Research Council on Mathematics Learning (RCML) 2015

Mathematics Curriculum: Paving the road to student learning

Las Vegas, NV
February 26–February 28, 2015

Picture taken from https://mylongandwindingroad.wordpress.com

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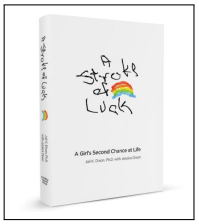
Founders Lecture

Daniel Brahier, Bowling Green State University
Principles, Actions, and RCML
Friday, February 27th, 4:30 - 5:30, Room: Zeus
Abstract With the publication of Principles to Actions, the National Council of Teachers of Mathematics has revisited the research and revised and its vision for reforming mathematics education. Similarly, RCML refocused its direction and mission with the change from its former name of RCDPM and continues to evolve. In this session, we explore the transformation of mathematics education over time and how RCML can help to shape the future of the teaching and learning of mathematics for all students.
Biography Daniel Brahier is a Professor of Mathematics Education at Bowling Green State University who also teaches junior high mathematics at St. Rose School in Perrysburg, Ohio. Throughout his career, he has taught science and mathematics at high school and middle school levels and has served as a school principal and district curriculum consultant. He is the author of several books on mathematics education, including a methods textbook entitled *Teaching Secondary and Middle School Mathematics* and most recently served as a lead author of NCTM's new *Principles to Actions* document. He is married and the father of three sons. His wife and oldest son are also mathematics teachers.

Wilson Lecture

Alex Dixon and Juli K. Dixon, University of Central Florida
How do we fill the gaps? A case study approach to rethinking RtI
Thursday, February 26, 2015, 5:30 PM - 6:30 PM, Room: Zeus
Abstract Students with special needs are often taught exclusively through key words and direct instruction. Learn first-hand from a student with special needs how teaching key words and direct instruction were successfully replaced with teaching for understanding in an inclusive environment.
Biography *Alex Dixon* was a normal, bright, healthy girl, when a sudden onset of a mysterious illness took over her life. Months of treatments failed to provide relief from acute pain and muscle spasms. Doctors across the country were at a loss. A last attempt at treatment - brain surgery - stopped the spasms but caused a massive stroke. At age 12, Alex had to relearn everything. Now 17, Alex shares her story and her amazing recovery. She provides a personal account of strategies for supporting a student with special needs to learn mathematics with depth.

Juli Dixon, Alex's mom, is professor of mathematics education at the University of Central Florida. A prolific writer, she has published numerous textbooks and articles as well as delivered keynote presentations throughout the United States. Juli used everything she knew about teaching and learning to "re-teach" Alex. Her perspectives on "what worked" are relevant to current issues in mathematics education in general as well as to teaching students with special needs.



Learn more about Alex's story at `http://www.astrokeofluck.net`.

WELCOME!

RCML Welcome Statement: Welcome to the 42^{nd} RCML Annual Conference! We would like to thank all of the speakers, attendees, and contributors of the conference. We hope you enjoy all of the sessions and receive valuable information that you can share with your colleagues. We welcome you to Las Vegas, and we anticipate you will have a wonderful experience. Please let us know if we can assist you in anyway. Enjoy the conference!

Conference Chairs: Jeff Shih and Travis Olson, University of Nevada, Las Vegas

Program Chair: Christa Jackson, Iowa State University

Acknowledgements:

University of Nevada, Las Vegas
A special thank you goes to the University of Nevada, Las Vegas for their support of the 2015 RCML Conference.

EAI Education
A special thank you for EAI Education and Barbara Tuzzeo for donating conference bags for the attendees. We appreciate their support of the 2015 RCML Conference.

Proposal Reviewers
We extend a special thanks to the team who reviewed proposals: Robert Afonso, Mollie Appelgate, Chris Austin, Kayla Blyman, Jonathan Bostic, Kelley Buchheister, Laura Callis, Maureen Cavalcanti, Kansas Conrady, Becky Darrough, Bill Deleeuw, Eileen Faulkenberry, Angela Krebs, Maranda Miller, Travis Olson, Sarah Roberts, Thomas Roberts, Alejandra Salinas, Sasha Wang, and Sean Yee.

Program Layout
A huge thank you goes to Dr. Keith Emmert for working many hours to prepare the layout of the program booklet.

Overview of Friday Morning Sessions				
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Apollo 5	*Development of the Draw a Mathematics Teacher Test and Rubric* Juliana Utley, Stacy Reeder, Adrienne Redmond-Sanago	*Assessing Preservice Teachers' Attitudes toward Mathematics Over Time* Cindy Jong, Thomas Hodges	*Readin', Ritten', and Rithmetic - NAEP Mathematics and Reading Scores* Pat Jordan	*Students' engagement, confidence, and use of technology for learning algebra* Linda Venenciano, Judith Olson, Melfried Olson, Stephanie Capen
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Apollo 8	*Characteristics of Different Learning Environments in Geometry Classrooms* Zhonghong Jiang, Alex White, Brittany Webre	*Item Response Theory Analysis Applied to Math Assessment Instruments* Jerry Obiekwe	*Smoothing The Ups and Downs: Tools for Professional Transitions* Kansas Conrady, Jonathan Bostic, Sean Yee, Sarah Ives

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Apollo 7	*Strengthening Prospective Elementary Teachers' Conceptions of Factors* Ziv Feldman, Matt Roscoe	*The Impact of a Two Year Professional Development Program on Math Teachers* Sue Brown	*The challenges and possibilities of the edTPA* Tony Thompson, Kwaku Adu-Gyamfi, Maureen Grady	*Empowering Ownership of Proof with Communal Proof-Writing Criteria* Sean Yee, Boyle Justin, Winnie Ko, Sarah Bleiler
Apollo 8	*Advancing Additive Reasoning with Second Differences* Nathaniel Phillips, Catherine Ulrich	*A Second grader's understanding of negative numbers* Seungoh Paek, Daniel Hoffman	*Bridging the algebra gap: Effects of an online summer math refresher* Jodi Frost, Nicole Bailey , Eric Graves, Ellie Pounds	*The 30 Second Challenge: Improving Preservice Computational Fluency* Rachel Bachman, Dixie Blackinton

The Influence of Beliefs on Five Pre-service Teacher's SCK Development		Room: Zeus Time: 4:30-5:30
Vecihi Zambak	Clemson University	vzambak@g.clemson.edu

With the introduction of Mathematical Knowledge for Teaching (Ball, Thames & Phelps, 2008) into the lexicon for mathematics education, mathematics teachers are expected to develop a subject-matter knowledge special to the profession of teaching: Specialized Content Knowledge (SCK). Even though SCK as a new construct was defined, the way to support the development of this knowledge during teacher education is not clear. In this case study, I examined the SCK development of five pre-service teachers' SCK development with Geometer's Sketchpad during three clinical interviews. Teachers' beliefs about mathematics, teaching and technology were hypothesized to be factors influencing the impact of technology on knowledge development. Results indicated that teachers with Platonic beliefs about mathematics, content-focused beliefs about teaching with an emphasis on conceptual understanding, and substantive beliefs about technology developed their SCK more than teachers having other type of beliefs about mathematics, teaching and technology.

Community College Student Perspectives and Experiences with PBL		Room: Zeus Time: 4:30-5:30
Rachel Bates	Redlands Community College	rachel.bates@redlandscc.edu

Despite the various forms of research that has highlighted the cognitive understanding of how mathematical knowledge is acquired and utilized, students typically experience mathematics through years of fragmented encounters leading them to believe that mathematics is comprised of meaningless symbols, memorizing inflexible formulae and procedures, and exercises far removed from their own interests. This pervasive manner of teaching mathematics undermines meaningful learning. Students who were previously unsuccessful in learning "drill-and-skill" algorithms are basically presented with the same instructional approach yet again. The methods that failed to develop students' mathematics understanding in PK-12 are found to be unsuccessful for most of the students in community college. Although there is a plethora of research on reform based statistics, there is little research on the perspective of the problem based learner in college level introductory statistics courses. The purpose of this study was to describe, through a phenomenological approach; the characteristics of a non-traditional introductory statistics course designed for undergraduate students, approaches to learning statistical concepts as the student engaged in problem based learning activities and to focus on the perceived student learning experiences and emerging statistics understanding as a result of engaging in various problem based learning activities within the course.

Assessing Children's Number Understanding through a Web-Based System		Room: Zeus Time: 4:30-5:30
David Pugalee	Center for STEM Education, UNC Charlotte	david.pugalee@uncc.edu

This paper reports on the effectiveness of a professional development project Assessment Practices to Support Mathematics Learning and Understanding for Students (APLUS). The project assists the implementation of an assessment model in grades K-3, with the accent on providing teachers in K-2 with the skills and knowledge to effectively use a web-based assessment system focusing on elementary number understanding. Though no statistically significant differences between the student treatment group and student control group were revealed, the average performance for classroom and school were found to have significant impacts on student performance and the connection between performance and time passed from the beginning to the end of the use of the assessments.

The evolution of PSTs' beliefs: Examining the effect of teacher preparation		Room: Zeus Time: 4:30-5:30
Eileen Faulkenberry	Tarleton State University	efaulkenberry@tarleton.edu
Kathy Smith	Tarleton State University	ksmith@tarleton.edu
Beth Riggs	Tarleton State University	eriggs@tarleton.edu
Thomas Faulkenberry	Tarleton State University	faulkenberry@tarleton.edu

Pre-service teachers at this regional university take a series of 3 mathematics education courses during their teacher preparation experience. This study will examine how the pre-service teachers' beliefs change over the course of these three semesters. Data includes qualitative and quantitative measures collected throughout the semesters.

Korean Secondary Math Teachers' Understanding of Formative Assessment		**Room: Zeus Time: 4:30-5:30**
Sun Hee Lee	University of Illinois at Urbana-Champaign	lee771@illinois.edu

My dissertation research was conducted to learn about twelve Korean secondary math teachers' understanding of formative assessment. Conducting semi-structured interviews and qualitative data analysis, I investigated the following: (a) Korean secondary math teachers' understanding of formative assessment; (b) social, educational, and policy contexts that affect how teachers implement formative assessment practices; and (c) how teachers learn about formative assessment. Korean teachers were able to distinguish between formative and summative assessments. They demonstrated a wide range of formative assessment strategies, which were clustered around three practices of DAP (elicit, interpret, and use assessment information). Teachers were systemically involved in professional development programs based on institutes and school districts, which helped them adopt new educational policies into their practice. Because literature documents that there is a gap between teachers drawing inference about student learning and planning further instructional steps based on the evaluation, teachers' formative assessment knowledge was captured through three tasks. Teachers examined students' written work on two-digit multiplication problem and part-whole comparison of fractions, and examined scenarios of a lesson on the law of exponents. One scenario represents convergent formative assessment (traditional approach) and the other divergent formative assessment (social-constructivist approach).

Students' Mathematics-Related Beliefs and STEM Model-Eliciting Activities		**Room: Zeus Time: 4:30-5:30**
Cathrine Maiorca	University of Nevada, Las Vegas	cemaiorca@icloud.com

The mathematics and mathematics-related beliefs that have been cultivated in the traditional classroom setting need to change in order for students to fully participate in the age of information. In this new age, mathematical thinking is no longer just computations, it is also the ability to construct, describe and explain phenomena, i.e. modeling. One way to change mathematics-related beliefs is through integrated STEM model-eliciting activities. The purpose of this presentation is to discuss a study on students' mathematics-related beliefs and how they are influenced by model-eliciting activities. In this presentation the initial findings of a qualitative case study will be examined and directions for possible future research will be discussed.

Developing Productive Disposition in Struggling Mathematics Students		**Room: Zeus Time: 4:30-5:30**
Maureen Grady	East Carolina University	gradym@ecu.edu

This presentation will look at evidence from classroom observations and student interviews that high school students with a history of poor success in mathematics can develop a productive disposition towards mathematics. We will examine evidence of the ways in which these students have come to see mathematics as connected and sensible and have come to believe that their efforts can help them to be successful in mathematics. We will then look at instructional practices that seem to influence the development of this disposition.

