

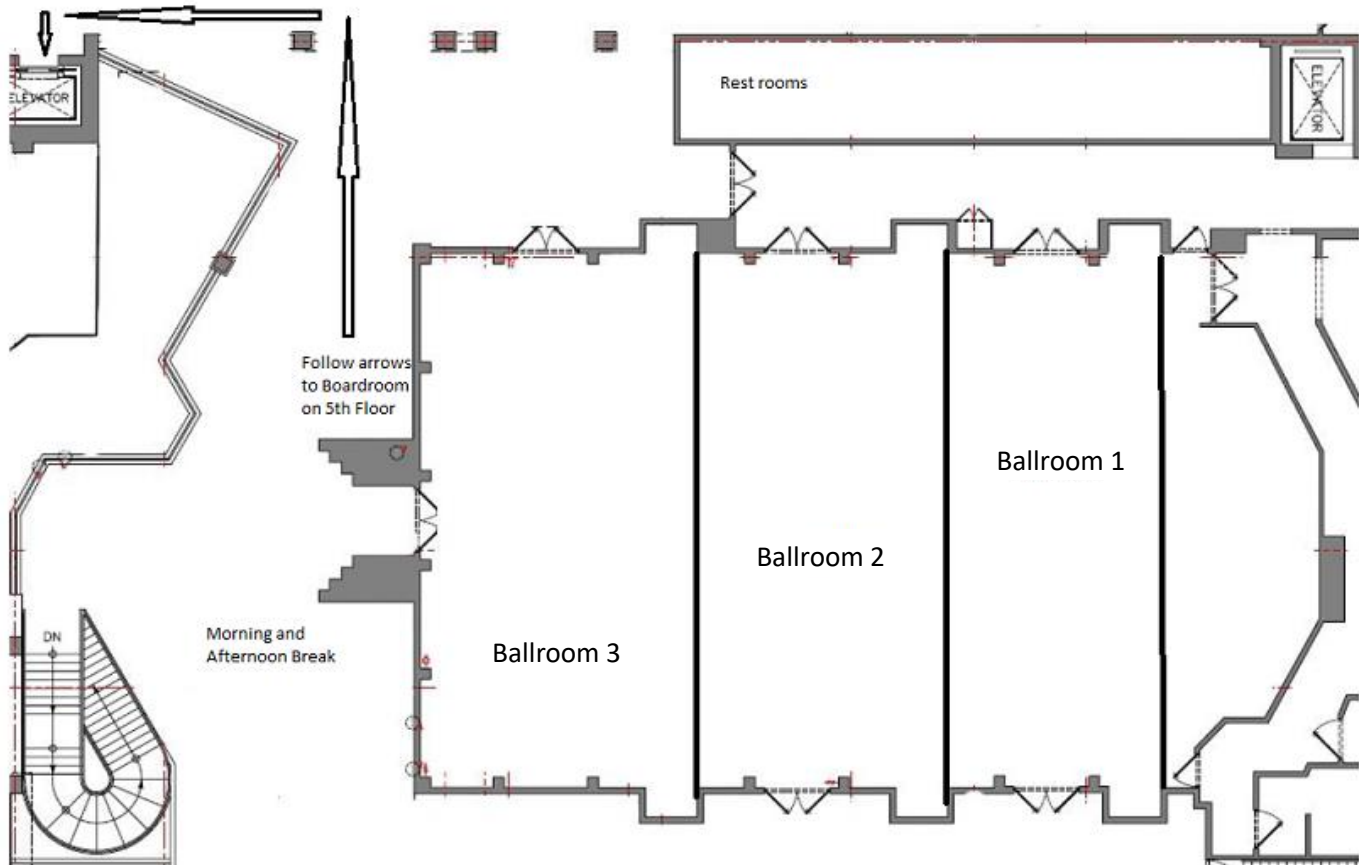


Making Mathematics Meaningful for Students

6th International Realistic Mathematics Education Conference

Grand Cayman Marriott Beach Resort,

Grand Cayman, Cayman Islands



Parallel sessions will be held in Ballroom 1(BR1), Ballroom 2 (BR2) , Ballroom 3 (BR3) and the 5th floor Sunshine Suite (542).

