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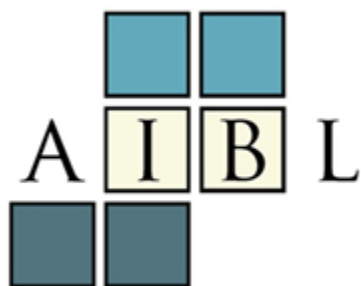


Program
*17th Annual Legacy of R. L. Moore –
Inquiry-Based Learning Conference*

“Engaging in IBL”

Denver, Colorado, June 19-21, 2014

Sheraton Denver Downtown



Journal of Inquiry-Based
Learning in Mathematics

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Diana White, University of Colorado Denver

Betsy Yanik, Emporia State University

Thursday, June 19

Registration

9:00AM–5:00PM **South Convention Lobby**

Pre-Conference Workshops

9:00AM– 11:00AM **Silver, Mezzanine Level**

Inquiry-Based Learning (IBL) in Mathematics

Leader: **Michael Starbird**,
University of Texas at
Austin

9:00AM–11:00AM **Spruce, Mezzanine Level**

Garnering Support for IBL – From Brainstorming to Proposal Writing

Moderator: **William “Bill” McKenna**,
EAF

Panelists: **Ron Douglas**, Texas A&M
University
Ed Ahnert, EAF
Randy Cone, Virginia
Military Institute

Welcome and Overview

1:00PM–1:10PM **Grand Ballroom 2**

Angie Hodge, University
of Nebraska Omaha
Theron “TJ” Hitchman,
University of Northern
Iowa

Plenary Presentation

1:15PM–2:00PM **Grand Ballroom 2**

Inquiry-Based Learning to Engage and Empower the Disfranchised
Julian Fleron and **Philip Hotchkiss**,
Westfield State University

Parallel Sessions: Nuts and Bolts

Upper Level IBL Courses

2:25PM–3:50PM **Tower Court A**

Chair: **Brian Katz**, Augustana
College

2:25PM *IBL Number Theory with n students
(for large values of n)*

Lola Thompson, Oberlin College

2:55PM *Students’ Use of Geometry Axioms to
Construct Proofs*

Dorin Dumitrascu, Adrian College

3:25PM *A Second Year Perspective on
Teaching Abstract Algebra*

Mary Shepherd, Northwest Missouri
State University

IBL Tips

2:25PM–3:50PM **Tower Court B**

Chair: **Betsy Yanik**, Emporia
State University

2:25PM *What Did I Do Wrong (or Right)?*

Mindy Capaldi, Valparaiso University

2:55PM *A First-Timers Perspective: Trials,
Tribulations, and Lessons Learned*

Ellie Kennedy, Northern Arizona
University

3:25PM *What’s Worked for Me*

Susan Crook, Loras College

Creating IBL Notes

2:25PM–3:50PM **Tower Court C**

Chair: **Amanda Matson**, Clarke
University

2:25PM *Undergraduate Real Analysis:
Designing Course Notes*

David M. Clark, SUNY New Paltz

2:55PM *Creating and Editing Course Notes for
a Graph Labeling Course*

Alison Marr, Southwestern University

3:25PM *Revising IBL Materials*

Victor Piercey, Ferris State University

Thursday, June 19

Flipped IBL

2:25PM–3:50PM **Tower Court D**

Chair: **David Crombecque**,
University of Southern
California

- 2:25PM *A Tale of Two Calculus Classes*
Brian Dorn, University of Nebraska
Omaha and **Larissa Schroeder**,
University of Hartford
- 2:55PM *Aspects of the Flipped/Inquiry Based
Learning Approach in a “Large”
College Algebra Classroom: An
Ongoing Report*,
Perry Lee and **Padraig McLoughlin**,
Kutztown University of Pennsylvania
- 3:25PM *The Successful First Week of a Flipped
Calculus 1 Course*
Robert Sachs, George Mason
University

Supporting IBL Instructors and More

2:25PM–3:50PM **Grand Ballroom 2**

Chair: **Jane Cushman**, Buffalo
State University

- 2:25PM *Developing Communal
Understanding of Proof-Writing
Criteria*
Sarah Bleiler, Middle Tennessee
State University, **Yi-Yin Ko**, Indiana
State University, **Justin Boyle**,
University of New Mexico, and **Sean
Yee**, Fullerton College
- 2:55PM *Panel Discussion on a Mentoring
Program for Using IBL Methods in
Teaching College Geometry*
Nathaniel Miller, **Lee Roberson**,
Sarah Rozner Haley, and **Becky Anne
Dibbs**, University of Northern
Colorado
- 3:25PM *Supporting Instructors in Making the
Transition to IBL: Lessons from IBL
Workshops*
Chuck Hayward, University of
Colorado, Boulder

Break for Refreshments

3:50PM–4:15PM **Grand Ballroom 1**

Parallel Sessions

General IBL and IBL Outreach

4:15PM–5:15PM **Tower Court A**

Chair: **Robert Vallin**, (Lamar
University)

- 4:15PM *An Important Aspect of the Moore
Method*
Melvyn Jeter, Illinois Wesleyan
University
- 4:45PM *Taxi Cab Circles*
Michael Gagliardo, California
Lutheran University

IBL Outreach II

4:15PM–5:15PM **Tower Court B**

Chair: **Betsy Yanik**, Emporia
State University

- 4:15PM *IBL Experiments in the MathCircle at
ASU Tempe*
Matthias Kawski, Arizona State
University
- 4:45PM *Look, Ma, No Hand(outs)s! Guidance
in Response to Student Inquiry at
MathILy*
Sarah-Marie Belcastro, MathILy and
Smith College