Getting Virtual: Exploring the Benefits and Challenges of using Second Life		**Room: Zeus Time: 4:30-5:30**
Glenn Phillips	Texas A&M University	glennallenphillips@gmail.com

Through a five-year National Science Foundation grant, the Knowledge for Algebra Teaching for Equity (KATE) team has used Second Life, a virtual environment, to give middle-grade, pre-service teachers an extra-curricular teaching experience. Students respond well to "real" teaching opportunities that place students directly in front of middle-grade students. However, apart from some methods courses and student teaching semesters, it is difficult (and sometimes irresponsible) to put unprepared pre-service teachers in control of classrooms. Second Life offers a "risk-free" zone where pre-service teachers can prepare a lesson, consider the context of their classroom, present a lesson, follow through with practice, and reflect on their experience with little liability and never leaving the campus. Additionally, operating Second Life as an instructor or avatar student gives pre-service teachers more training and comfort with the virtual platform, which will, in its present form or another, one day be common in all classrooms. This presentation considers the benefits of teaching and tutoring in Second Life, explores the ways KATE has used Second Life, and suggests how future classrooms could adapt the training program and protocol used in KATE.

Teacher Application of Questioning in Contextualizing Algebraic Functions		**Room: Zeus Time: 4:30-5:30**
Eloise Kuehnert	University of North Texas	eloise.kuehnert@unt.edu
Sarah Pratt	University of North Texas	sarah.pratt@unt.edu

This proposal aims to outline the application of teacher questioning of two middle school teachers within a contextualized algebra lesson. The connection between a teachers' MKT and the quality and nature of questioning, as measured by AssessToday© (Eddy & Harrell, 2012), will be examined. During a summer professional development, participants attended Six Flags over Texas to collect data then followed with a 5E lesson involving Hot Wheels© tracks that would emulate their roller coaster experiences. A pre-interview will be conducted before the observation followed by a post-interview. Preliminary findings and future plans will also be included in the display.

Significantly Traumatized Children in the Mathematics Classroom		**Room: Zeus Time: 4:30-5:30**
Jared Williams	Spokane Public Schools	JaredW@spokaneschools.org
Keith Adolphson	Eastern Washington University	kadolphson@ewu.edu

This preliminary study explored the connection between students who had experienced significant childhood trauma and subsequent mathematics learning. The purpose of this project was to observe the behavior and responses of traumatized middle school students immersed in a problem-centered mathematics learning environment that was intentionally designed to address their needs. Preliminary results suggest positive growth was observed in each students' willingness to explore mathematics, ability to determine what they were capable of, ability to communicate their needs, apparent motivation, or positive affective responses such as enthusiasm and attitude.

Early Childhood Gender Differences in Number Sense When Learning with iPads		**Room: Zeus Time: 4:30-5:30**
Amy Adkins	University of Nevada, Las Vegas	adkinsa5@unlv.nevada.edu
Jeffrey Shih	University of Nevada, Las Vegas	jshih@unlv.edu
Lina DeVaul	University of Nevada, Las Vegas	zangl@unlv.nevada.edu
Taro Ito	University of Nevada, Las Vegas	taro@unlv.nevada.edu
Charles Allen	University of Nevada, Las Vegas	cmallen@unlv.nevada.edu

iPads offer a new and engaging platform for young children to learn mathematics. In this poster presentation, attendees will learn how a progressive set of number sense intervention apps impacted the learning of early childhood number sense development. Specific skills of number sense such as the ability to identify numbers, order numbers, match quantities to numbers, subitize numbers, and compare quantities will be examined with respect to gender. Results will be shared and the progress of girls and boys will be discussed.

Assessing Pre-service Mathematics Teachers' Misunderstanding of Probability		**Room: Zeus Time: 4:30-5:30**
Lina DeVaul	University of Nevada, Las Vegas	zangl@unlv.nevada.edu

The purpose of this study is to assess the misunderstandings of probability that pre-service math teachers have when solving the Monty Hall Problem. Thinker-Doer Pair Activity (Hart, Schultz,& Najee-ullah,2004) and six types of Socratic questions (Paul & Elder, 2006) were used as diagnose tools. Two graduate students who enrolled in secondary mathematics education course participated in this study. Findings showed that participants had solid probability calculation process knowledge; however, participants didn't understand or accept the Law of Large Numbers; participants also stronger belief on logical reasoning conclusion (for example, game theory) than their belief on probability calculation result.

High School Predictors of College Mathematics Readines		**Room: Zeus** **Time: 4:30-5:30**
Ryan Hale	Barry University	ryan.hale@mymail.barry.edu

Research on the relationship between socioeconomic status and educational outcomes of students is abundant, but research related into factors that are capable of mediating the effects of poverty on the education of children is limited. The high school longitudinal study of 2009 (HSLS:09) collected data from over 21,000 ninth grade high school students, related to the educational and social experiences of students. Data were also linked to students' performance on a mathematics assessment. The present study used HSLS:09 data to identify factors that predict mathematics performance above and beyond socioeconomic level, in order to provide educators of impoverished children direction in terms of tackling the issue of mathematics competency. Two such factors were identified to have a significant level of predictive power over and above socioeconomic level; future plans for math achievement, and parental influence. Of these two factors. future math plans has the greatest ability to predict achievement in mathematics over and above socioeconomic level. These findings shed light on the importance of providing low socioeconomic level students with opportunities to understand the importance of mathematics in order to plan for future mathematics coursework. The need to increase parental involvement in educational endeavors is also underscored. Key Words: At-risk, mathematics achievement, low socioeconomic level, poverty.

Inservice Teachers Perception of Using Literacy Strategies in Mathematics		**Room: Apollo 1 Time: 8:00-8:45**
Carolyn Pinchback	University of Central Arkansas	carolinp@uca.edu
Shoudong Feng	University of Central Arkansas	sfeng@uca.edu
This presentation is based upon a project funded in part by a federal grant under Title II Part B of the No Child Left Behind Act (P.L. 107-110) administered by Arkansas Department of Education. The goal of this project is to increase the level of content knowledge and skills in STEM areas by integrating science, technology, engineering and mathematics with literacy programs. Thirty teachers participated in a professional development course that integrated science, mathematics, literacy, and technology for elementary/middle level teachers from the central part of the state. The focus of this presentation will be the literacy strategies that were presented to the teachers in the instruction of mathematics. The speakers will also share the teachers' comments about the strategies.		

Teaching Secondary Mathematics from Historical and Cultural Perspectives		**Room: Apollo 2 Time: 8:00-8:45**
Roland Pourdavood	Cleveland State University	r.pourdavood@csuohio.edu
Patrick Wachira	Cleveland State University	p.wachira@csuohio.edu
Perspectives on Science and Mathematics is a new course development for prospective secondary mathematics and science teachers. The course explores a selection of topics and episodes in the history of science and mathematics. The specific objectives and expectations are part of four broad, interlocking goals: (1) provide an overview of history of science and mathematics; (2) enable future teachers to enact these historical perspectives and contexts throughout their pedagogy; (3) promote intellectual curiosity and sharpen critical thinking skills; and (4) improve presentation and writing skills. By developing, preparing, and teaching mathematics and science lessons at the intermediate and secondary school settings in historical contexts, the interns will have a better appreciation of teaching profession. We will share our two years of experience working with prospective mathematics and science teachers. The conference participants will have opportunities to reflect and share their ideas and perspectives relative to the proposed presentation.		

Navigating the Video Stream for Mathematics Education		**Room: Apollo 3 Time: 8:00-8:45**
Lucas Foster	Northeastern State University	fosterlb@nsuok.edu
The effectiveness and value of video presentations in the mathematics classroom has long been researched and debated, with disparate results. This paper examines the results of incorporating videos into a mathematics education classroom, including the benefits and pitfalls that exist when attempting to utilize video streaming as part of the course curriculum.		

Supporting K-10 Teachers' Proficiency with the SMPs		**Room: Apollo 4 Time: 8:00-8:45**
Jonathan Bostic	Bowling Green State University	bosticj@bgsu.edu
Gabriel Matney	Bowling Green State University	gmatney@bgsu.edu
The aim of this session is to share key features and research evidence of the impact two PD programs, which supported teachers to provide students more frequent - and richer - opportunities to engage in the Standards for Mathematical Practice. The two PD programs were designed for teachers in different geographical locations; one program supported elementary teachers while the other secondary teachers. Within these programs, teachers videotaped their instruction at the beginning and end of this yearlong PD. Evidence of students' engagement in the Standards for Mathematical Practice was analyzed using a protocol (Fey, Kobett, Wray, 2013). Results of this analysis and videos of mathematics teachers' pre- and post-PD instruction will be shared for discussion. We will synthesize our session by exploring implications for mathematics-focused Common Core State Standards PD and instruction.		

Development of the Draw a Mathematics Teacher Test and Rubric		**Room: Apollo 5** **Time: 8:00-8:45**
Juliana Utley	Oklahoma State University	juliana.utley@okstate.edu
Stacy Reeder	University of Oklahoma	reeder@ou.edu
Adrienne Redmond-Sanago	Oklahoma State University	adrienne.redmond@okstate.edu

The use of drawings is one way of examining personal beliefs. Given the potential for launching reflection on and a discussion about the impact of personal beliefs on one's teaching mathematics, we will discuss the development of the Draw a Mathematics Teacher Test and rubric for assessing the mental models or images held by preservice teachers. Additionally, we will share samples of preservice teachers' drawings. Attendees will be encouraged to provide feedback on the scoring rubric.

Impact of Student Understanding of Function on Their Understanding of Limit		**Room: Apollo 6** **Time: 8:00-8:45**
Taylor Jensen	Western Governors University	tajknight@gmail.com

Since the concept of limit in introductory calculus usually concerns a process applied to a single function, it seems reasonable to believe that a robust understanding of function is beneficial to and perhaps necessary for a meaningful understanding of limit. In order to measure the strength of the correlation between understanding of function and understanding of limit, two tests—the Precalculus Concept Assessment (PCA) to measure function understanding and the Limit Understanding Assessment (LUA) to measure limit understanding—were administered to students. Correlations between students' PCA scores and students' LUA scores were calculated, as were correlations between students' PCA scores and students' scores on particular subcategories of limit understanding measured by the LUA. The relative strength of the computed correlation coefficients as well as graphical scatterplots of the results provide useful insights as to the nature of the relationship between students' understanding of function and their understanding of limit. Based on these results, it is concluded that understanding of function is a significant predictor of future understanding of limit. Recommendations for practicing mathematics educators and indications for future research are provided.

An Examination of Factors Impacting College Algebra Readiness		**Room: Apollo 7** **Time: 8:00-8:45**
Elizabeth Howell	Southern Methodist University	ehowell@smu.edu

Nationally, many students entering higher education via community colleges are under-prepared for college level mathematics courses. Many community college students require developmental mathematics coursework prior to becoming eligible to enroll in credit math courses such as College Algebra. Additionally, many students have difficulty successfully completing the sequence of developmental courses, and as a result success in College Algebra is increasingly difficult to obtain. Recent education initiatives suggest that acceleration through the developmental sequence is a promising model for students, as well as the practice of mainstreaming developmental students into credit mathematics courses with additional supplementary support. Yet little evidence exists to support that these models are effective at scale for most students struggling with college mathematics. By examining longitudinal data for a cohort of community college mathematics students over a five year period, we are examining rich information as to what paths through developmental math courses were most successful for students requiring remediation. Non-academic factors such as race/ethnicity, SES, gender, language background, previous math coursework, SAT/ACT test scores, and measures of engagement in the college will be considered as potential moderators on successful completion of College Algebra through one of these paths.