*Audience indicated by:

Primary (Pri)

Secondary (Sec)

College (coll)

Pre-service/Initial Teacher Training (ITT)

Teacher Development (TD)

Thursday, September 20th, 2018

9:00 am – 10:15 am	Keynote Moving from disowning to owning Realistic Mathematics Education			David Webb Frank Eade
Break				
Parallel Sessions 10:45 am – 12:15 pm	What is in the books? Textbook analysis to reveal learning opportunities <i>*Pri/ITT/TD/Researcher</i> <i>Marc van Zanten & Marja van den Heuvel-Panhuizen</i>	Examining the MiC books Models you can count on and Some of the Parts <i>*Pri/sec/ITT/TD/researcher</i> <i>Mieke Abels & Frank Eade</i>	Will the storage rack fit through the door?" – How are pre-service teachers' solutions of a "realistic task" influenced by context? A qualitative study on solution concepts <i>*Pri/sec/ITT</i> <i>Bernd Wollring & Andrea Peter-Koop</i>	Realistic Mathematics Education and Social Awareness: The Privilege Project <i>*Sec/coll/ITT/TD/researcher</i> <i>Kathleen Gibson-Dee</i>
12:15 pm – 1:30 pm	Lunch POSTER PRESENTATIONS			
Parallel Sessions 1:30 pm – 2:30 pm	Designing discourse with ICT environment that affects reification of function <i>*Sec</i> <i>Minoru Ohtani</i>	Engaging primary school students in meaningful mathematical activities <i>*Pri/ITT</i> <i>Cinzia Bonotto & Marzia Baroni</i>	Classroom Activities for Digital Interactive Simulations to Support Realistic Mathematics Education <i>*Pri/sec/ITT/TD</i> <i>Jeffery Bush & Nancy Kress</i>	Preparing student teachers for realistic mathematics situations through a workable mathematical modelling <i>*ITT/researchers</i> <i>Rina Durandt</i>
Afternoon Break				
2:45 pm – 4:00 pm	Plenary The (he)art of Realistic Mathematics Education			Paul Drijvers
6:30 pm – 8:00 pm	Opening Ceremony and Cocktail Reception at Governor's House. Transportation provided and departs from lobby at 6:15 pm.			

Friday, 21st September, 2018

9:00 am – 10:15 am	Keynote Developing teachers' practices through the use of Lesson Study and RME			Betina Zolkower
Break				
Parallel Sessions 10:45 am– 12:00 pm	A smooth slope to slide is a smooth slide to slope <i>*Sec/coll/ITT/TD/Researcher</i> <i>Rogier Bos</i>	Assisting Inservice Mathematics Teachers in Utilizing RME and STEM Design Principles When Collaboratively Co-Imagining a Lesson. <i>*Sec/coll/ITT/TD</i> <i>Kevin J. Reins</i>	Closing the numeracy gap with Malati Fractions <i>*Pri/sec/ITT/TD</i> <i>Irma Vazquez & Jacqueline Sack</i>	
12:00 pm – 1:15 pm	Lunch POSTER PRESENTATIONS			
Parallel Sessions 1:15 pm – 2:30 pm	Utilising the principles of RME to design and teach meaningful mathematics lessons in the government primary schools of The Cayman Islands <i>*Pri/sec/ITT/TD/researcher</i> <i>Gillian Dasent</i>	Making Math Makes Sense: How to create math learning experiences with hands-on models to enhance field trip excursions and classroom inquiry <i>*Pri/sec/TD/researcher</i> <i>Lauren Siegel</i>	Math simulations in the classroom: Changes in teacher practice <i>*Pri/ITT/TD/researcher</i> <i>Susan Miller</i>	
Afternoon Break				
2:45 pm – 3:45 pm	Plenary Reviewing the research into algebraic thinking and proportional reasoning			Dietmar Kuchemann