General IBL I

4:15PM–5:15PM **Tower Court C**

Chair: **Diana White**, University
of Colorado, Denver

- 4:15PM *Mixing IBL and Flipped Classroom
Concept in a Pre-Calculus Course*
Joyati Debnath, Winona State
University
- 4:45PM *Teaching Teachers to Teach with IBL*
Regina Jackson and **Michel Smith**,
Auburn University

General IBL II

4:15PM–5:15PM Tower Court D

Chair: **Suzanne Dorèe**,
Augsburg College

4:15PM *Inquiry-Based Learning, Cognitive
Dissonance, and Taking K-12
Teachers to the Next Level*

Thomas Judson, Kimberly Childs, and
Deborah Pace, Stephen F. Austin
State University

4:45PM *An IBL Approach to Abstract Algebra*

Daniel Kiteck, Indiana Wesleyan
University

Centers Reports

4:15PM–5:15PM Grand Ballroom 2

Chair: **Ron Douglas**, Texas A&M
University

Representatives of:

University of Texas at Austin

University of Michigan

University of Chicago

University of California, Santa

Barbara

Reception

5:30PM–6:30PM Grand Ballroom 2

Dinner

6:30PM *Right Place, Right Time*

Michael Starbird, University of Texas
at Austin

Friday, June 20

Breakfast

7:45AM–8:45AM

Grand Ballroom 1

Roundtable Discussions

8:45AM–9:30AM

Grand Ballroom 2

Organizer: **Brian Katz**, Augustana
College

Course Topics

- Liberal Arts Math
- Math for Elementary Teachers
- Linear Algebra
- Calculus
- Real Analysis
- Abstract Algebra
- Graduate Courses

5–Minute Reports I

9:40AM–10:10AM

Grand Ballroom 2

Chair: **Jacqueline Jensen–
Vallin**, Lamar University

Break for Refreshments

10:10 AM–10:40 AM

Grand Ballroom 1

IBL Futures Report

10:40 AM–11:45 AM

Grand Ballroom 2

Panelists: **Ron Douglas**, Texas A&M
University
Tina Straley, EAF
Stan Yoshinobu,
California Polytechnic
State University, San Luis
Obispo

Lunch

12:00PM–1:15PM

Grand Ballroom 2

*Creating a Common Vision for the
Undergraduate Math Program in
2025*

Karen Saxe, Macalester College

Friday, June 20

5–Minute Reports II

1:30PM–2:00PM **Grand Ballroom 2**
Chair: **Judith Covington**,
Louisiana State
University, Shreveport

Parallel Sessions:

Favorite IBL Activity

2:20PM–3:30PM **Tower Court A**
Chair: **Michael Gagliardo**,
California Lutheran
University

2:20PM *POGIL: How IBL is Used in Chemistry*
Elaine Bailey, Piedmont College

3:00PM *Is $D_x f(g(x)) = f'(g(x))$?*
Larissa Schroeder, University of
Hartford

2:20PM–3:30PM **Tower Court B**
Chair: **Jacqueline Jensen–
Vallin**, Lamar University

2:20PM *The Coins go 'round 'n 'round*
Suzanne Dorée, Augsburg College

3:00PM *Embracing Beauty: Learning
Symmetry Through Art in Grade
School and Beyond*
Alessandra Pantano, University of
California, Irvine

2:20PM–3:30PM **Tower Court C**
Chair: **Diana White**, University
of Colorado, Denver

2:20PM *Teaching PIE to 10 Year Olds* **Harold
Reiter**, University of North Carolina
Charlotte

3:00PM *Building Our Conceptual
Understanding of Formulas for
Volume*
Brian Bowen, West Chester
University

2:20PM–3:30PM **Tower Court D**
Chair: **Judith Covington**,
Louisiana State
University, Shreveport

2:20PM *Models for Multiplication and
Division: An IBL Activity for Pre-
Service Teachers*
David Crombecque, University of
Southern California

3:00PM *The Vermont Mathematics Initiative:
Inquiry Based Learning for
Elementary Teachers*
Kenneth Gross, University of
Vermont

2:20PM–3:30PM **Grand Ballroom 2**
Chair: **Mary Shepherd**,
Northwest Missouri State
University

2:20PM *Day-to-Day Implementation of
Inquiry-Based Learning in
Mathematics Classrooms: Faculty
Concerns*
**Anne Cawley, Vilma Mesa, and Inah
Ko**, University of Michigan

3:00PM *Guided Reinvention of Rings*
John Paul Cook, University of Science
and Arts of Oklahoma, **Brian Katz**,
Augustana College, and **Milos Savic**,
University of Oklahoma

Break for Refreshments

3:30PM–4:00PM **Grand Ballroom 1**

Parallel Sessions

Reflections on IBL

4:00PM–5:35PM **Tower Court A**
Chair: **Ron Taylor**, Berry College

4:00PM *Personal Observations and
Reflections on the Teaching Methods
of R. L. Moore*
Stephen Jones, Esq., Attorney

4:35PM *How Much 'Moore' Do My Students Want?*
Brad Bailey, University of North Georgia

5:10PM *Taking IBL to New Communities*
Wayne Tarrant, Rose-Hulman Institute of Technology

IBL Calculus

4:00PM–5:35PM **Tower Court B**
 Chair: **Larissa Schroeder**, University of Hartford

4:00PM *IBL Drops In: Activities for a One–Semester Applied Calculus Course*
Karl–Dieter Crisman, Gordon College