The Mathematical Education of PSTs: A Stroll Through Some Literature		Room: Apollo 1 Time: 9:00-9:45
Kansas Conrady	University of Oklahoma	kansas.conrady@ou.edu
Elayne Bowman	University of Oklahoma	ewbowman@ou.edu

Despite the model one may select, it is becoming widely recognized that one must know more than just a set of standard algorithm and procedures in order to successfully teach mathematics. While the Mathematical Knowledge for Teaching Framework (MKT) has labeled additional types of necessary knowledge (Ball, Thames, & Phelps, 2008), the Conference Board for Mathematical Sciences (CBMS) provided a series of recommendations for how this knowledge should be obtained in the Mathematical Education of Teachers II (CBMS, 2010). The six recommendations presented in METII were used as a framework to explore current literature and provide insight on the overall effectiveness of this framework on the development of future teachers of mathematics. Findings and suggestions for future studies as described in this literature will be shared.

Flipping College Algebra to Increase Student Engagement and Achievement		Room: Apollo 2 Time: 9:00-9:45
Jennifer Clinkenbeard	California State University Fullerton / Claremont Graduate University	jclinkenbeard@fullerton.edu
Cherie Ichinose	California State University Fullerton	cichinose@fullerton.edu

The flipped learning environment blends the innovation of online learning with student centered face-to-face instruction. In this session, we present a pilot study comparing a flipped college algebra class with a traditional lecture. The data were gathered in spring and summer of 2014. The model for the flipped class engages the student on three distinct occasions: online modular mini-lectures with embedded questions; a pre-assessment; and an in-person math lab discussion facilitated by the professor. Using a pre- and post-test method, we employ standardized assessments and rubrics in both course models to compare both academic and affective domains. Preliminary findings suggest that the passing rates for students in the flipped model were statistically higher than students in the traditional class ($t = 3.701$, $df = 650$, $p < .001$). In addition to comparing the grades of individual students in each classroom model on each major exam as well as their final course grade, we also consider the change in content mastery as demonstrated by the student via the Mathematics Diagnostic Testing Project; the change in reported mathematical beliefs via the 2012 Programme for International Student Assessment; and the comparison of responses with regard to the class setting.

Conceptual Versus Procedural Approaches to Ordering Fractions		Room: Apollo 3 Time: 9:00-9:45
Lynda Wiest	University of Nevada, Reno	wiest@unr.edu
Troy Thomas	University of Nevada, Reno	troysailer@yahoo.com
Frank Amankonah	University of New Mexico-Gallup	amankona@unm.edu

This paper reports the performance of 30 rising seventh-grade girls on a task in which they were asked to order four fractions from least to greatest. Less than three-fifths attained correct answers. The performance gap was widest between students who attended Title I schools and those who did not, the latter being much more likely to attain correct answers. The achievement gap was less prominent by race/ethnicity, family socioeconomic status, and community type (suburban/urban versus rural). Participants tended to use procedural and conceptual approaches equally, but conceptual approaches were more successful. The most common procedural strategy was converting fractions to equivalent fractions, and the most common conceptual strategy was making drawings that illustrated part-whole concepts. The most problematic fractions to place in order of relative size were the two middle fractions, which were somewhat closer to each other in size than other adjacent pairs and were farthest from the benchmarks of 0 or 1. Based on these and other research findings, we conclude that it would benefit students to possess a greater repertoire of specific strategies, especially conceptual strategies such as the use of number lines, benchmarks, and set models, for working with fractions.

Urban teachers' pedagogical changes from CCSSM professional development		**Room: Apollo 4 Time: 9:00-9:45**
Susie Morrissey	Illinois Institute of Technology	gmorriss@hawk.iit.edu
Gorjana Popovic	Illinois Institute of Technology	gorjana.popovic@gmail.com
Ozgul Kartal	Illinois Institute of Technology	ozgulkartal@gmail.com

Professional development (PD) was provided at the end of the 2013-14 school year to high school teachers on examples of mathematics problems for each of the Common Core Mathematical Practices (MP), as well as discussion on determining when and how mathematics problems meet the standards set forth in the MP. PD on converting existing problems to meet CCSSM and on observing MP in students was provided to the teachers in the fall and throughout the first semester. Teachers also received mentoring on additional ways to include MP. Teachers were observed at the beginning of semester one and again at the end of semester one, and completed self-assessments of their use of MP before each observation. Researchers also completed these assessments, during each observation. Teachers involved in this study include high school mathematics teachers from charter schools in a large urban district. Data sources include teacher self-assessments and researcher assessments of teachers use of MP at the beginning and the end of semester one. Assessments were examples of where in each lesson each of the eight MP was expected to be evident (teacher self-assessment) or was observed (researcher assessment of teacher). Researchers will present a comparison of teacher self-assessments and researcher assessments of teachers use of MP at the beginning of semester one with those assessments completed at the end of semester one.

Assessing Preservice Teachers' Attitudes toward Mathematics Over Time		**Room: Apollo 5 Time: 9:00-9:45**
Cindy Jong	University of Kentucky	cindy.jong@uky.edu
Thomas Hodges	University of South Carolina	hodgeste@mailbox.sc.edu

This presentation reports on the development of attitudes toward mathematics among preservice elementary teachers (n=146) in relation to their experiences as K-12 learners of mathematics and experiences within a teacher education program. Using the Rasch Rating Scale Model and parametric analyses, results indicate that significant changes in attitudes occurred over the duration of mathematics methods coursework and student teaching. Further, these changes can be explained, in part, by various teacher education experiences. In particular, having a student teaching experience with meaningful mathematics instruction played a significant role for those who entered with negative attitudes toward mathematics. The Mathematics Experiences and Conceptions Surveys (MECS) will also be discussed as instruments for studying teacher development, evaluating teacher education programs, exploring teaching experiments, and understanding factors influencing preservice teachers' conceptions.

Trigonometry Students' Conceptions of Variable: x Marks the Spot		**Room: Apollo 6 Time: 9:00-9:45**
Ben Wescoatt	Valdosta State University	bmwescoatt@valdosta.edu

Developing a robust understanding of the symbols of algebra is an important cognitive step for students transitioning from arithmetic to algebra (Herscovics & Linchevski, 1994). While students' conceptions of literal symbols, generically called variables, become more sophisticated with experience (Knuth, Alibali, McNeil, Weinberg, & Stephens, 2005), high school and college students appear to still hold weak conceptions, inhibiting problem-solving efforts (Gray, Loud, & Sokolowski, 2009; Trigueros & Ursini, 2003; Ursini & Trigueros, 2004). Utilizing a semiotic analysis, this current study explores college students' conceptions of variable as manifested while verifying trigonometric identities. Although students generally viewed a variable in the function argument as a general number, many students did so by either mentally replacing or overwriting the argument with a preferred letter, usually x, the prototypical variable (Knuth, Alibali, McNeil, Weinberg, & Stephens, 2005). While doing so facilitated the verification of the identity, the dependence on the letter x as a default variable inhibited some students from recognizing identities; additionally, the referent for the symbol became conceptually vague and problematic. The talk will share analyses of interviews and student work in addition to discussing frameworks of variable conceptions and how activities involved in verifying identities and general mathematics possibly influence the development of variable conceptions.

Middle School Students' Algebraic Reasoning of the Least Common Multiple		**Room: Apollo 7 Time: 9:00-9:45**
James Telese	University of Texas, Brownsville	James.telese@utb.edu
Benjamin Avalos	Education Service Center, Region One	bavalos@bisd.us
This paper will present the result of a problem solving activity designed to elicit students' understanding of the Least Common Multiple. The task was given to bilingual middle school students. Content analysis revealed various strategies and depth of understandings, from simplistic approaches to more complex thinking strategies related to the Least Common Multiple. Student work samples will be presented to illustrate the range of algebraic reasoning.		

Generating Mathematical Discourse through an Online Platform		**Room: Apollo 8 Time: 9:00-9:45**
Tyrette Carter	North Carolina A&T State University	tscarte1@ncat.edu
Kimberly Erwin	North Carolina A&T State University	kderwin@ncat.edu
Nichole Smith	North Carolina A&T State University	nlsmith2@ncat.edu
Communication benefits the growth of students at all ages. Thompson and Chappell (2007) suggest that communication helps students develop their mathematical literacy. Also, Vygotsky (1978) stated that social interaction plays an important role in children's cognitive development. Expecting students at the K-12 level to interact and clearly articulate their thinking to the teacher and their peers can be an overwhelming to a teacher, in particular a beginning teacher. However, providing future teachers with the skills necessary to facilitate this level of discourse can also be challenging. Equipping online candidates/pre-service teachers with the same skill set can be a daunting task. This proposal supports the goals of RCML because it provides research and rich discussion on issues that affect mathematics teaching and learning and how these issues have increased due to online platforms. The purpose of this presentation is to explain how discourse is facilitated through a purely online program with pre-service vs. in-service Elementary Education Teachers the advantages and disadvantages.		

Effect Book Type & Teacher Training on Math-Talk During Shared Book Reading		**Room: Apollo 1 Time: 10:00-10:45**
Lynn Columba	Lehigh University	hlc0@lehigh.edu
Shared book reading provides opportunities for adults to engage in literacy-related interactions with children in meaningful ways. Research has examined various dimensions of adult and child behavior during shared book reading interactions with some focus on how book type affects the reading experience. Little research, however, has examined systematically the use of shared book reading in a mathematical context. Thus, the purpose of the study was twofold: (1) to examine the effect of book type on teacher use of mathematical vocabulary during shared book reading in preschool classrooms and (2) to examine the effect of training teachers specifically to use mathematical vocabulary during shared book reading. A multielement design with two preschool teachers was used. Results generally indicated that the use of mathematical storybooks resulted in increased teacher math talk as compared to the use of non-mathematical storybooks. Since shared book reading is a common practice in preschool classrooms, strategically choosing books to address mathematical skills can increase attention to mathematics throughout daily routines and a means of increasing teacher math talk. Training and instructional supports appeared to result in an increase in math talk over that achieved by mathematical storybooks alone.		

The Role of Research in Teacher Preparation		**Room: Apollo 2 Time: 10:00-10:45**
Daniel Brahier	Bowling Green State University	brahier@bgsu.edu
Science and Math Education in ACTION is a scholarship program designed to enhance the preparation of mathematics teachers. The program offers extensive research and community internship opportunities for pre-service teachers and prepares them to be teacher-researchers. The voices of the students themselves will be presented at this session, with the intent to engage the audience in a conversation about the role of research in teacher preparation. Some results of the impact of this program will also be presented for discussion.		

Building Conceptual Understanding of Fraction Division with Remainders.		**Room: Apollo 3 Time: 10:00-10:45**
Rebecca Gault	University of Central Florida	rebecca.gault@knights.ucf.edu
Laura Tapp	University of Central Florida	Laura.tapp@knights.ucf.edu
Juli Dixon	University of Central Florida	juli.dixon@ucf.edu
Our presentation describes how pre-service teachers in our study developed content knowledge about fraction division with remainders. The study highlights the role of student led learning in a discourse rich environment designed to encourage productive struggle leading to deepening conceptual understandings of fraction division with remainders. Attendees should leave our presentation with a description of how pre-service teachers in this study developed content knowledge about fraction division with remainders. We believe that studies focused on how pre-service teachers make sense of mathematical ideas will guide mathematics educators when they prepare their content classes. Furthermore, pre-service teachers who participate in conceptual rich mathematics courses should be able to facilitate the development of conceptual understanding of mathematics in their students.		