Saturday, 22nd September, 2018

9:00 am – 10:15 am	Keynote Principles of Realistic Mathematics Education based on experience working with teachers from around the world			Maarten Dolk
Break				
Parallel Sessions 10:45 am - 12:00 pm	RME and Maths Recovery- A Symbiotic Relationship <i>*Pri/ITT/TD/researcher</i> <i>Maggie Landers</i>	Oral Assessments: Engaging Students in Articulating their Thinking <i>*Pri/sec/ITT/TD/researcher</i> <i>Mary Nelson</i>	Surrounding the Earth with Millions of <i>Playmobil</i> : A Guided Experience of Mathematizing and Didactizing <i>*Pri/sec/ITT/TD</i> <i>Silvia Gabriela Pérez, Betina Zolkower</i>	Productive Struggle – Mining the Power that Lurks within “I Don’t Know” <i>*Sec/coll/ITT/TD</i> <i>William R. Speer</i>
12:00 pm – 1:15pm	Lunch Anchor and Den			
Parallel Sessions 1:15 pm – 2:30 pm	Building Third Grade Students’ Understanding of Division Using RME Framework <i>*Pri/ITT/TD/researcher</i> <i>Blidi Stern</i>	Collaborative design of realistic mathematics lessons for lower secondary school students in Japan <i>*Sec/coll/TD/researcher</i> <i>Shinya Itoh</i>	Using reality in mathematics education: exploring new opportunities <i>*Pri/sec/coll/ITT/TD/research</i> <i>Kees Hoogland</i>	New developments in Realistic Mathematics Education: Research-based designed primary school mathematics education to promote higher-order thinking <i>*Pri/ITT/TD/researcher</i> <i>Marja van den Heuvel-Panhuizen & Michiel VeldhuisFormative</i>
Break				
2:45 pm – 3:45 pm	Plenary Where to Next?			David Webb Frank Eade

Thursday, 20th September, 2018

Keynote

Moving from disowning to owning Realistic Mathematics Education

David Webb and Frank Eade

David and Frank will explore how they gradually came to recognise the importance of RME practices alongside other practices that inevitably influence practioners in any country. They will tell personal stories but will look to recognise the generalizability of the journey for educators and teachers. The ideas will be illustrated with examples from primary to college level mathematics and associated teaching strategies.

Plenary

The (he)art of Realistic Mathematics Education

Paul Drijvers

Paul will examine key aspects of RME that will be illustrated by examples from lower and upper secondary mathematics education. From a more personal perspective, he will explain the talk’s title: the (he)art of Realistic Mathematics Education.

Parallel Sessions

What is in the books? Textbook analysis to reveal learning opportunities [Pri/ITT/TD/Researcher]

Marc van Zanten & Marja van den Heuvel-Panhuizen

Textbooks largely determine what teachers teach and students learn. Therefore, knowledge of what is in the textbooks is very important. In this session, the presenters will discuss their experiences analyzing textbook materials through the lens of Realistic Mathematics Education. You can acquire practice in analyzing textbooks yourself. For this, you may bring your own textbooks with you.

Looking at two examples of MiC books: Models You Can Count On and Some of the Parts Mieke Abels and Frank Eade [Pri/Sec]

Mieke Abels and Frank Eade

Models You Can Count On will focus on specific examples of models used by students in late primary and early high school. You will see very specific examples of how students are encouraged to develop thinking and strategic skills alongside developing the normal arithmetic skills. Some of the Parts examines the early development of fractions and will allow you to explore how models and contexts support the development of initially informal understanding of fractions and how over time this becomes more sophisticated

Will the storage rack fit through the door?" – How are pre-service teachers' solutions of a "realistic task" influenced by context? A qualitative study on solution concepts [Pri/sec/ITT]

Bernd Wollring & Andrea Peter-Koop

The front door of is 2 m high and 1 m wide. A storage rack is 2.40 m wide, 2.05 m high and 20 cm deep. Will it fit through the door? This prototypic task has been presented to pre-service teachers in different contexts which had significant influence on the solution. Participants will engage in the evaluation of a variety of work samples with respect to different realistic versus curricular settings.

Realistic Mathematics Education and Social Awareness: The Privilege Project [Sec/coll/ITT/TD/researcher]

Kathleen Gibson-Dee

This session discusses how challenging and invigorating learning about the intersectionality of privilege was incorporated in ways that changed students' hearts and minds in a statistics course. Students were given the opportunity to view privilege through the eyes of those who have little, found evidence of real differences in privilege, and then reflected on how this project changed their hearts and minds.