4:35PM *Projects for Calculus Classes*
Yun Lu, Kutztown University

5:10PM *IBL in Calculus, Number Theory, and Abstract Algebra*
Amanda Matson, Clarke University

IBL and Technology

4:00PM–5:35PM **Tower Court C**
 Chair: **Dana Ernst**, Northern Arizona University

4:00PM *Utilizing Web 2.0 Technology Tools for Inquiry-Based Learning*
Cindy York, Northern Illinois University

4:35PM *Replicating IBL Strategies in an Online Mathematics Course for Teachers*
Annika Denkert, University of Nebraska Lincoln

5:10PM *Transforming Calculus with Technology and IBL*
James "JC" Price, University of Arkansas - Fort Smith

IBL Assessment

4:00PM–5:35PM **Tower Court D**
 Chair: **Jane Cushman**, Buffalo State University

4:00PM *Assessment Methods in IBL Courses*
Timothy Whittemore, University of Michigan

4:35PM *Informal Student Presentations in IBL Courses: To Assess or Not Assess?*
Nina White, University of Michigan

5:10PM *Using Points to Customize Student Participation*
Kathi Crow, Salem State University

IBL Math Ed

4:00PM–5:35PM **Grand Ballroom 2**
 Chair: **Judith Covington**, Louisiana State University, Shreveport

4:00PM *Modifying Children's Mathematical Tasks for Use in IBL Content Courses for Prospective Elementary Teachers*
Dana Olanoff, Widener University, **Amy Hillen**, Kennesaw State University, **Eva Thanheiser**, Portland State University, **Rachael Welder**, Hunter College CUNY, **Ziv Feldman**, Boston University, and **Jennifer Tobias**, Illinois State University

4:35PM *Utilizing a Research-Based Rubric to Assess Students' Creativity in Proof and Proving*
Milos Savic, University of Oklahoma, **Gulden Karakok**, University of Northern Colorado, **Gail Tang**, University of La Verne, **Molly Stubblefield**, University of Oklahoma, and **Houssein El Turkey**, University of Oklahoma

5:10PM *Inquiry-Based Learning in Discrete Mathematics*
Ali Shaqlaih, University of North Texas at Dallas

Saturday, June 21

Breakfast

7:15AM–8:15AM **Grand Ballroom 1**

Parallel Sessions

IBL Research

8:15AM–9:25AM **Tower Court A**

Chair: **Amanda Matson**, Clarke University

8:15AM *Working Hard is Better Than “Being Smart”: Research and Incorporation of a Growth Model of Intelligence*
William “Bill” McKenna, University of Texas at Austin

8:55AM *Learning Progressions and Teaching Experiments: IBL in Science Classrooms (Grades 6-12)*
Nissa Yestness, Colorado State University, and **Kitty Roach**, University of Northern Colorado

IBL Assessment

8:15AM–9:25AM **Tower Court B**

Chair: **Victor Piercey**, Ferris State University

8:15AM *Grading in an IBL Course*
Jacqueline Jensen-Vallin, Lamar University

8:55AM *Reading Skills for IBL Mathematics*
Dan Goldner, Boston Public Schools

General IBL

8:15AM–9:25AM **Tower Court C**

Chair: **Randy Cone**, Virginia Military Institute

8:15AM *Broadening School-Based Conceptions of Inquiry to Cultivate Critical Consciousness and Develop Mathematical Knowledge*
Steven Greenstein, Montclair State University

8:55AM *Engaging High School Students in Discovery*
Violeta Vasilevska, Utah Valley University

IBL and the Flipped Classroom

8:15AM–9:25AM **Tower Court D**

Chair: **Larissa Schroeder**, University of Hartford

8:15AM *Using the Flipped Classroom for Inquiry Based Learning*
Betty Love, University of Nebraska Omaha, and **Cindy Corritore**, Creighton University

8:55AM *Deep Learning Methods, a Modified R. L. Moore Learning Methodology*
Paul Stephen Prueitt and **Jim Leverett**, Second School Inc.

IBL Assessment

8:15AM–9:25AM **Grand Ballroom 2**

Chair: **Judith Covington**, Louisiana State University, Shreveport

8:15AM *Student Adventures in Calculus, IBL Style*
Katie Wanek, **Oscar Castillo**, **Josiah Krutz**, **Kayla Timm**, **Dylan King**, **Marissa Gigantelli**, and **Angie Hodge**, University of Nebraska Omaha

8:55AM *An IBL Proofs Course: Student Perspectives, One Year Later*
Matthew Cole, **Jennifer Robillard**, **Nicole Trommelen**, and **Julianna Stockton**, Sacred Heart University

Break for Refreshments

9:25AM–9:45AM **Grand Ballroom 1**

Parallel Sessions

Teaching Inquiry

9:45AM–10:55AM **Tower Court A**

Chair: **Dana Ernst**, Northern Arizona University

9:45AM *Inquiring Minds Want to Know (I)*
Elizabeth Thoren, University of California, Santa Barbara

10:25AM *Inquiring Minds Want to Know (II)*
Brian Katz, Augustana College

IBL Calculus

9:45AM–10:55AM **Tower Court B**

Chair: **Ellie Kennedy**, Northern Arizona University

9:45AM *Moore, Calculus and a Search for Research Mathematicians*
John W. Neuberger, University of North Texas

10:25AM *A Try and Re-Try of Class Flipping Calculus*
Melissa Tolley, Wingate University

General IBL

9:45AM–10:55AM **Tower Court C**

Chair: **Ron Taylor**, Berry College

9:45AM *Greater Upstate New York Inquiry-Based Learning Consortium Activities*
Jane Cushman, Buffalo State University