Supporting an Elementary Teacher Implementing the Common Core State Standar		**Room: Apollo 4 Time: 10:00-10:45**
Heather Lockwood	Eastern Washington University	hlockwood86@gmail.com
Keith Adolphson	Eastern Washington University	kadolphson@ewu.edu
Elementary Mathematics Specialist (EMS) certifications have been established in more than half of the states around the country. This presentation describes and discusses an action research project of a graduate student/certified teacher serving as a de facto EMS/mathematics coach for a fifth grade teacher in a suburban elementary school. The goal of the project was to help the teacher negotiate the implementation of the Common Core State Standards for Mathematics (CCSSM). Coaching efforts focused on dissecting and analyzing the CCSSM, problematizing mathematical tasks, and nurturing the teacher's ability to foster mathematical discourse and alter the sociomathematical norms of the classroom. Project results will be addressed from multiple perspectives, the EMS/coach, subject teacher, and the teacher's students.		

Readin', Ritten', and Rithmetic - NAEP Mathematics and Reading Scores		**Room: Apollo 5 Time: 10:00-10:45**
Pat Jordan	Oklahoma State University	patricia.jordan@okstate.edu
The latest NAEP results indicate that minority students are making progress in their knowledge of mathematics when compared to their white counterparts. The gap between the groups remains as wide. Perhaps answers to the question, What other influences might be responsible for the discrepancies among the scores? Is there a relationship between students' scores on the Mathematics portion of the test and their scores on the Reading portion of the test? This statistical analyses research will report on the links between the content scores on the current NAEP Report.		

Investigations Into Mathematics Teachers' Propositional Logic Capabilities		**Room: Apollo 6 Time: 10:00-10:45**
Travis Olson	University of Nevada, Las Vegas	travis.olson@unlv.edu
Melfried Olson	University of Hawaii at Manoa	melfried@hawaii.edu
This paper describes the responses of preservice and in-service secondary mathematics teachers related to a question involving propositional logic. This session will present the question the teachers were asked to solve and provide quantitative data regarding their solutions and qualitative data relative to the reasoning behind their solutions. Background for this research is situated in three constructs, mathematical knowledge for teaching, context of proof in psychological and mathematical reasoning, and connections to the Standards of Mathematical Practice 2 (reason abstractly), 3 (construct viable arguments), and 7 (look for structure). Over 50 participants were given a prompt with a set of four cards placed face up. They were told each card contained either a circle or star on one side, and either a triangle or square on the other side. Participants were asked to determine which card(s) from a selection of four must be turned over to verify the statement "Every card with a star on it has a triangle on it." From the mathematics they previously studied one would assume the prospective teachers had the background to examine the question and create an abstract symbolic representation that could be used to identify the correct cards. Data from the choices made by the prospective teachers will be provided along with examples of the reasoning used to justify these choices. We will end with a discussion of the implications related to the three constructs.		

Understanding Integer and Binomial Multiplication		Room: Apollo 7 Time: 10:00-10:45
Sarah Pratt	University of North Texas	sarah.pratt@unt.edu
Amie Tennyson	Hurst Euless Bedford ISD	AmieTennyson@hebisd.edu
The researchers of this study collected and analyzed a series of design experiments multiplication and division of integers and polynomials with pre-service middle grades mathematics teachers. The research questions that were maintained across three distinct design experiments were: 1) How does a prospective middle grades mathematics teacher conceptualize multiplication of integers and polynomials?; and, 2) How does that knowledge change? Over time, some adaptations occurred as to how questions are asked as well as how tasks are scaffolded. Regardless, two consistent findings emerged. First, participants were limited in their understandings of why a negative times a negative equals a positive, and, second, participants struggled with binomials and connecting them to real-life applications. During this session we will engage in the mathematics through hands-on activities then the researchers will share findings from our design experiment. We will conclude with conversations about the concepts as well as conclusions to be drawn from the data and what that could mean for future research.		

Learning to Listen-What A Pre-service Teacher Can Learn from an Interview		Room: Apollo 8 Time: 10:00-10:45
Sandra Trowell	Valdosta State Univsersity	strowell@valdosta.edu
Understanding and making sense of students' mathematics learning is an essential part of negotiating a rich mathematics learning environment. Pre-service teachers were asked to conduct clinical interviews with P-8 students. Listening to students rather than teaching or correcting, and making sense of a students' mathematics was to be the focus of this assignment. This presentation will discuss what students learned about listening to students, assessing students, and choosing appropriate mathematics tasks.		

Momentum: Building Capacity for Change through Connections		Room: Apollo 1 Time: 11:00-11:45
Ann Assad	Austin Peay State University	assadd@apsu.edu
Lauren Wells	Austin Peay State University	wellsl@apsu.edu
The goal of Momentum: Building Capacity for Change through Connections was to increase student achievement by increasing elementary teachers' capacity to teach mathematics in a STEM-centered environment using children's literature. This professional development program, funded through Tennessee's Race to the Top grant, took a problem-solving approach to learning mathematical content as well as pedagogy. Teams from seven schools in four school districts completed the program, 27 elementary teachers. The program included 17 eight-hour professional development days spread over 18 months. During workshops, participants solved mathematics problems emerging from children's literature and from real life situations. They planned lessons based on these problems, often making connections to topics from science. They then taught those lessons and shared student work samples in subsequent workshops in grade level groups. To support their classroom activities, participants received sets of children's literature, software, professional memberships, and conference attendance. Online activities targeted specific topics such as using software, reviewing curriculum, and designing lessons. Pre- and post-assessment data, along with artifacts such as teacher and student work samples, revealed significant increases in participants' content knowledge, problem solving ability, and confidence in their ability to plan significant mathematical experiences for children.		

Using an Emporium Model in Precalculus: Lessons Learned and Next Steps		Room: Apollo 2 Time: 11:00-11:45
Tracey Howell	UNCG	thhowell@uncg.edu
Carol Seaman	UNCG	ceseaman@uncg.edu
Our goal for the presentation is to engage participants in discussions around the successes and challenges of using an Emporium model of instruction in our undergraduate Precalculus classes, which serve as the introductory mathematics course for STEM majors. In the mathematics classrooms of colleges and universities across the United States, the Emporium model of instruction has become a popular alternative to traditional lecture courses for introductory-level mathematics classes. These blended courses combine online components and face-to-face classroom learning experiences to provide a unique learning experience and promote student understanding. We feel strongly that the pedagogical changes we have implemented are better serving our students and enabling them to become both stronger mathematically and more confident in their abilities to understand and "do math". We will also share our plans for future modifications of and expansions to our Emporium model classes.		

Is there a relationship between whole number and fraction understanding?		**Room: Apollo 3 Time: 11:00-11:45**
Gayle Millsaps	Eastern Washington University	gmillsaps@ewu.edu
Steffe's work with fractions (2010) suggests that students' development of whole number concepts and operations can contribute to students' capacity for understanding fractions although there may not be a direct relationship. In particular, the schema that children exhibit with respect to their understanding of whole numbers might predict the schema attainment for understanding fractions. In this study, seven third grade students were interviewed at the beginning of the school year to examine what schemas they had developed with respect to whole numbers using "multiple groups" problems (Empson, 2011) with whole number solutions. They were interviewed after an initial fraction learning sequence and again at the end of the school year using problems that required reasoning about fractions. The interviews were analyzed for the types of whole number and fraction schemas that each student exhibited as they answered problems designed to elicit whole number or fraction reasoning, respectively. The analysis of the interviews indicated a correlation between the students' whole number reasoning and their capacity for reasoning about fractions.		

Investigations Into Teachers' Perspectives on Mathematical Modeling		**Room: Apollo 4 Time: 11:00-11:45**
Cathrine Maiorca	University of Nevada, Las Vegas	cemaiorca@icloud.com
Travis Olson	University of Nevada, Las Vegas	travis.olson@unlv.edu
With a new emphasis on modeling in the common core, a study was developed to understand the preconceived knowledge about mathematical modeling that in-service teachers bring to their classrooms.		

Students' engagement, confidence, and use of technology for learning algebra		**Room: Apollo 5 Time: 11:00-11:45**
Linda Venenciano	University of Hawaii at Manoa	lhirashi@hawaii.edu
Judith Olson	University of Hawaii at Manoa	jkolson@hawaii.edu
Melfried Olson	University of Hawaii at Manoa	melfried@hawaii.edu
Stephanie Capen	University of Hawaii	stephaniecapen@gmail.com
This presentation reports how students' attitudes changed over a year while enrolled in a technology-based, algebra-focused mathematical modeling course for struggling high school learners. The 9th grade students were enrolled in both an Algebra I course and a course, Modeling Our World (MOW), specifically developed for students who were anticipated to struggle in Algebra I. MOW uses curriculum materials consisting of investigative lessons that provide opportunities to explore algebra topics through the use of contextual, mathematical modeling. Student attitudes were collected using subscales of the Mathematics and Technology Attitude Scale. After students completed a year of either Algebra I only or Algebra I and MOW, students who had taken Algebra I and MOW positively increased their behavioral engagement in mathematics, mathematical confidence, and confidence with technology more than students only enrolled in Algebra I. While the change in affective engagement was negative for both groups, students who took Algebra I and MOW had a smaller negative change than students only enrolled in Algebra I. We will share specific results and then discuss the implications of these results including other research questions that these data suggest, such as, how implementation of course materials affects students' attitudes, how teacher's beliefs practices affect students' attitudes, and how the contextually relevant investigations support students' confidence and engagement.		

Writing as a mode of learning mathematics: Cognitive and affective aspects		**Room: Apollo 6 Time: 11:00-11:45**
Sarah Ives	California State University, Sacramento	sarah.ives@csus.edu
Writing as a mode of learning is powerful due to the fact that one is originating and creating a construct that is also graphically recorded. Through writing we are engaging our hands, eyes, and brain, simultaneously processing and producing concepts. Writing in mathematics however, has not traditionally been a widespread pedagogical practice. While it is gaining attention as a promising tool for student learning – as well as informing instructors of what students know – little research has been done on how we can assess mathematical writing in an informative way. In this presentation I will describe a variety of writing assignments, given in two mathematics content courses for prospective K-8 teachers, designed to address both cognitive and affective aspects of learning mathematics. I am interested in learning how you may be using writing in your mathematics courses, therefore time will be built in for discussion and sharing of lessons learned.		

Teacher-Student Interactions in Single-Sex and Coeducational Math Classes		**Room: Apollo 7 Time: 11:00-11:45**
Traci L. Carter	Clemson University	tracic@clemson.edu
S. Megan Che	Clemson University	sche@clemson.edu
William C. Bridges, Jr.	Clemson University	wbrdgs@clemson.edu
Dennis Kombe	Clemson University	dkombe@clemson.edu
In this study, which is part of a larger NSF-funded project, we examine teacher-student interactions in single-sex and coeducational public middle grades mathematics classes by using the Classroom Assessment Scoring System - Secondary (CLASS-S) instrument (Pianta et al., 2008). Six teachers who teach more than one type of mathematics class (all-boys, all-girls, and coeducational) were videotaped for five instructional sessions of each class type taught. Two research team members with whom inter-rater reliability was established viewed and scored each instructional session using the CLASS-S. Results of the analysis and supporting video clips will be shared and discussed.		

A Learning Trajectory for Transformation-based Reasoning In Geometry		**Room: Apollo 8 Time: 11:00-11:45**
Nicole Panorkou	Montclair State University	panorkoun@mail.montclair.edu
Steven Greenstein	Montclair State University	greensteins@mail.montclair.edu
By designing a conceptual framework around transformation-based reasoning that will help students reach the geometry expectations as put forth in the Common Core Standards for Mathematics, this project addresses the need to strengthen geometry instruction in the elementary grades. We propose that engaging young students in the transformation-based concepts of invariance and equivalence in the context of topology can provide a stronger foundation for the subsequent learning of the concepts of similarity and congruence in Euclidean geometry. In this presentation, we will present our efforts to develop a learning trajectory that models the development of learners' transformation-based reasoning. We will also share our efforts to design and develop a dynamic geometry environment to mediate learners' conceptual progression along that trajectory by emphasizing the dynamic nature that connects concepts associated with this form of reasoning.		