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Designing discourse with ICT environment that affects reification of function [Sec]

Minoru Ohtani

Understanding functions is difficult for junior secondary students. There is substantial inconsistency in discourse about functions that may cause difficulties for students. This session will look at designing consistent discourse within a dynamic

ICT environment, and adopt two design heuristics: making a distinction between function and its representation; telling properties of changing quantity in dynamic ICT environment.

Engaging primary school students in meaningful mathematical activities [Pri/ITT]

Cinzia Bonotto & Marzia Baroni

This presentation focuses on the primary school level and explores classroom activities whose focus is on fostering a meaningful approach toward realistic mathematical modelling, and problem solving, as well as a problem-posing attitude. In particular this project investigated the potential that the combination of these processes has for identifying and stimulating critical thinking in mathematics.

Classroom Activities for Digital Interactive Simulations to Support Realistic Mathematics Education [Pri/sec/ITT/TD]

Jeffrey B. Bush & Nancy Kress

Jeffrey presents the design process and preliminary findings from an NSF funded study on how teachers use PhET interactive simulations with activities designed to support the principles of RME. After discussing the activity design process, preliminary findings from observations and interviews of teachers who used these activities as partial replacements for district's curriculum are presented.

Preparing student teachers for realistic mathematics situations through a workable mathematical modelling approach [ITT/researchers]

Rina Durandt

Exposing student teachers to realistic mathematics situations through a workable modelling approach provided an opportunity to develop their mathematical modelling competencies and positively influence their disposition. This inquiry contributed towards identifying some desirable elements and concrete design principles to be included in the professional development programmes of mathematics student teachers.

Friday, 21st September, 2018

Keynote

Developing teachers' practices through the use of Lesson Study and Realistic Mathematics Education

Betina Zolkower

Betina's keynote will focus on her experiences in improving mathematics instruction in Argentinian and US classrooms by developing teachers' practices through the use of lesson study, RME approaches and whole group interactive teaching. It will centre on how teachers conduct classroom interaction and how this interaction expands students' potential for making and exchanging mathematical meanings in verbal language, diagrams and symbolic-algebraic language.

Plenary

Reviewing the research into algebraic thinking and proportional reasoning

Dietmar Kuchemann

Dietmar will look at some recent materials exploring algebraic and proportional reasoning alongside an examination of the extensive research into late primary and early high school students' increasing competence in algebraic and multiplicative reasoning.

Parallel Sessions

A smooth slope to slide is a smooth slide to slope [Sec/coll/ITT/TD/Researcher]

Rogier Bos

Are 14/15 year olds able to reinvent the rather technical notions of slope and tangent line? In this presentation we present results of an internationally field tested task to this purpose. It was designed in context of the EU Erasmus+ project Meria. Central to the task is the design of a smooth slope to slide. But will it be a smooth slide to slope?

Assisting Inservice Mathematics Teachers in Utilizing RME and STEM Design Principles When Collaboratively Co-Imagining a Lesson [Sec/coll/ITT/TD]

Kevin J. Reins

What are possibilities for the intersection of RME and STEM? This session will discuss the researcher's efforts to help inservice mathematics teachers operationalize principles of RME and STEM in lesson design and development, and provide a framework for their work. Come see and engage in a Polygon Spoons activity they created.

Closing the numeracy gap with Malati Fractions [Pri/sec/ITT/TD]

Irma Vazquez & Jacqueline Sack

Irma and Jacqueline will share the Malati Fractions framework and some results from an 8th Grade project with at-risk boys, and our 3rd Grade after-school project, now in its second year. The audience will engage in some of the problems as they discuss how the students have developed over this academic year.

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Utilising the principles of RME to design and teach meaningful mathematics lessons in the government primary schools of The Cayman Islands [Pri/sec/ITT/TD/researcher]

Gillian Dasent

This presentation endeavours to provide an insight into how the government schools of The Cayman Islands have utilised exemplar mathematics lesson plans, that were designed based on the RME approach, in their classrooms and during Lesson Study Cycles. These lessons afford our young mathematicians multiple opportunities to advance their mathematical thinking, develop computational fluency and a mathematical growth mind set through realistic meaningful contexts, the use of a variety of visual representations, mathematical models, collaboration, challenging tasks and natural differentiation. Examples of the lesson plans created, video clips of teams at different stages of the Lesson Study cycle, examples of students' work, and rubrics for lesson observations will be shared during this presentation.