10:25AM *Breaking the Silence*
David Cusick, Marshall University

General IBL

9:45AM–10:55AM **Tower Court D**

Chair: **Randy Cone**, Virginia Military Institute

9:45AM *An Analysis of Inaccuracies in Grades 5-12 Assessment Questions*
Lee Mahavier-Peterman, Goose Creek Memorial High School

10:25AM *IBL Workshops*
G. Edgar Parker, James Madison University

General IBL

9:45AM–10:55AM **Grand Ballroom 2**

Chair: **Tom Judson**, Stephen F. Austin State University

9:45AM *What Kinds of Comments Do Students Make About Other Students' Proof Attempts?*
Annie and John Selden, New Mexico State

10:25AM *IBL Teaching Methods in an Advanced Class on Vietoris Homology*
Jeffrey Ford and Frank Sturm, Auburn University

Break for Refreshments

10:55AM–11:15AM **Grand Ballroom 1**

Plenary Presentation

11:20AM–12:20PM **Grand Ballroom 2**

IBL Episodes in K-12 Teacher Education and Professional Development
Dale Oliver, Humboldt State University

5–Minute Reports III

12:30PM–1:00PM **Grand Ballroom 2**

Chair: **Ron Taylor**, Berry College

Concluding Remarks

1:00PM–1:15PM **Angie Hodge**, University of Nebraska Omaha, and **Theron "TJ" Hitchman**, University of Northern Iowa

Notes

ABSTRACTS

Thursday, June 19, 2014

Grand Ballroom 2

1:15 **Julian Fleron and Philip Hotchkiss**, Westfield State University. *Inquiry-Based Learning to Engage and Empower the Disfranchised*

The popular refrain “I’m so bad at math I can’t even balance my checkbook” is symbolic of society whose mathematical perceptions, beliefs, and abilities are dysfunctional. In our view, a majority of our society has been disfranchised and disempowered. The educational, emotional and economic impacts are profound and disturbing.

Inquiry-based learning (IBL) offers powerful learning opportunities for all students – especially, we believe, for those that have been disengaged and disempowered by the typical approach. At the university level, one of the more representative cohorts of the disfranchised is our general education students. In this workshop, you will actively explore ways in which IBL can have a transformative impact on this audience.

Through classroom videos you get to come inside our classrooms – see students working together, critiquing, inventing, debating, justifying and sharing mathematics – and deconstruct what has nurtured these active pursuits. You will interact with students’ mathematical work, their discoveries and their mathematical creations. And you will share in our students’ experiences through their journals, songs, poems, artwork and interviews – building new norms for what is possible.

We hope that this experience helps focus attention on the disfranchised and stimulates action on the use of IBL in engaging and empowering them.

Parallel Sessions

Tower Court A

2:25 **Lola Thompson**, Oberlin College, *IBL Number Theory with n students (for large values of n)*

I spent nearly a year planning my first IBL number theory course in exquisite detail, only to wind up with an enrollment that was 2-3 times larger than I was expecting. Rather than abandoning my plans (and teaching a standard course with lectures and textbooks), I decided to make a number of last-minute adjustments. In this talk, I will discuss some time-saving (and sanity-preserving) techniques for using IBL in a larger-than-expected course. Topics include: structuring and evaluating group homework assignments, managing student presentations in larger classes, and fostering a productive collaborative environment in a tightly-packed lecture hall.

I will model the way that I run my class by giving participants worksheets and breaking them into groups. I will ask participants to solve an "exploratory" problem and then I'll demonstrate how I motivate my students to make good conjectures and build up to more difficult concepts.

Tower Court B

2:25 **Mindy Capaldi**, Valparaiso University, *What Did I Do Wrong (or Right)?*

From grading participation to giving oral exams, you might be surprised at what worked, and didn’t work, in my IBL classes. I compare and contrast IBL strategies used in a 20 student abstract algebra course and four student topology course, and present the success (or not) of those strategies. We will also discuss proposed solutions to the not-so-successful ideas and other unexpected problems that arose.

I will present my strategies, poll participants on whether they think it was successful or not, then discuss what really happened. I will also take the not successful ideas, ask participants to partner and come up with a solution, and then discuss their/my proposed solutions.

Tower Court C

2:25 **David M. Clark**, SUNY New Paltz, *Undergraduate Real Analysis: Designing Course Notes*

My favorite IBL activity is authoring new IBL course notes in collaboration with colleagues and students. I will present an outline for doing this in the context of a two-semester real analysis course I am now designing. Drafts of notes need to be worked through by students to determine what works best for them. They also need pilot testing by other faculty working through them with their own students. Well vetted and thoroughly revised notes can then be made public and be broadly used.

These particular notes arose as a result of a movement to drop real analysis from our requirements for secondary school teachers because it was too difficult for them. My view was that secondary school mathematics teachers need to have a depth of understanding of the numbers beyond what they themselves will teach directly. But they need it from a course that they can realistically do in an IBL format. I am designing a real analysis course intended to fulfill this goal.