Differentiated Instruction in a Standards-Based Mathematics Curriculum		**Room: Apollo 1 Time: 1:30-2:15**
Carolyn Mitten	University of Florida	cmitten@ufl.edu
Tim Jacobbe	University of Florida	jacobbe@coe.ufl.edu

Since the release of the NCTM Standards for Mathematics, many standards-based curricula have been developed which emphasize both conceptual understanding and problem-solving skills. Transitioning from a traditional to standards-based curriculum brings with it many challenges for implementation in the classroom. One significant difficulty for mathematics educators is identifying appropriate differentiation strategies that help all students gain access to a deeper understanding of mathematics—something a standards-based curriculum can support. This session presents the findings of a study investigating elementary in-service teachers' use of differentiated instruction when implementing a new standards-based curriculum. After transitioning to the use of the new curriculum, teachers completed a survey describing their understanding and use of differentiation strategies both before and after implementation. Select teacher observations were conducted to identify how these strategies were enacted in the classroom and any barriers encountered. Successful differentiation strategies for practitioners and implications for future professional development when implementing similar standards-based curriculum will be discussed.

Learning to Teach Together: A Mathematics Educator & A Pre-Service Teacher		**Room: Apollo 2 Time: 1:30-2:15**
Ryan Fox	Belmont University	ryan.fox@belmont.edu
Nicole Bamford	Penn State-Abington	lnb5150@psu.edu

How does a teacher plan to teach a new course? Once the course is planned, how does the progress of course compare to the teacher's original plans? In addition, what if a pre-service teacher observed the planning process and the implementation? In this session, a mathematics educator and a pre-service teacher will discuss experiences teaching and observing the educator's leading a math course for the first time. From planning the course to discussing classroom interactions, we share the highs and lows of teaching a course for the first time. In addition to observation component of the course, we coordinated our classroom observations with research articles and practitioner-based readings to support the mathematical and pedagogical learning of the pre-service teacher. These experiences encouraged us to think about how we could create a model to support the mathematical and pedagogical developments of pre-service teachers in the future. We welcome audience members' feedback on our process and suggestions for future implementations.

Technology, Intermediate Algebra: Effects on Anxiety, Opportunity to Learn		**Room: Apollo 3 Time: 1:30-2:15**
Kenneth Butler	University of South Florida	butlerk1@usf.edu
Ruthmae Sears	University of South Florida	ruthmaesears@usf.edu

This study focuses on the role technology, computer based learning environments, and computer based assessments have on student mathematics anxiety and the opportunity to learn in a developmental algebra classroom for first year college students. Using a mixed methods research design, it was found that technology in the classroom does not improve mathematics anxiety for all students and mandated use of computer based learning environments may increase student anxiety when this is seen as an unnecessary burden. The computer based learning environment (MyMathLab) was generally procedural and algorithmic, and it was found that students valued this aspect of the computer based environment. Future research is needed to understand how conceptual understanding and other strands of mathematics proficiency can be enhanced in the computer based learning environment. Future research is also needed to determine how interpersonal relationships can be encouraged in technologically enhanced curricula.

Nevada Ready! Supporting the Transition from HS to (and Through) College		**Room: Apollo 4 Time: 1:30-2:15**
William Speer	Unoversity of Nevada Las Vegas	william.speer@unlv.edu

Many states in the United States have endorsed a set of Common Core State Standards (or some close-knit variation to the CCSS). Most often these are not viewed as "exit standards" but instead are described as college- and career-readiness standards. As these standards evolve through implementation and use, perceptions of "academic preparedness" may also mature with stakeholder expectations. The changing landscape of assessments in the K-12 is a reflection of the rethinking taking place in regards to assessment as an endpoint versus as a starting point. Of course, we are interested in whether students have mastered a particular content set or objectives, but we are also concerned with their preparedness to go on in their explorations of formal and informal learning. The discussion is particularly targeted toward college and career readiness in mathematics and English/Language Arts and what such scores mean relative to students' academic preparedness for college. Higher education leaders should play an active role in this discourse as they will be direct beneficiaries if students arrive on campuses prepared to meet the demands they will face. This session offers a case study (of sorts) of Nevada's multi-pronged approach to assisting in this transition from secondary school to college and careers with a particular emphasis on retention and progression in the "first years" of university life and on to completion of a formal bachelor's degree that "defines a college education."

SECONDARY MATHEMATICS TEACHERS' DISPOSITION TOWARD CHALLENGE		**Room: Apollo 5 Time: 1:30-2:15**
Yirah Valverde	The University of Texas at El Paso	ymvalverde@miners.utep.edu

This research focuses on mathematics teachers' disposition toward challenge and its correlation with teaching practice and student performance. The study will employ a mixed methods methodology and focusing on the following guiding research question: To what extend teachers' disposition towards challenge affects teaching practice and students' performance and what is the nature of that relationship? The research is still being conducted and data continues to be analyzed.

Mathematical Conversations		**Room: Apollo 6 Time: 1:30-2:15**
Nancy Cerezo	Saint Leo University	nancy.cerezo@saintleo.edu
Sharyn Disabato	Saint Leo University	sharyn.disabato@saintleo.edu

The presenters used Sammons (2011), Using Literacy Strategies to Make Meaning in Mathematics and Hyde (2006), Comprehending Math: Adapting Reading Strategies to Teach Mathematics, K-6 as resources of literacy and mathematics knowledge to tie the first four mathematical practices in Common Core to the infusion of language arts communication skills: reading, writing, listening, and speaking with these four mathematical practices. They further analyzed familiar reading comprehension strategies to build middle school students' comprehension and graphic connections for mathematical concepts as thought processes. Relevant research was also reviewed to share how to link the use of students' metacognitions to the mathematical practices for communicating within various groups: student to text; student to teacher, and student to student.

Perceptions of Mathematics and Gender in Middle School Single-Sex Classroom		**Room: Apollo 7 Time: 1:30-2:15**
Dennis Kombe	Clemson University	dkombe@clemson.edu
S. Megan Che	Clemson University	sche@clemson.edu
William C. Bridges, Jr.	Clemson University	wbrdgs@clemson.edu

This study examined middle school students' perceptions about mathematics as a gendered domain. Participants responded to items on Who and Mathematics survey instrument (Forgasz, Leder, & Kloosterman, 2004). Findings suggest that irrespective of class type, female students were more likely than male students to respond non-neutrally to survey items, resisting the notion that mathematics was a male domain. The findings mirror earlier scholarship on girls' and boys' locus of control, with indications note that girls were more likely than boys to work hard and worry when they did not do well in mathematics, whilst boys were more likely than girls find mathematics boring and distract other students from their work. Sex related differences based on class type were not observed.

Characteristics of Different Learning Environments in Geometry Classrooms		Room: Apollo 8 Time: 1:30-2:15
Zhonghong Jiang	Texas State University	zj10@txstate.edu
Alex White		aw22@txstate.edu
Brittany Webre		bwebre@gmail.com

This study was a part of a larger research project funded by NSF. The major goal of the larger project was to investigate the impact of using an instructional approach that utilizes dynamic geometry (DG) software to teach high school geometry on teachers and students. To probe more deeply into the teachers' and students' thinking processes, this study used in-depth interviews of selected teachers and students to collect qualitative data to address the following research question: What characterize the different learning communities in the experimental and control groups? The main findings of the study include: Teachers from both groups were comfortable with making conjectures and testing them. Since the DG group teachers used the dynamic capabilities of the software to aid in their investigations, they were able to produce quality conjectures more quickly. However, as to proving their conjectures, teachers varied considerably. Some could generate correct proofs, mostly for relatively simple geometric problems, some were able to work out parts of a proof but had difficulties to put the parts together, and the others were quite weak in proofs. Seeing that some of the teachers who had stronger mathematics knowledge than their peers still had misconceptions on some basic mathematical facts, we got to know: It is by no means easy to really increase teachers' mathematics content knowledge and particularly their proof abilities. To achieve this goal is a long-term task.

Playing with Math: An Elementary School/University Partnership		Room: Apollo 1 Time: 2:30-3:15
Elizabeth Ward	Texas Wesleyan University	ekward@txwes.edu
Elisabeth Johnston	Plymouth State University	epjohnston@plymouth.edu

The purpose of this session is to describe the formation and evolution of a K-5/university partnership designed to enhance elementary students' mathematics achievement and the mathematical PCK of pre-service teachers. Two key considerations are central to the partnership. First, the mathematics activities in the intervention were based on best practices for mathematics instruction (NCTM, 2000). Second, the instructional activities implemented by the pre-service teachers are based the needs identified by the teachers of the elementary students (Tomanek, 2005). Qualitative data from the pre-service teachers and quantitative data from the elementary students based on the state assessment will be presented. The results from this research continue to influence the development of mathematics pedagogy courses within the participating university and can inform other programs regarding the development of high-quality mathematics field experiences for pre-service teachers.

Using Action Research to support teacher development		Room: Apollo 2 Time: 2:30-3:15
Eileen Faulkenberry	Tarleton State University	efaulkenberry@tarleton.edu
Lesley Leach	Tarleton State University	leach@tarleton.edu

This study investigated the impact of action research on the professional development of teachers. The action research project was a portion of a year-long professional development program designed to improve pedagogical and content knowledge with the ultimate goal of improving their standards-based instructional practices. This presentation will examine the effects of the action research project on both the participants and their students.

Co-Teaching Strategies with Pre-Service Teachers to meet InTASC Standards		Room: Apollo 3 Time: 2:30-3:15
Alan Zollman	Indiana University Southeast	alanzoll@ius.edu

With the emphasis on using standardized mathematics test scores for teacher evaluation, mathematics teachers increasingly are hesitant to allow a pre-service teacher in their classrooms. Co-teaching strategies are research methodologies that may be able to coordinate the needs of classroom teacher and the pre-service teacher. We use co-teaching strategies to address the ten Interstate New Teacher Assessment and Support Consortium (InTASC) Core Teaching Standards on the Learner and Learning; Content Knowledge; Instruction Practice; and Professional Responsibility for our pre-service secondary mathematics teachers.

Accepting the Challenge: A case study of CCSS-M implementation		**Room: Apollo 5 Time: 2:30-3:15**
Kwaku Adu-Gyamfi	East Carolina University	adugwamfik@ecu.edu
Tony Thompson	East Carolina University	thompsonan@ecu.edu
This research involved a case study of one high school teacher's endeavor to teach mathematics with fidelity to the CCSS-M including the Standards of Mathematical Practice. Over a two year period, data were collected via observations, interviews, surveys, and artifacts (e.g., lesson plans, activities, student work). Results indicate that after initially struggling to understand and implement the CCSS-M, the teacher made significant changes to her teaching. Areas most strongly impacted were higher-level reasoning, academic language, and formative assessment.		

Mathematics teachers' beliefs about teaching and learning mathematics		**Room: Apollo 6 Time: 2:30-3:15**
Adem Ekmekci	Rice University	ekmekci@rice.edu
Danya Corkin	Rice University	dmc7@rice.edu
This study investigates the extent to which teacher experience, mathematics knowledge, and professional development contribute to teachers' beliefs, which as the research clearly indicates, are strongly related to instructional practices and student learning and achievement in mathematics (Philipp, 2007). To what extent did factors such as teachers' content knowledge, certification type, and years of teaching relate to their beliefs? To what extent did comprehensive professional development change their beliefs? Were there differences among beliefs of elementary, middle, and high school mathematics teachers? To answer these questions, 420 K-12 mathematics teachers in five cohorts were surveyed before and after rigorous professional development program consisting of a three-week summer program and six follow-up meetings during academic year following the summer program. The teachers' beliefs survey consisted 49 items measuring teachers' views on the nature of mathematics knowledge, beliefs about theoretical models of teaching and learning mathematics, mathematics curriculum and instructional materials, student engagement, and important mathematical concepts and standards. Data analyses include multiple regression analysis and repeated measures analysis of variance. The paper will address the implications of findings for preparation and professional development of mathematics teachers.		