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Making Math Makes Sense: How to create math learning experiences with hands-on models to enhance field trip excursions and classroom inquiry [Pri/sec/TD/researcher]

Lauren Siegel

Math Happens works in collaboration with museums, cultural centers, nature centers, archives and other public institutions. Using newly available digital fabrication tools and with access to original texts by mathematicians, we can create models, exhibits and "making" experiences for students that truly bring math concepts to life.

This session will include making and taking your own math tool!

Math simulations in the classroom: Changes in teacher practice [Pri/ITT/TD/researcher]

Susan Miller

Math simulations provide realistic contexts for students, supporting students in their own mathematizing. Yet, how do these simulations play out in the classroom? Learn how teachers' instructional practices change with the use of these simulations, and how specific design features of these sims impact these practices!

Saturday, 22nd September, 2018

Keynote

Developing Principles of Realistic Mathematics Education based on experience working with teachers from around the world

Maarten Dolk

Maarten will focus on the principles of RME drawing on experiences working with teachers and teacher educators in the USA, Europe, Asia, and South Africa to illustrate how these can be developed in practice.

Plenary

Where to next?

David Webb and Frank Eade

David and Frank will explore how we can develop collaborations across the regions so as to enhance effective mathematics teaching and learning.

Parallel Sessions

RME and Maths Recovery- A Symbiotic Relationship [Pri/ITT/TD/research]

Maggie Landers

An interactive presentation focusing on the blending of RME principles and Maths Recovery to develop authentic mathematical learning. Participants will reflect and analyse video samples of maths learning experiences from classroom settings while investigating the commonalities and contrast between these two theoretical perspectives of Maths Education. The use of mathematical models as *tools for thinking* will be featured strongly throughout this presentation with many opportunities for participants to explore the impact on students' mathematisation of situations.

Formative Oral Assessments: Engaging Students in Articulating their Thinking [Pri/sec/ITT/TD/researcher]

Mary Nelson

Oral assessments are ungraded, small group sessions where facilitators begin to understand student thinking; and students clear up misconceptions, make important connections and negotiate meaning with peers. Students report orals improve their understanding, increase their confidence and help them see the relevance of what they are learning.

Surrounding the Earth with Millions of *Playmobil*: A Guided Experience of Mathematizing and Didactizing [Pri/sec/ITT/TD]

Silvia Gabriela Pérez, Betina Zolkower

How can the principles of Realistic Mathematics Education (RME) provide a guiding framework for instructional design; lesson/unit planning; teaching; and analyzing and interpreting classroom interaction and student-generated work? We will answer this question by working with a newspaper clipping; framing, solving and discussing a problem; and analyzing a selection of productions around that same problem by 7th grade students from a school in San Carlos de Bariloche (Patagonia, South of Argentina).

Productive Struggle – Mining the Power that Lurks within “I Don’t Know” [Sec/coll/ITT/TD]

William R. Speer

Not everyone wants to be a mathematician, but everyone can learn to experience and appreciate the beauty of mathematics in ways consistent to what mathematicians do. We must orchestrate the process of students constructing their own “new” knowledge, and, most importantly, recognize the value of applying that knowledge in ways different from the situation in which it was first encountered or learned.

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Building Third Grade Students’ Understanding of Division Using RME Framework [Pri/ITT/TD/researcher]

Blidi Stemm

Contextual tasks from a unit to develop third grade students’ understanding of division are used to illustrate the potential of RME design principle as a model to improve the teaching and learning of mathematics in Liberia primary schools. A series of questions and representations are used to make connections between informal, pre-formal and formal representations.

Collaborative design of realistic mathematics lessons for lower secondary school students in Japan [Sec/coll/TD/researcher]

Shinya Itoh

This presentation describes collaborative design of realistic mathematics lessons by a researcher and lower secondary teachers in Japan. Lessons related to the Earthquake Early Warning System for 7th grade are treated as one of the examples. In this lesson, students were guided to mathematize shake and spread of an earthquake by using tables, graphs and formulae of functions and to realize significance of mathematics learning.

