and assessment writers.

### **Exploring secondary school mathematics teachers' understanding of statistical graphs**

*Ajeevsing Bhoola & Leena Ramkalawon*

One of the most basic tasks in statistics is to represent data graphically and this suggests that teachers need to possess graphical competence. We explore the statistical graph comprehension of one pre-service and one in-service secondary school mathematics teachers through a series of video recorded interviews. Initially, both teachers claimed strong self-efficacy towards teaching statistical graphs conceptually. However, thinking processes deployed by them to selected statistical tasks revealed procedural knowledge rather than the claimed conceptual knowledge. These consequences suggest that the focus should be on developing the necessary competencies of teachers to work with statistical graphs effectively.

### **Designing a detailed instructional framework: A teaching experiment in multiplication and division**

*David Ellemor-Collins*

Within a larger design research project, we developed an instructional framework for multiplication and division, to be refined through a teaching experiment with low-attaining primary students. We describe the instruction at multiple scales, from the broad organization into domains and phases, through the sequencing of small topics, to the details of specific instructional activities. We also map the multiple dimensions of mathematisation involved: progressions toward larger numbers, more abstract settings, more formal notations, more sophisticated strategies, and so on. The framework contributes to research on arithmetic instruction; and also to our developing notions of frameworks, learning trajectories, and instructional design.

## **Testing a Framework of Cognitive Ability and Student's Thinking Process in Geometric Argumentation**

*Tsu-Nan Lee & Caroline Bardini*

This study aims to analyse student's thinking process in geometric argumentation from geometric examples and counter-examples between Grade 3, 5 and 7 students in Victoria, Australia and Taiwan. There are two experiments in this study. The first will test and compare cognitive frameworks of geometric argumentation. The second will analyse student's thinking process through geometric examples. It is anticipated that this study can provide a better understanding of thinking process in geometric activities and assist students enhance their abilities in geometry.

## **Pattern-based learning in Linear Algebra**

*Rosemarie Mohais*

In the traditional Mathematics classroom, usually a small fraction of students are able to form or recognise patterns which are core to solving problems, however, many other students never get as far. Pattern-based learning is a new developing strategy that aims to promote effective teaching/learning of Mathematics by enabling all students to recognise patterns. The technique involves presentation of the solutions to standard well-known problems through software. Once the student has gained experience in solving multiple problems using a clear pattern of solution, he/she can then independently apply the technique. In this poster, Pattern-based learning is applied to Linear Algebra.

## **Effects of using different types of display and rules on pre-schoolers patterning recognition in Malaysia: A preliminary study**

*Sharifah Norul Akmar Syed Zamri & Nor Adlina Fadil*

The aim of this preliminary study is to explore the effects of using different types of display and pattern rules on achievement in pattern recognition among pre-schoolers in Malaysia. A total of one hundred and fifty six pre-schoolers were involved in this study. The instrument used was adapted from Gadzichowski (2012). It contains 25 patterns which were divided into five different groups based on display; colour, shape, object, letter and number. Each group comprised five different patterns with rules of increasing difficulty. Each child was interviewed individually. A correct answer was given 1, otherwise zero. Descriptive statistics and a two factor ANOVA for correlated measures were conducted. Results show that the overall achievement of the children was rather low. Children find certain rules easier than others. The different displays had no significant impact on the achievement of pattern recognition amongst these children.