Studying the Effectiveness of a Pre-K iPad Number Sense Curriculum		**Room: Apollo 7 Time: 2:30-3:15**
Jeffrey Shih	University of Nevada, Las Vegas	jshih@unlv.edu
Amy Adkins	University of Nevada, Las Vegas	adkinsa5@unlv.nevada.edu
Lina DeVaul	University of Nevada, Las Vegas	zangl@unlv.nevada.edu
Charles Allen	University of Nevada, Las Vegas	cmallen@unlv.nevada.edu
Taro Ito	University of Nevada, Las Vegas	taro@unlv.nevada.edu
This session describes the results of a randomized control study at an urban HeadStart Center where young children were provided iPads for mathematics instruction. A researcher-developed set of apps was compared to the most popular early childhood mathematics apps. Discussion will center on the results of the study as well as what we learned about conducting research in this setting.		

Item Response Theory Analysis Applied to Math Assessment Instruments		**Room: Apollo 8 Time: 2:30-3:15**
Jerry Obiekwe	The University of Akron Wayne College	accessx@uakron.edu
Item Response Theory (IRT) is a concept enhanced by mathematical modeling that deals with the response pattern of test takers in a particular test. These patterns can be used to ascertain the ability index, discrimination index as well as the difficulty level of each item on the test. It can also be used in determining the differential item functioning, and whether each item is interpreted the same way by each examinee. These response patterns often times lead to the modification of the instrument with the objective of making it better. There are essentially three types of IRT. The one-parameter model, which is often called the Rasch Model, the two-parameter model and the three-parameter model. There are of course some clear distinctions among these models. Their application to any situation may be driven by the objective of the research questions as well as whether their assumptions are met. This study employed IRT to analyze test instruments for an undergraduate mathematics course. The results of that analysis and its implications to teaching and learning will be presented.		

Using Feedback to Develop 6th grade Math Pedagogical Content Knowledge		**Room: Apollo 1 Time: 3:30-4:15**
Cynthia Orona	University of Arkansas	orona@uark.edu
Conra Gist	University of Arkansas	gist@uark.edu
Kelli Dougan	University of Arkansas	kdougan@starfishnw.org
Dennis Beck	University of Arkansas	debeck@uark.edu
This pilot study focused on understanding how one rural, sixth grade mathematics teacher develops pedagogical content knowledge through the creation and revision of lesson plans and classroom instruction in response to a series of practice and feedback loops facilitated by math content experts. An online platform will be used to facilitate the development of the teacher's math pedagogical content knowledge through content modules, teacher generated lesson plans and videos, and feedback and reflection protocols. Over a five-month period of time, the teacher engaged in four cycles of practice and feedback loops focused on the domains of number/computation and algebraic ideas. Pre-tests and post-tests were conducted at the beginning and end of each domain to determine the teacher's baseline math pedagogical content knowledge and growth in the baseline knowledge. Each cycle involved the teacher viewing an online mathematics content module, creating and revising lesson plans, teaching the lesson, and receiving feedback on lesson plans and classroom videos from the math content experts. The practice and feedback loop ends with the teacher reflecting on the overall formative assessment data of their instructional practice. Initial results from the pilot study will be discussed to determine how the study can be refined for full-scale implementation.		

Influences of OTL and Technology when Learning Functions from a UCSMP Study		**Room: Apollo 2 Time: 3:30-4:15**
Laura Hauser	University of South Florida	Lahauser@usf.edu
The study reported here is a secondary analysis of data collected during the field trial of the University of Chicago School Mathematics Project's Precalculus and Discrete Mathematics (Third Edition) curriculum. This study examines the use of technology when students (n = 270) solve function problems and the relationship between their use of technology,their opportunity to learn, and their achievement on multiple choice and constructed response assessments. Use of technology and its relationship to achievement is examined on a per problem basis. The results show that, in most cases, students are using technology when appropriate. Results from a path analysis of the data indicate use of technology has a direct effect on both opportunity to learn and student achievement, even when controlling for prior knowledge.		

VSTEM: Visualizing Science, Technology, Engineering, & Mathematics		**Room: Apollo 3 Time: 3:30-4:15**
Mary Baker	University of North Dakota	mary.baker@email.und.edu
Visualizing STEM: What does that mean? Motivating students to learn mathematics and to be excited about how they can and will be using this knowledge in their future careers is often a complex problem teachers are confronted with on a day-to-day basis. In this session, we will share how one group of university faculty interacted with middle school science and mathematics teachers and students in a Mathematics and Science Partnerships Grant that was designed to motivate students to engage in and enjoy more mathematics and science lessons that are related to the topic of solar energy. From building solar houses to building a solar city, students interacted with scientists and mathematicians from the university as they explored how the problems associated with American's energy generation and consumption could possibly be addressed through the use of solar energy. Additionally, students and teachers interaction with university faculty also exposed them to the exciting career opportunities that exist in STEM-related careers. In this session we shall share, not only the curriculum developed, but also the student impact results of our study. Visualizing STEM: Seeing is believing!		

The Flipped Classroom: What Does the Research Say?		**Room: Apollo 4 Time: 3:30-4:15**
Beth Cory	Sam Houston State University	bcory@shsu.edu
Many educators have hailed the flipped classroom approach, but does the growing body of research on this new instructional method truly show that it is effective? In this session, participants will be given an overview of the various research studies analyzing student perceptions and student achievement regarding the flipped classroom approach as well as tips for implementing their own flipped mathematics classrooms.		

K-8 Teachers' Self-Efficacy Beliefs for Teaching Mathematics		Room: Apollo 5 Time: 3:30-4:15
Frank Amankonah	University of New Mexico-Gallup	amankona@unm.edu
Lynda Wiest	University of Nevada, Reno	wiest@unr.edu

Teachers' self-efficacy beliefs have been suggested as one of the instructional strategies that can improve students' mathematics performance. Three research questions guided this mixed-method study: (a) the effects of K-8 teachers' self-efficacy beliefs for teaching mathematics, (b) factors that influence those beliefs, and (c) how and why those beliefs might influence teachers' mathematics instruction. Differences were explored by the participants' variables; gender, school level, school type, and years of teaching mathematics. Study used the Modified Teacher Self-Efficacy Beliefs Scale—Mathematics (MTSEBS-M) survey instrument to collect both quantitative and qualitative data and 66 teachers participated in the study. Teachers believe that the higher their self-efficacy belief, the more they tend to use classroom instructional approaches such as planning mathematics evaluations to accommodate student differences and engaging students in developing higher-order thinking skills in mathematics, and that their high level of confidence creates positive attitude among students. Teachers feel more confident in teaching number and operations than other content areas. Further, teachers believe that factors such as government policy, colleague dispositions and practices, and teacher mathematics enjoyment and ability, influence their confidence for teaching mathematics. Themes emerge include: mathematics content knowledge, teaching experience, and professional development.

Problem Solving in Preschool: One Program's Alignment to NAEYC and NCTM		Room: Apollo 7 Time: 3:30-4:15
Elisabeth Johnston	Plymouth State University	epjohnston@plymouth.edu
Elizabeth Ward	Texas Wesleyan University	ekward@txwes.edu

This session will highlight the findings of a study focused on how preschool teachers support students' mathematical learning as recommended by NAEYC and NCTM. The presenters will include an overview of the position statement from NAEYC and NCTM that provided the framework for this study. Data will be reviewed pertaining to how preschool teachers supported students' development of problem solving skills. In addition, the presenters will engage participants in a discussion about how these findings may influence professional development for early childhood professionals.

Smoothing The Ups and Downs: Tools for Professional Transitions		Room: Apollo 8 Time: 3:30-4:15
Kansas Conrady	University of Oklahoma	kansas.conrady@ou.edu
Jonathan Bostic	Bowling Green State University	bosticj@bgsu.edu
Sean Yee	University of South Carolina	yee@math.sc.edu
Sarah Ives	California State University, Sacramento	sarah.ives@csus.edu

Riding the roller coaster through the final phases of the dissertation and the first year in your very own tenure-track position is much more fun with the company of others. Take a brief break from the research presentations and meet others that are waiting in line for the roller coaster (currently working on your masterpiece), those on the roller coaster (anyone that has defended and currently in your first year on the other side), and the panel that has recently stepped off the roller coaster (third and fourth year of the tenure track). Additionally, this meeting will allow you to meet other researchers in your specific field of study that you may want to collaborate with in the future. The panel of early career mathematics educators represents both a variety of institutions as well as years in their track and would love to help ease the excitement of the journey around the track. There will also be plenty of time for questions in this low-stress tenure-free zone.

Teachers empowered via personal self-sustaining professional development		**Room: Apollo 1 Time: 8:00-8:45**
Hannah Slovin	University of Hawaii at Manoa	hslovin@hawaii.edu
Fay Zenigami	University of Hawaii at Manoa	zenigami@hawaii.edu
Judith Olson	University of Hawaii at Manoa	jkolson@hawaii.edu
Linda Venenciano	University of Hawaii at Manoa	lhirashi@hawaii.edu

Teachers become co-authors of their own professional development through planning and reflection on lessons as they examine content and format of these lessons. Participants will explore materials developed for a course geared for students who need extra support in Algebra I. We will discuss how teacher materials from the program have been used during group PD sessions with special emphasis on how teachers used them beyond these sessions. The digital format of the materials allows teachers to become co-authors of their own professional documents by making adaptations for their class, writing questions, creating presentations for students to view, adding links related to the lesson topics, and archiving records and products of taught lessons for future use, thus generating personal self-sustaining PD. In this session, participants will engage in tasks from the group PD that address content and pedagogy, examine the teacher materials and interact in self-sustaining ways with them by adding their own notes, photos, and questions. Thus, we address a concern raised in the NCTM's Principles to Action (p.101) that, "Teachers frequently feel as though professional development is something done to them, instead of something done for them, involving them as active partners in their own professional growth ...."

IBL in the Mathematical Statistics Class		**Room: Apollo 2 Time: 8:00-8:45**
Lanee Young	Fort Hays State University	lyoung@fhsu.edu

This session will discuss methods, challenges, lessons, etc used in implementing Inquiry Based Learning into the Mathematical Statistics classroom. Qualitiative evidence will be provided to support the effectiveness of such learning methods.

Reconceptualizing Math Content Courses for Pre-Service Secondary Teachers		**Room: Apollo 3 Time: 8:00-8:45**
Brian Gleason	Nevada State College	brian.gleason@nsc.edu
Ryan Fox	Belmont University	ryan.fox@belmont.edu

In this session, we present our work on how we re-conceptualized a content course for pre-service secondary mathematics teachers by extending the idea of conceptual analysis, as presented by Usiskin and colleagues (Usiskin, Peressini, Marchisotto, & Stanley, 2003). Rather than focusing on particular grade bands or a standard sequential set of topics, we presented major concepts in the secondary mathematics curriculum (e.g., function, randomness, symmetry, orthogonality). We examined each of these concepts through the same mathematical processes (e.g., definitions, examples, representations, generalizations, curricular connections, applications). The goal of the re-conceptualization was to present mathematics content to prospective secondary teachers as a coherent field of study, rather than a set of memorized rules, formulas, and graphs. Because we were not aware of attempts by other teacher educators to present content to future teachers in this way, and because this re-conceptualization was significant enough to render known existing materials insufficient, we created the materials for the course on our own. We present our work to seek feedback from the mathematics education community and solicit ideas on possible future directions for our work, such as extending the re-conceptualization process to elementary content courses or secondary or elementary methods courses.

Video Games = Spatial Abilities = Mathematics		**Room: Apollo 4 Time: 8:00-8:45**
Darlinda Cassel	University of Central Oklahoma	dcassel2@uco.edu
Lana Canale	University of Central Oklahoma	lkoch4@uco.edu

There is a lot of negative advocacy in the media regarding the influence of video games. This has caused a negative connotation towards the influence of video games on children's cognitive, psychological, and social development, regardless of the type of video game. Behavior problems are usually a common conception people have of video game influences. However, not a lot of research exists to show connections between game playing and children's cognitive development. Therefore it was deemed necessary to explore possible positive effects of video games by investigating the influence of video games on children's cognitive development.