Using reality in mathematics education: exploring new opportunities [Pri/sec/coll/ITT/TD/research]

Kees Hoogland

Kees will show examples of current research on using technology to represent reality, for example, with images, short video-clips, dynamic animations, and instances of augmented reality. The presentation will focus on inspiring new perspectives on how to bring problems from real life into classrooms to prepare students for mathematical problem solving.

New developments in Realistic Mathematics Education: Research-based designed primary school mathematics education to promote higher-order thinking [Pri/ITT/TD/researcher]

Marja van den Heuvel-Panhuizen & Michiel Veldhuis

In this presentation new developments within Realistic Mathematics Education are discussed based on experiences and findings from the Beyond Flatland project, which aims to make the Dutch primary school mathematics curriculum more mathematical. We present our developed teaching sequences for early algebra, dynamic data modelling, and probability for Grade 5

Poster Presentations

Developing a digital mathematics environment in interaction with design research

Mieke Abels Freudenthal Institute

Numworx LMS – Learning Management System - is the online environment in which course activities are presented. Students and teachers log in here, each with their own role. Teachers present activities per class or group, after which the students work on the activity. Work and results are stored in a database on the Numworx server, available for teachers to examine and analyze. For students, Numworx LMS is a personal online interactive course book, for teachers Numworx LMS provides a way to organize their course and to keep tabs on the progress and problems of their students.

Numworx content is divided into exercise modules, allowing students to practice specific aspects or skills, and course series to augment teaching materials, or replace sections of these. Many modules reflect the influence of Realistic Mathematics Education (RME). Functionalities in the DME, such as feedback options and adaptivity of the educational content, originate from the didactical vision of the Freudenthal Institute. Models and representations play a central role, for example the balance method for solving equations, cutting figures in calculating a surface, an interactive bar model to develop an understanding of fractions. Using interactive models and representations is an important cornerstone of this digital environment. Opportunities created by Numworx for math education give rise to research questions. At the same time the use of Numworx by design research contributes to the features of the digital environment. Many teaching modules have been developed and improved in research projects. Most of these research projects were based on a design research approach in which research and design went hand-in-hand. An example of a research project in which the DME plays a significant role is the FaSMEd project (Formative Assessment in Science and Mathematics Education, <https://research.ncl.ac.uk/fasmed>).

AmadEUs – analysis of didactic elements used in teaching situations in the subject of mathematics

Christoph Ableitinger, Astrid Anger, Christian Dorner University of Vienna, Faculty of Mathematics

The analysis and further development of competencies of math teachers is one of the central concerns of research in the didactics of mathematics. Lesson studies have been proved an effective and enduring concept to improve the quality of teaching. In our project, we use a similar concept for pre-service teacher education and broaden it by integrating students into the lesson analysis process. Hence, their individual and subjective views play an essential role. Analysing interesting scenes of filmed lessons, we try to reconstruct the respective didactic strategy used, determine the influence of the strategy and develop possible alternative didactic strategies.

Developing and Applying Mathematical Understandings and Skills by Primary Students

Camella Buddo, Avalloy McCarthy-Curvin, Delmar Sherriffe University of the West Indies, Mona Campus, Jamaica

The focus in mathematics education globally has undergone several changes in theoretical underpinnings from traditional behaviourism to contemporary constructivism. The shift in emphasis in the mathematics classroom is from drills and practices to situations whereby learners construct their own knowledge and understandings, and apply them in real-world situations. The extent to which this can be achieved depends on the appropriateness of: the mathematics curriculum, instructional practices and assessment strategies, as well as the perspectives that major stakeholders have of mathematics teaching and learning. This poster showcases primary teachers' classroom practices for teaching mathematics, and factors that influence their abilities to not only implement a curriculum as intended, but also to present the real contexts in which mathematics applies.

Assessing Mathematics Learning Realistically. The impact of students' hopes, expectations, anxiety and learning on their success in a college math course

Kathleen Gibson-Dee University of South Florida St. Petersburg

Realistic Mathematics pedagogy must also examine realistic assessment of learning, which differs from traditional mathematics assessment, which tends to focus on a few high stakes exams and predominantly procedural and algorithmic skills. Realistic mathematics assessment should focus instead on learning and provide a way for students to be less anxious and more confident in their mathematical thinking. The purpose of this study was to examine the relationships between hope, expectation, math anxiety, and students' final course scores in College Algebra within the context of an instructional strategy intended to improve student achievement and reduce math anxiety.