Tower Court D

2:25 **Brian Dorn**, University of Nebraska, and **Larissa Schroeder**, University of Hartford, *A Tale of Two Calculus Classes*

One of the challenges of using video in both inquiry-based and inverted mathematics courses is providing ways for students to actively engage with the content while watching the video. Ideally, educational videos available to students would not only expose them to new course content, but they would serve as an “object to think with” collaboratively—e.g., one about which students can converse to uncover shared misconceptions, pose additional lines of inquiry, or gain feedback from each other. In this presentation, we will discuss a web-based media player, TrACE, that provides means for students to asynchronously pose questions, add comments and respond to classmates while watching a video. In particular we will present research data from two different implementations of TrACE in Calculus 1 courses during the 2014-2015 academic year, giving particular emphasis on how instructors’ adoption of the tool and pedagogical approaches affect the quantity, quality and type of interactions between students. How session will be active or engaging:

As part of the presentation, we will demonstrate the media player TrACE. We will provide time for audience members to brainstorm potential ways they could incorporate TrACE into their courses or suggest modifications to TrACE that would support their teaching.

2:25 **Sarah K. Bleiler**, Middle Tennessee State University, **Yi-Yin Ko**, Indiana State University, **Justin D. Boyle**, University of New Mexico, and, **Sean P. Yee**, Fullerton College, *Developing Communal Understanding of Proof-Writing Criteria*

In undergraduate proof courses, students primarily observe their instructor’s polished and complete proofs and may perceive their instructors as the sole authority to judge the validity of their proof productions. Within such learning environments, undergraduates often view proof as a process that they need to replicate and miss opportunities to negotiate their agreement on the validity of acceptable proofs. In order to support undergraduates in learning proof as a communal, negotiated, and sense-making process, we designed and implemented a series of activities where students constructed arguments, validated others’ arguments, used their validations to develop a list of proof-writing criteria, and revised and resubmitted their arguments based on the class-developed criteria. In this way, what “counts” as mathematical proof was determined by the classroom community as a whole, rather than solely by the instructor. In this presentation, we will discuss the results of this instructional sequence, implemented in two content courses and two methods courses at four different institutions, and will provide implications for supporting undergraduates’ proof learning as they actively consider what counts as ‘proof.’

During this presentation, we will engage participants in validating students’ sample arguments to illustrate the structure of our activities and to highlight the potential for reflection on proof-writing

Grand Ballroom 2

criteria. We will also share samples of our students' revisions of their original arguments based on their community-developed criteria.

Tower Court A

2:55 **Dorin Dumitrascu**, Adrian College, *Students' Use of Geometry Axioms to Construct Proofs*

I present findings from a study on how the undergraduates in a College Geometry course use the axioms of geometry to improve on their mastery of reading and constructing proofs. The course was conducted using the small-group guided discovery method, at a liberal arts college in the Midwest. I will focus on two pedagogical aspects. First I will discuss activities and the special selection of geometry topics that I prepared for guided discovery. I will comment on the effectiveness of this setting in the assimilation of the course content. Then I will assess the proof techniques and the quality of arguments which appeared in the written solutions from the final evaluation of the course. Guided discovery method was a completely new teaching and learning experience for all the students of this study. Their perception of the method will also be discussed.

The participants will experiment with select activities that proved successful in my guided discovery approach to the geometry course.

2:55 **Ellie Kennedy**, Northern Arizona University, *A First-Timers Perspective: Trials, Tribulations, and Lessons Learned*

As a first-timer teaching an IBL course, I taught Discrete Mathematics using a modified-Moore method. I started with existing notes that needed modification to fit the content of the course and I would like to share the lessons that were learned in administering the modified notes in my class. I also gathered other activities and teaching techniques from websites and IBL experts. Some ideas worked great, others worked with some modification and some things that I tried did not work at all. I would like to share the trials, tribulations and the lessons that were learned along the way.

Tower Court B

2:55 **Alison Marr**, Southwestern University, *Creating and Editing Course Notes For a Graph Labeling Course*

In the Spring of 2013, with the help of an AIBL small grant, course notes for a special topics course titled "Introduction to Graph Labeling" were developed. In this talk we'll work through some of the successful activities from that course and try to find ways to incorporate similar activities into the later part of the course when questions become more difficult. In particular, we might attempt to answer: when focused on solving current research questions in the field, how can we provide enough guidance and "low hanging fruit" so that the students don't stop making progress. Knowledge of graph theory is helpful, but not needed as we try to find ways to make these notes better.

Tower Court C

2:55 **Perry Lee and Pdraig McLoughlin**, Kutztown University of Pennsylvania, *Aspects of the Flipped/ Inquiry-Based Learning Approach in a "Large" College Algebra Classroom: An Ongoing Report*

Inquiry-Based Learning (IBL) in a mathematics classroom has been shown to be very effective for engaging students in the understanding of course material. That is, students interact with peers and the instructor by asking questions and conjecturing (by doing mathematics) in the classroom. Recently, the 'flipped' or inverted approach to teaching courses has received considerable attention, and in these flipped courses, students come to class prepared before the class meeting. The common denominator in the flipped and IBL methodologies seems to be an emphasis on student engagement in the classroom. One author implemented a method which uses both the flipped and the IBL methods (or the F/IBL method) into his 'large' College Algebra classroom during the past Fall 2013 and Spring 2014 semesters for managing and engaging students inside the classroom setting.

During this past 2014 Spring semester, student-learned outcomes were assessed to determine the effectiveness of this F/IBL approach in his large College Algebra classroom compared to two other large

Tower Court D

College Algebra classrooms that were both taught using the traditional lecture-style methods. This talk will address the differences in the F/IBL approach used in the Fall 2013 semester versus the Spring 2014 semester; will also present preliminary data of student learned outcomes from the F/IBL and two other College Algebra large classes during the 2014 Spring semester; and what the next phase of this research shall be.