Exploring African American elementary students' mathematical identities		**Room: Apollo 5 Time: 8:00-8:45**
Thomas Roberts	University of Kentucky, Department of STEM Education	thomas.roberts@uky.edu

Identities are an important factor in how people determine what is important to them and to their situation (Holland, Lachiotte, Skinner, and Cain, 1998). Mores specifically, academic identities are projections of how one views oneself as a learner (Murrell, 2008). Thus, as mathematical identities can be considered a specific type of academic identities, how African American elementary students (re)create their mathematical identities reflects their view of themselves as a learner of mathematics. However, there has been relatively little research in the area of mathematical identities of elementary students in general and specifically for African American elementary students. Given the trend of accepting and advancing what Stinson (2006) refers to as the discourses of deficiency and discourses of rejection in the context of the "gap gazing fetish" (Gutierrez, 2008) evident in much of the literature on students of color's performance on standardized testing, an approach that values the students' voices and perceptions in a successful context is needed to redress the abundance of literature possessing a deficit view. A theoretical framework designed to address the limitations of deficit views by exploring how African American elementary students' negotiate and (re)create successful mathematical identities that positively contribute to their learning of mathematics will be presented with potential qualitative methodological approaches to further the research in this area.

Multi-mentoring strategies for math teacher preparation and induction		**Room: Apollo 6 Time: 8:00-8:45**
Keith Hubbard	Stephen F. Austin State University	hubbardke@sfasu.edu
Lesa Beverly	Stephen F. Austin State University	beverlyll@sfasu.edu

The recruitment and retention of qualified mathematics teachers are well-documented challenges in high schools across our nation. Research has suggested multiple reasons for the existence of these phenomena – among them is insufficient teacher preparation for the challenges faced in the classroom. We examine the preparation of mathematics students seeking to become certified high school teachers. In this presentation, we will discuss traditional mentoring within the mathematics teacher preparation pipeline as it compares to an alternative model that strongly incorporates a multi-mentoring structure. Through analysis of differing student teaching protocols, persistence patterns in secondary education coursework, student exit interviews, journals from early exposure experiences with mathematics teaching, and reflections from students (certified and noncertified) who teach, we extrapolate best practices in mathematics teacher preparation programs.

Strengthening Prospective Elementary Teachers' Conceptions of Factors		**Room: Apollo 7 Time: 8:00-8:45**
Ziv Feldman	Boston University	zfeld@bu.edu
Matt Roscoe	The University of Montana	roscoem@mso.umt.edu

Research on prospective elementary teachers' understanding of prime factorization and divisibility concepts has shown that prospective teachers struggle to outgrow their reliance on tedious computational methods when identifying a number's factors. The literature suggests that this developmental obstacle originates in an inability or unwillingness to attend to a number's prime factorization. This session will share results from an intervention in which a set of three prime factorization tasks were implemented with 71 prospective elementary teachers across two institutions. The study documents the promise of this set of tasks in encouraging prospective teachers to attend to prime factorization as a way to identify a number's factors, as well to support a change in their conceptions of factor. Preliminary results from pre- and post-tests show that the use of these tasks strengthened prospective teachers' abilities to use prime factorization to identify a number's factors and to construct a more robust understanding of factor.

Advancing Additive Reasoning with Second Differences		**Room: Apollo 8 Time: 8:00-8:45**
Nathaniel Phillips	Virginia Tech	ndphill@vt.edu
Catherine Ulrich	Virginia Tech	culrich@vt.edu

Reasoning about differences (additive comparisons) of two quantities has been shown to be difficult for students (e.g., Thompson, 1993; Vergnaud, 1988) and becomes increasingly important in middle grades students' work with integers and algebra (e.g., Thompson & Dreyfus, 1988). Utilizing a constructivist teaching experiment methodology, we worked with two sixth-grade students over the course of eight teaching sessions on complex additive situations. In these situations, students not only had to operate on differences of two quantities, but also had to operate on the difference of those differences (a second difference). In the first session, neither student could solve a second difference task without support from the teacher/researcher, while in the eighth session (almost seven months later) both were able to independently do so in multiple contexts. Our analysis of the intervening session reveals important changes in the students' ability to construct, differentiate, and reflect on the quantities involved in these complex additive situations. Preliminary findings indicate that purposeful selection of the context and variation of the number and type of missing quantities/differences promoted these changes. This analysis provides a foundation for a more detailed characterization of the development of additive reasoning. Implications for future research will be discussed.

Secondary Mathematics Teacher Preparation: A Collaborative Tetrad Model		**Room: Apollo 1 Time: 9:00-9:45**
Jennifer Eli	The University of Arizona	jeli@math.arizona.edu

Student teaching is often described as the most influential part of teacher preparation. During student teaching, pre-service teachers are expected to put into practice the integration of content and pedagogy under the mentorship of knowledgeable others in a classroom setting. The traditional model of student teaching supervision involves daily interaction with an in-service teacher coupled with periodic visits by a university supervisor, usually a mathematics educator. Although university mathematicians are responsible for significant portions of teacher preparation prior to student teaching, they are often absent during this crucial period. In this session, I propose a new model of collaboration for supporting mathematics teacher preparation that includes both mathematicians and mathematics educators in the student teaching semester. I will discuss preliminary findings from the implementation of the tetrad model with a focus on the professional noticing of all tetrad members.

ELEMENTARY MATHEMATICS TEACHER BELIEFS		**Room: Apollo 2 Time: 9:00-9:45**
Brian Evans	Pace University	bevans@pace.edu

The purpose of this study was to understand teacher beliefs about teaching mathematics over the course of an elementary mathematics teaching methods course. The participants came from three groups of in-service and preservice teachers in master's degrees programs at a university in New York: New York City Teaching Fellows, Teacher Education Assessment and Management program, and traditional preservice teachers. Findings revealed an increase in positive beliefs about teaching mathematics over the semester, but there were no differences in participants' beliefs between the three programs.

Literacy Strategies to Impact Learning in the College Calculus Classroom		**Room: Apollo 3 Time: 9:00-9:45**
Tena Roepke	Ohio Northern University	t-roepke@onu.edu
Debra Gallagher	Bowling Green State University	dgallag@bgsu.edu

Two university faculty, a content literacy instructor and a mathematics instructor, share their efforts to integrate literacy-based instructional strategies in a college calculus classroom. Specific strategies and classroom examples will be discussed. Students were surveyed about their perceptions of these instructional strategies and the impacts they believe these had on their learning of the mathematics content. These survey results will be discussed extensively. Some discussion of related research will be shared as well as possible next steps for the current project.

Cognitive Skills and Mathematics Problem-Solving Performance		Room: Apollo 4 Time: 9:00-9:45
Ardyth Foster	Armstrong State University	ardyth.foster@armstrong.edu
Geared towards teacher educators and elementary and middle-school mathematics teachers, the findings of a study that explored relationships between students' cognitive skills and their mathematics problem-solving performance will be presented. The existing complexities within this area, along with the potential implications for collaboration among students and their teachers/peers, and for appropriate and effective pedagogical decision making, will be discussed. By addressing possible relationships between students' cognitive skill strengths and skill-based assessment methods, this presentation will provide opportunities for exploring and discussing potential impacts on teaching and assessment methods that are geared towards students' learning strategies/styles, and that engage students in meaningful critical thinking activities. The importance and effectiveness of skill based instruction and assessment have the potential for closing achievement gaps and promoting learning for all students.		

What I Learned About Concept Maps on My Summer Vacation		Room: Apollo 5 Time: 9:00-9:45
Mary Swarthout	Sam Houston State University	swarthout@shsu.edu
What are concept maps? Can the use of concept maps impact learning and instruction in mathematics? The session will feature a definition of concept maps, details about different uses of concept maps for research and instructional planning, and a summary of results from the current research literature. Details on present technology tools allowing for creation and editing of maps will be shared as a part of encouraging conversation about ways that the mapping tool can be incorporated in instructional planning and research projects to investigate factors related to mathematics learning.		

The Impact of a Two Year Professional Development Program on Math Teachers		Room: Apollo 7 Time: 9:00-9:45
Sue Brown	University of Houston-Clear Lake	browns@uhcl.edu
Eighteen teachers participated in a two-year externally funded grant. Five content areas of middle school mathematics and two instructional skills objectives were addressed by the project. Content areas were patterns; relations and functions; variables and equations; ratio and proportion, and proportional and non-proportional reasoning. Instructional skills targeted were the use of manipulatives, cooperative grouping, differentiated instruction, and student-centered instruction, and the ability to successfully ask higher-level questions during teaching. Program evaluation relied on pre- and posttests of content knowledge; participant input surveys; the Classroom Community Scale; classroom observations rated with the Reformed Teacher Observation Protocol Scales (RTOP); digital Questioning Portfolios with videos of participants' own teaching; and standardized state test results for a subset (n=892) of participants' students. Based on both objective measures and participants' reactions, this program was a success. Teachers' content knowledge did increase, and classroom observations, survey data, and videotaped lessons indicated that the majority were successfully integrating grant activities and content into their own classes. With respect to evidence of impact on participants' students STAAR scores, the percent attaining satisfactory or above scores ranged from 72% to 86%, all above Texas statewide percentages.		

A Second grader's understanding of negative numbers		**Room: Apollo 8 Time: 9:00-9:45**
Seungoh Paek	University of Hawaii at Manoa	spaek@hawaii.edu
Daniel Hoffman	University of Illinois at Urbana-Champaign	dlh2109@illinois.edu

What are negative numbers? This is a difficult question, even for adults, so we know it is a very challenging question for young children. Researchers argue negative numbers are difficult to understand due to three factors: 1) the conflict between the practical meaning of magnitude or the quantity associated with numbers in early arithmetic teaching and the concept of negative numbers (Fischbein, 1987; Hefendehl-Hebeker, 1991), 2) the conflict between two different meanings of the "-" sign (Janvier, 1985; Carraher, 1990), and 3) the absence of a good, intuitive, and familiar model which would consistently satisfy all the algebraic properties of signed numbers (Glaeser, 1981, quoted in Fischbein, 1987). Given this background, the researcher attempted to address the challenge of negative numbers from an instructional designer's perspective. More specifically, the researcher designed instruction that introduced negative numbers in a manner that is consistent with positive numbers and uses a familiar instructional tool (e.g. a number line), while emphasizing the different meanings of the minus sign. The first step in this process was a clinical interview to examine how young children begin to understand negatives while providing instruction in one-to-one sessions. For the presentation, the findings of the interview, as well as suggested instructional design approaches to negative numbers, will be discussed.

Creating statewide math initiative by collaboration and design research		**Room: Apollo 1 Time: 10:00-10:45**
Teruni Lamberg	University of Nevada, Reno	Terunil@unr.edu
Travis Olson	University of Nevada, Las Vegas	travis.olson@unlv.edu
Jeffrey Shih	University of Nevada, Las Vegas	jshih@unlv.nevada.edu
Ed Keppelman	University of Nevada, Reno	keppelma@unr.edu
Peggy Lakey	University of Nevada, Reno	plakey@unr.edu

A framework for a statewide professional development mathematics initiative that involved collaboration among multiple agencies is presented. The data collected ranged from documenting the design decisions made and the impact of the professional development. The framework revealed the need for a jointly negotiated vision, co-creation of knowledge with regard to issues, format and delivery of professional development, willingness to learn, adaptability to local context and collegiality influenced design decisions that were made. These design decisions impacted the nature of tasks and delivery of the professional development. The findings revealed that the teachers found the professional development meaningful and the data revealed that teacher content knowledge was positively impacted.