Teacher Perceptions and the Impact on their Practice of a Four-pronged Professional Development Model

Karina Hensberry, George J. Roy University of South Florida

The SunBay Mathematics Project promotes a curricular activity system in which professional development (PD), realistic curricular materials, and dynamically-linked virtual representations help teachers engage in student-centered instruction. Students "play" with interactive simulations and engage in multiple predict-check-explain cycles. In addition to the project's problem-based curriculum and technology, a key component is PD. To support effective implementation of materials and pedagogy, the PD focused on: teachers' mathematical content development; students' interactions with the curriculum; productive beliefs about students; and creating a collaborative teacher network. We developed a research-based, three-year PD that was high-touch, responsive, and collaborative.

We examine these research questions:

- What are teacher *perceptions* of this professional development model?
- In what ways has this professional development model impacted teacher *practice*?

Developing Pre-Service High School Teachers' 3D Visualization Skills using Intuitively Accessible Models

Jacqueline Sack & Judith Quander University of Houston Downtown

Aligned with the principles of guided reinvention, a range of activities have been created and enacted using the giant triangles that foster powerful mathematical knowledge shifting from concrete to abstract through learners' interaction with the materials. In general, the activities begin with intuitively reasonable constructs that immediately engage learners. For example, by considering how many triangles can be connected side to side to completely fill the space about one vertex, what happens if one is removed and the two open sides are connected? Continuing in this way, pentagonal, square and triangular pyramids emerge. This particular activity has been used successfully in mathematics methods courses for undergraduate pre-service teachers entering elementary, middle and high school teaching professions, where in previous mathematics courses, use of small hand-size models fail.

Mathematics education and utilization of technology in Japan

Takehiro Tsubokawa National Institute of Technology

In the history of Japanese mathematical culture, there was use of the abacus. Japanese have been reading and writing and doing calculations from before modern times. Children used the abacus as a tool to calculate. However, in modern times, Japanese children only use paper and pencils to learn mathematics, in contrast to using graphing calculators and various PCs in many countries. Among them, there are teachers who use the latest technology for math lessons in Japan. They have developed their own teaching materials while learning much from T3 in the USA. I will present their educational

perspectives and examples of important teaching materials from an analysis of their over 700 proceedings of T3 Japan over the last two decades.

Thinking Algebraically in Context. Examples for Teacher Educators

Sandra Vernon-Jackson University of South Florida, St Petersburg

“One of the most important and persuasive concepts in mathematics is that of a function” (Willoughby 1997). This poster presentation for practitioners is a strategy for engaging students in a fundamental algebraic thinking activity (FATA) is enacted. This engaging, effective activity is presented in the context of realistic situations and is implemented in our STEM Teacher Education program. Elementary students who are immersed in FATA will design their own working models and, generate mathematical meaning-making, while programming input /output abstractly and concretely. The FATA provides a support for teachers in scaffolding or differentiating their teaching of algebraic thinking.

Problem Solving in Context: Examples from Teacher Education

Sandra Vernon-Jackson and Karina Hensberry University of South Florida, St Petersburg

Students will make connections within the context of realistic situations to develop their math problem-solving strategies. This problem solving (PS) in context strategy, is implemented in our STEM Teacher Education program and is about students seeking pertinent mathematics information in context while making conjectures. It supports teachers in scaffolding or differentiating their teaching of PS. This PS in context strategy allows students to be immersed in their learning through discourse and sense making. Students are engaged in doing math and developing mathematical habits of mind. Strategies will be shared on how it was enacted with practitioners.

Comparative research of mathematics classroom assessment in the US and China

Wanqiu Yang Northeast Normal University (China); University of Colorado Boulder

We examine differences and similarities between U.S and Chinese use of in classroom assessment from different angles related to RME reality principle and Dutch Assessment Pyramid – i.e., use of problem context and Mathematical Reasoning Level. Other related aspects of teachers’ assessment practice, such as the quantity and frequency of the assessment offered by teachers, will be discussed in the findings.