Grand Ballroom 2

2:55 **Nathaniel Miller, Lee Roberson, Sarah Rozner Haley, and, Becky-Anne Dibbs**, University of Northern Colorado, *Panel Discussion on a Mentoring Program for Using IBL Methods in Teaching College Geometry*

From Fall 2011 until Spring 2014, the Educational Advancement Foundation funded a mentoring program at the University of Northern Colorado in which three mathematics education graduate students were mentored in teaching a College Geometry class using IBL methods. This will be a panel discussion of these three students, Lee Roberson, Sarah Rozner Haley, and Becky-Anne Dibbs, along with their mentor, Nathaniel Miller, discussing this mentoring program and how it has changed their teaching.

Tower Court A

3:25 **Mary Shepherd**, Northwest Missouri State University, *A Second Year Perspective on Teaching Abstract Algebra*

After a “bad” first experience teaching Abstract Algebra last spring (2013), and much soul searching over the summer, I have found an IBL Abstract Algebra book, I like and that fits much closer to my teaching style. I have been using the new book this spring (2014). I will report on both courses and try to share some of the many and daily light bulb experiences of the students, and some of the difficulties encountered and overcome.

I plan to intersperse into the talk several short activities from my course.

Tower Court B

3:25 **Susan Crook**, Loras College, *What’s Worked for Me*

Class preparation can often be a game of “beg, borrow, or steal” as we try to get ready for a number of classes each semester. We all benefit from hearing the experiences of those who have gone before (a technique that can be applied to students in an IBL classroom as well!). In this presentation, I will detail activities and strategies that have worked for me in my full IBL classes as well as those that I sneak into other more traditional classes. I’ll also cover some strategies I tried that did not work well and why I think they were not successful.

Tower Court C

3:25 **Victor Piercey**, Ferris State University, *Revising IBL Materials*

Once you have tried your IBL materials, how do you revise them? In this session, participants will assist in this process by briefly working through a portion of course materials and providing suggestions to the author for improvement. If time permits, we will identify some common criteria used during this process that may form the beginning of a rubric for the evaluation of IBL materials. The materials come from a course entitled Quantitative Reasoning for Business, which is roughly at the level of intermediate algebra.

Participants will work through materials in small groups and come up with at least one recommendation for improvement. If time permits, whole group reporting out will involve collecting a list of criteria used during the process which would form a foundation for a rubric for evaluating IBL materials.

Tower Court D

3:25 **Robert Sachs**, George Mason University, *The Successful First Week of a Flipped Calculus I Course*

The first week of any course establishes a tone and expectations for the rest of the term. I will report on a carefully designed set of IBL activities that worked well for me this past fall. My context is Calculus I at a research university in an active learning classroom (72 students, 2 learning assistants). The first week

established that students would write on the whiteboard walls and share responsibility for their learning. It also got the attention of the large fraction of the class that was calculus-aware. Some data on this experiment will also be presented.

Participants will receive a copy of the course syllabus which includes useful language on IBL. They will critique and improve the materials from the first week and discuss possible student responses.

3:25 **Chuck Hayward**, University of Colorado Boulder, *Supporting Instructors in Making the Transition to IBL: Lessons from IBL Workshops*

Professional development is one way of drawing new instructors into the IBL community. This talk offers insights on how to support faculty and graduate students interested in learning to teach with IBL methods, both informally and through formal professional development activities. Since 2010, five week-long workshops have been held to help instructors learn to implement IBL in their classrooms. Each workshop served between 40 and 55 instructors, who were given pre-workshop, post-workshop, and one-year follow-up surveys to assess the workshop, participants' learning, and participants' instructional practices. The workshops have been effective at helping participants to implement IBL: for the three cohorts for which follow-up data are available, at least 58% of participants reported using at least some IBL methods in the year following the workshop. This talk will share results from the participants' surveys, highlighting the features of effective professional development of IBL practitioners. In addition, 16 past participants were interviewed about their teaching practices and discussed factors that had both helped and hindered their ability to implement IBL in their classrooms, providing lessons on how colleagues can support instructors who are making the transition to IBL.

I will begin the presentation by having small groups discuss and share how they currently develop others (or how they would plan to do so). They will share best practices or ideas for good strategies. Then, we will share and compare our findings from the IBL workshops.

4:15 **Melvyn Jeter**, Illinois Wesleyan University, *An Important Aspect of the Moore Method*

An important aspect of the Moore Method is to develop within each student the confidence that he or she can create mathematics and effectively communicate it to colleagues in clear written and verbal form. Requiring students to work on challenging problems that may take an extended period of time to solve is a vital part of this process. The most important thing that students often take from their Moore classes is the ability to work on challenging problems, eventually solving some of them, and possessing the ability to successfully present the solutions to their peers. We are constantly told this by our graduates.

I hope to have Karl Pierburg who is the Senior Director for Football Systems for the Atlanta Falcons attend the meeting to explain how his experience in Topology at Illinois Wesleyan University provided him with the skills that has led to his success with the NFL.

4:15 **Matthias Kawski**, Arizona State University, *IBL Experiments in the MathCircle at ASU Tempe*

Given the special demographics and ASU being the only research university in the Phoenix metro area (compare Boston or San Francisco), the MathCircle at ASU Tempe uses its locally singular resource, research faculty, to meet the needs of students who need more math than schools and community colleges can deliver.

Our focus is, as far as feasible, to start with problem settings that are meaningful to even advanced middle school students, and which ideally show a line that connects with cutting edge research, even Abel or Nobel prizes (e.g., network sorting, stable marriage problem).