Language Acquisition in Mathematics for Struggling Students – What Works		**Room: Apollo 2 Time: 10:00-10:45**
Bill Jasper	Sam Houston State University	jasper@shsu.edu

Students sometimes struggle learning mathematics, because they do not understand the vocabulary used in a classroom. This is especially true for English Language Learners, who often skim the surface of concept understanding due to language acquisition problems. This session will summarize research-based intervention strategies that help to enhance student learning. In addition, examples of how to best incorporate academic language during mathematics lessons will be discussed, with audience interaction.

The Core-Math Project: Teacher Educators Partnering with K-5 Schools		**Room: Apollo 3 Time: 10:00-10:45**
Kerri Richardson	University of North Carolina at Greensboro	kdricha2@uncg.edu

In this session, I share a professional development model for mathematics teaching and learning implemented with elementary teachers. The unique model includes on-going support for student-centered learning while enabling teachers to take graduate courses toward becoming elementary math specialists.

LOCUS: Assessing Students' and Teachers' Knowledge of Statistics		**Room: Apollo 4 Time: 10:00-10:45**
Catherine Case	University of Florida	ccase@ufl.edu
Steve Foti	University of Florida	fotisj@ufl.edu
Douglas Whitaker	University of Florida	whitaker@ufl.edu
Tim Jacobbe	University of Florida	jacobbe@coe.ufl.edu

The Levels of Conceptual Understanding of Statistics (LOCUS) assessments are the product of a multi-year NSF grant (DRL-1118168) designed to measure conceptual understanding of statistics and are aligned with both the Common Core State Standards (CCSS) and the American Statistical Association's Guidelines for Assessment and Instruction of Statistics Education (GAISE) (Franklin et al., 2007). The LOCUS assessments were developed using a modified version of evidence-centered design (Jacobbe, Case, Whitaker, & Foti, 2014) and are available as paper-and-pencil assessments (multiple choice and constructed response items) and as an online assessment (multiple choice items only). The online version provides feedback about the components of the statistics problem-solving process as outlined in the GAISE framework (Formulating Questions, Collecting Data, Analyzing Data, and Interpreting Results) as well as the CCSS standards each item is related to. The assessments have been validated for use with students in grades 6-12; there are on-going efforts to validate the assessments with tertiary level introductory statistics students and pre-service teachers. This presentation provides an overview of the LOCUS assessments, including the development process, the results the operational implementation with 3500 students in grades 6-12, and the on-going validation process with pre-service teachers.

How They See it: Pre-service Elementary Math Majors Images of Their Future		**Room: Apollo 5 Time: 10:00-10:45**
Keith Adolphson	Eastern Washington University	kadolphson@ewu.edu

This study draws upon the unusual circumstance of our institution having undergraduate elementary and middle-level mathematics education majors. It builds on the work of Utley and Showalter to look longitudinally at how these preservice majors' images of themselves as teachers of mathematics might change over time. Data gathered early and near the end of the program were analyzed to make comparisons of changes in these images as their course of study in the major developed. Discussion will characterize our program, describe the study, summarize results, and speculate on implications and possible programmatic changes.

The Response of Preservice Teachers to Algebraic Misconceptions of Students		**Room: Apollo 6 Time: 10:00-10:45**
Ayse Tugba Oner	Texas A&M University	aysetugbaoner@email.tamu.edu
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The purpose of the study was to determine which types of misconceptions were the most difficult to address and how the performance in eliminating algebra misconceptions was related to preservice teachers' (PST) problem solving knowledge and teaching efficacy. One of the obstacles that impede mathematics proficiency is the presence of algebra misconceptions. We believe that mathematics PSTs should be fully equipped in detecting and eliminating misconceptions before they reach their classroom. In this study we gave middle school mathematics PSTs assignments where they were tasked to help students with misconceptions about ratios, proportions, decimals, percents, surface areas and volumes. In addition to the assignments, we gave a test where the majority of the questions were about algebra and other questions on how PSTs would assist a student who needed help with misconceptions. Besides these assignments and the test, an instrument evaluating PSTs' beliefs about teaching was given. We present the results of our investigation and highlight the misconceptions that caused the majority of the problems. The beliefs of the PSTs that are related to their capacity to overcome algebra misconceptions are also presented.

The challenges and possibilities of the edTPA		**Room: Apollo 7 Time: 10:00-10:45**
Tony Thompson	East Carolina University	thompsonan@ecu.edu
Kwaku Adu-Gyamfi	East Carolina University	adugwamfik@ecu.edu
Maureen Grady	East Carolina University	gradym@ecu.edu
The East Carolina University mathematics education program is currently in its 3rd year of implementation of the edTPA (educative Teacher Performance Assessment). This presentation explores the diverse and sometimes unanticipated impact that implementation of the edTPA has had on our program; this presentation will include the perceptions and experiences of pre-service teachers, clinical teachers, and university faculty regarding the edTPA as well as the impact of the edTPA on coursework and policies. Recommendations for implementing the edTPA in mathematics education programs will be provided.		

Bridging the algebra gap: Effects of an online summer math refresher		**Room: Apollo 8 Time: 10:00-10:45**
Jodi Frost	Indiana State University	Jodi.Frost@indstate.edu
Nicole Bailey	Indiana State University	Nicole.Bailey@indstate.edu
Eric Graves	Indiana State University	Eric.Graves@indstate.edu
Ellie Pounds	Indiana State University	Ellie.Pounds@indstate.edu
During the summer of 2014, Indiana State University's Math & Writing Center, in collaboration with the Department of Mathematics, piloted a two week online refresher program designed to help incoming freshmen at risk of failing their college algebra class succeed in their first semester. The program aimed to remind students of processes and concepts they may have forgotten over time, as well as to help them develop confidence and study skills. This was accomplished by using a mix of online resources and live tutoring, provided through Blackboard Collaborate. The presenters will introduce this program to participants, as well as discuss research and findings regarding student success based on participation in the program. Finally, they will solicit feedback regarding what could be improved upon in the future given that it is a work in progress.		

Collaborative Teaching in a Mathematics Classroom		**Room: Apollo 1 Time: 11:00-11:45**
Sheila Darker	Duluth Public Schools	sheila.darker@isd709.org
Kay Wohlhuter	University of Minnesota Duluth	kwohlhut@d.umn.edu
The purpose of this action research was to examine the decisions that influence collaborative teaching in a mathematics classroom. A special education teacher and a mathematics teacher shared all of the responsibility in an eighth grade classroom. This classroom included students with learning disabilities mainstreamed in a general education setting. In this session the researcher will share the successes, challenges, and implications of collaborative teaching in a mathematics classroom.		

Do Students with Disabilities have Access to Effective Math Instruction		**Room: Apollo 2 Time: 11:00-11:45**
Jeremy Winters	Middle Tennessee State University	jwinters@mtsu.edu
Dovie Kimmins	Middle Tennessee State University	dkimmins@mtsu.edu
Craig Rice	Middle Tennessee State University	crice@mtsu.edu
With the implementation of the Common Core State Standards for Mathematics, teachers and students will be required to think and reason about mathematics at a deeper level than ever before. Problem-solving skills will need to be emphasized more. Traditionally, teachers have perceived students with disabilities as not having the ability to do mathematical problem solving. Moreover, research indicates that a teachers' own ability to problem solve impacts a student's disposition towards, as well as ability to problem solve (Kroll & Miller, 1993; Henningsen & Stein, 2002). Grouws (2003) indicates that a teacher's ability to problem solve is vital to a student's ability to develop as a problem solver. This study researched the access of students with disabilities to deep mathematics by investigating special education teachers' perceptions of problem solving, as well as their skills to problem solve. The study involved special education and general education teachers. A total of 168 teachers participated (74 special educators and 94 general educators). Data was analyzed using MANOVA with independent variables being license type (special or general education) and level (elementary, middle, secondary) and dependent variables from the beliefs instrument (Indiana Mathematics Belief Scales (IMBS)) and a problem-solving instrument. Results and implications will be shared.		

Examining student achievement when using a modeling approach to algebra		**Room: Apollo 4 Time: 11:00-11:45**
Judith Olson	University of Hawaii at Manoa	jkolson@hawaii.edu
Fay Zenigami	University of Hawaii at Manoa	zenigami@hawaii.edu
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Materials were developed for a new course for 9th grade Hawaii public school students who might struggle in Algebra I. Although designed to primarily support struggling learners, the program does not follow a remedial mathematics design. Instead, it comprises investigations of interesting, culturally relevant topics through an algebraic lens that give students opportunities to explore algebraic topics in ways that promote the development of mathematical modeling. The course targets an identified subset of Common Core standards aligned to the content of algebra, particularly functions, with modeling, and promote the constructs of mathematical practices. Technology is integrated into lessons to begin development of concepts or enhance and extend algebraic ideas of the lessons. This session reports on the effects on students' mathematics knowledge of algebra concepts. We share how students' understanding of mathematics has been affected on pre- and post-assessments and the Algebra I end-of-course exam. We will discuss implications this has regarding the use of modeling to support student understanding of mathematics concepts and for dual enrollment in mathematics courses at this level.

Development of an assessment tool for communicating mathematically		**Room: Apollo 6 Time: 11:00-11:45**
Kathy Smith	Tarleton State University	ksmith@tarleton.edu
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Cecilia Silva	Texas Christian Universit	c.silva@tcu.edu
Natalie Smith	Texas Christian University	n.m.smith9@tcu.edu

Drawing from the National Council of Teachers of Mathematics (NCTM), the new Common Core for Mathematics, literacy literature, Lemke's four modes of communication (2004), and theoretical work in multi-functional communicative semiotic (Silverstein, 1995, 2004), we developed an analytical framework for cataloging student communication patterns. The four distinct sections of the analytical tool, looks at the mode of communicating, the application of these modes, the mathematical content the students can discuss and the process standards the students utilize to communicate. The culminating instrument allows researchers a multi-modal view of students' writing about communicating mathematically. Time will be utilizing the instrument i analyzing samples of student writing.

Empowering Ownership of Proof with Communal Proof-Writing Criteria		**Room: Apollo 7 Time: 11:00-11:45**
Sean Yee	University of South Carolina	yee@math.sc.edu
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Current reforms call for a stronger emphasis on teaching and learning proof in secondary mathematics. For example, the Standards for Mathematical Practices (NGA & CCSSO, 2010) and the Principles to Actions (NCTM, 2014) suggest students should be provided with opportunities to develop arguments and critique others' reasoning. These recommendations pose serious challenges for many secondary mathematics teachers who tend to focus on structure rather than content, and who see proof as a geometry "topic" that should be covered only with advanced mathematics students (Knuth, 2002). To address teachers' limited conceptions of proof and to encourage their active reflection on what counts as mathematical proof, we developed and implemented an instructional sequence for prospective secondary mathematics teachers (PSMTs). Our aim was for PSMTs to experience learning proof as a communal, negotiated, and sense-making process, rather than a rigid structure that is to be replicated (Stylianou, Blanton, & Knuth, 2009). In this report, we consider the influence of the instructional sequence on how PSMT's think about proof. Our research question is: In what ways do PSMTs perceive this instructional sequence as different from their prior experiences with mathematical proof?

The 30 Second Challenge: Improving Preservice Computational Fluency		**Room: Apollo 8 Time: 11:00-11:45**
Rachel Bachman	Weber State University	rachelbachman1@weber.edu
Dixie Blackinton	Weber State University	dblackinton@weber.edu

This presentation will share the results of an action research project to improve the computational fluency of prospective elementary teachers through the use of a commercially available daily mental math exercise called the "30 second challenge." This tool was used to augment the conceptual investigation of standard operational algorithms regularly included in this mathematics course to improve flexibility of mathematical calculations and proficiency with standard algorithms. The presentation will demonstrate how the tool was used in two different sections of the course, relay pivotal class conversations resulting from the use of the tool, and compare pretest/posttest results of the proficiency of future teachers with the addition, subtraction, multiplication, and division of whole numbers, fractions, decimals, and percentages.

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