Some session leaders use the MathCircles for teaching experiments that we are not quite ready to try in our regular college classes. In contrast to common exercises or competition problems, we prefer problems that are not quickly finished with a period at the end. Instead the highest premium earn

Grand Ballroom 2

Tower Court A

Tower Court B

open-ended problems for which each answer makes the student participants ask more questions, and which ideally open up entire lines of inquiry and research. An important goal is to develop a culture of inquiry in which it is normal to not get an answer in minutes, but instead convey that this working like a real mathematician!

We plan that for a portion of the session, participants engage as if they were participants in a typical MathCircle session, and then have participants reflect on their learning experience, and how this may be different from traditional learning environments.

4:15 **Joyati Debnath**, Winona State University, *Mixing IBL and Flipped Classroom Concept in a Pre-Calculus Course*.

Tower Court C

The idea of mixing IBL methods and flipped classroom approach came to me as I was talking to a high school teacher in town. I was directed to a collaborative research project that was written by two high school teachers for grade 9 students in a Humanities class. At the beginning it was not very clear to me how I could try and still be effective for my students in learning mathematics. I was not sure if I could actually implement this alignment. After contemplating it with fellow mathematicians I decided to give it try in a Pre-Calculus course. This presentation will highlight the experiences gained and the lessons learned by both of us (students and myself).

4:15 **Thomas W. Judson, Kimberly Childs, and Deborah Pace**, Stephen F. Austin State University, *Inquiry-Based Learning, Cognitive Dissonance, and Taking K-12 Teachers to the Next Level*

Tower Court D

Inquiry-based learning can be employed as a tool to challenge existing knowledge, beliefs, and practices of K-12 teachers. Research shows that professional development focused only on new material and changing a limited number of teaching practices will often result in teachers adopting only those ideas and skills that fit within their existing framework of teaching knowledge and practice. In order for one to be open to new ideas and new ways of doing things, it may be necessary to confront existing beliefs and practices by establishing cognitive dissonance, the feeling of discomfort a person experiences when presented with conflicting ideas or knowledge. If teachers are provided with sufficient time and support to work through any dissonance that they have experienced, they may be open to a transformation of their beliefs and practices. IBL creates an environment for transformative learning provided there is time and support for teacher to think through any dissonance that they have experienced and thus develop new beliefs and practices that fit with their new understanding. We will present evidence that IBL can be an important tool in training K-12 teachers, especially those teachers who are assuming a role of leadership.

4:45 **Michael Gagliardo**, California Lutheran University, *Taxi Cab Circles*

Tower Court A

This session on Taxi Cab Geometry will follow an activity I have used in class and during a Math Teachers' Circle. Participants will first gain some experience dealing with the taxicab metric before they are tasked with creating and exploring their own conjectures. Due to most peoples' familiarity with Euclidean geometry, this activity has been successful at introducing a variety of audiences to creating conjectures and has even produced the topic of a Masters' thesis.

The participants will get hands on experience creating circles and lines using the taxi cab metric and will then spend time creating and proving various conjectures about taxi cab geometry.

4:45 **Sarah-Marie Belcastro**, MathILy and Smith College, *Look, Ma, No Hand(out)s! Guidance in Response to Student Inquiry at MathILy*

Tower Court B

MathILy (short for "serious Mathematics Infused with Levity") is an intensive residential summer program for mathematically talented high-school students. IBL is integral to MathILy culture and practice. We use IBL with potential students starting with the Exam Assessing Readiness, which reaches about 10 times as many students as participate in MathILy. (We will share a copy of this year's EAR with

conference attendees.) As a way of simultaneously doing outreach and recruiting for MathILy, staff run activities for attendees at some math competitions.

The bulk of MathILy itself is inquiry-based classes, run without textbooks and also without worksheets or other pre-prepared guidance for inquiry. In this session we will describe the techniques we use to frame, encourage, and guide inquiry at MathILy, and we will invite fellow conference attendees to participate in a live demonstration of a bit of a typical MathILy Root Class meeting. Of course, we will also share a description of (and Q&A about) the structure of MathILy and process of MathILy admissions. Finally, we will describe how the MathILy approach to IBL can translate into college courses for mathematics majors.

4:45 **Regina Jackson**, and **Michel Smith**, Auburn University, *Teaching Teachers to Teach with IBL*

With the increased interest in the Common Core and the implementation of Common Core standards by many states comes the opportunity to encourage expanded use of the IBL in the K-12 classrooms. A program is being considered at Auburn whereby Elementary Teachers can obtain "certification" in Mathematics for Elementary Education as part of a graduate program for teachers pursuing Masters Degrees. Techniques of IBL have been modeled in a course for students in this program. As part of professional development, Middle School and High School teachers from lower Alabama attend summer workshops hosted by Troy-Dothan. IBL techniques are modeled in an intensive day-long workshop. A sampling of models from these programs will be presented.

4:45 **Daniel Kiteck**, Indiana Wesleyan University, *An IBL Approach to Abstract Algebra*

I taught a lecture-based Abstract Algebra class for three consecutive years. With less than satisfying results, I needed a new teaching method. I found a middle ground between lecture and the traditional Moore Method that I have now used the last two years. One of my primary goals is for my students to develop a deep understanding of proofs for an introduction to groups and rings. (I use the first half of Gillian's "Contemporary Abstract Algebra.") To accomplish this goal, the vast majority of each class time consists of students presenting the material, asking questions, and helping each other with understanding. No student knows beforehand who I will call, so all of the students prepare for all of the material. A single student is responsible for a presentation, but another student also stands at the front acting as a "support person" for encouragement and as a resource. When needed, I provide probing questions and connections. I see vast improvement in every way, from deeper questions from the students to better student evaluations.

6:30 **Dinner Speaker: Michael Starbird**, University of Texas at Austin, *Right Place, Right Time*

MOOCs and other technological applications in education force colleges to ask, "What value is added by having students in classes?" Passive lectures do not supply a compelling answer. IBL does.

Friday, June 20, 2014

12:00 **Lunch Speaker: Karen Saxe**, Macalester College, *Creating a Common Vision for the Undergraduate Math Program in 2025*

The mathematical sciences community is at a pivotal point. Politicians across the country and mathematicians throughout our community, not just mathematics educators, seem to be more keenly focused on undergraduate mathematics education issues than in the past. In order to capitalize on the current climate, the MAA is partnering with other professional societies to consider how we might modernize our curricula and programs to better prepare students for the demands of the 21st century workplace. We have a window of opportunity to catalyze widespread adoption of curricula and pedagogies that are geared toward the development of a broad base of intellectual skills and

competencies that better prepare students for the workforce, and are simultaneously endorsed by a broad cross-section of the mathematical community.

We have undertaken an initiative to bring stakeholders in the mathematics education enterprise together to reconsider our long-standing traditions, both curricular and pedagogical. The primary goal of this initiative is to develop a shared vision of the need to modernize the undergraduate mathematics curriculum, especially the first two years, a vision that a core group of professional societies can endorse and promulgate, and about which the societies have some degree of confidence that a broad cross-section of the community will embrace. In this talk, we will share more details about the initiative and where we are in the process

Parallel Sessions: Favorite IBL Activity

Tower Court A

2:20 **Elaine Bailey**, Piedmont College, *POGIL: How IBL is Used in Chemistry*

Process Oriented Guided Inquiry Learning (POGIL) is a student-centered teaching method that provides students with the tools to construct new knowledge and has been used in chemistry since 1994. In POGIL, students are broken into groups of four. The groups are provided with a carefully designed activity that guides them through core concepts. POGIL develops problem solving skills, critical thinking skills as well as a deeper understanding of the material. To ensure all students are actively engaged each student is made responsible for a specific task. Typical POGIL activities include very little lecture and are usually timed. My introductory classes often include non-STEM majors who find it difficult to learn under time constraints and without lecture. To serve these students, I have developed my own style of POGIL involving the following three components:

Mini Lecture

POGIL Activity

Wrap-Up Lecture/Mini Quiz

In this talk I will be presenting the inquiry-based method that I use in a chemistry classroom containing STEM and non-STEM majors. Currently this IBL technique is used in a variety of disciplines and in many high schools and colleges. Like many other IBL methods, POGIL can be adapted for use in virtually any STEM field.

Tower Court B

2:20 **Suzanne Dorée**, Augsburg College, *The Coins go 'round 'n 'round*

Take a number of coins and arrange them in piles. Now remove the top coin from each pile and form a new pile out of those collected coins. Repeat. What happens? This seemingly simple (and seemingly endless) process, first popularized by Martin Gardner in a 1983 article, leads naturally to many questions for students to explore. This session will allow attendees to participate (as students) in this classroom-tested activity; to uncover the learning objectives of the lesson; and to experience the pedagogical strategies employed. The lesson has been used in a sophomore level discrete mathematics (introduction to proofs course) and with high school mathematics teachers. The questions connect to graph theory, number theory, and dynamical systems — *if I say any more it will spoil the mathematical surprises*.

Participants will receive a copy of the activity, instructor notes, and bibliography which appear as a chapter I wrote for MAA Notes #74 *Resources for Teaching Discrete Mathematics: Classroom Projects, History Modules, and Articles*, edited by Brian Hopkins (2009). Part of my motivation for this session is to make more IBL folks aware of this useful resource. But mainly, it's just my favorite IBL activity.

Tower Court C

2:20 **Harold Reiter**, University of North Carolina Charlotte, *Teaching PIE to 10-Years Olds*

Understanding the principle of Inclusion/Exclusion does not depend on a solid foundation of algebra. I plan to show how we can use a collection of wooden cubes to introduce algebraic ideas and to

Tower Court D

understand some fundamental relationships between algebra and geometry. I've used this idea for each of the last 6 summers at math camps for students as young as nine.

2:20 **David Crombecque**, University of Southern California, *Models for Multiplication and Division: An IBL Activity for Pre-Service Teachers*

In a collaboration between the USC Rossier School of Education and the Mathematics Department, we have developed a class called The Foundations of Mathematics and the Acquisition of Mathematical Knowledge.

Every topic is covered using IBL activities. During class, students are given a set of creative activities. They then report on their results followed by a discussion. By the end of each session, students have developed on their own mathematical models and definitions of the concept in question. The class targets pre-service K1 through 12 teachers and takes a closer look at K-12 mathematics and the learning process specific to Mathematics. Through the semester, students will be encouraged to "adopt the habits of mind of a mathematical thinker and problem solver including reasoning and explaining, modeling, identifying structure, and generalizing" (quote from The Mathematical Education of Teachers). Pre-service teachers taking this class spend an entire semester rediscovering K12 mathematics through IBL while also practicing IBL activities they will be able to use in their own classrooms.

2:20 **Anne Cawley, Vilma Mesa, and Inah Ko**, University of Michigan, *Day-to-Day Implementation of Inquiry-Based Learning in Mathematics Classrooms: Faculty Concerns*

In this presentation, we present an update on a three-year investigation into the concerns and challenges instructors report facing as they implement inquiry-based learning [IBL] methods in undergraduate mathematics courses. Through an online survey, instructors completed bi-weekly logs to report about concerns on eleven aspects of their teaching: class preparation, designing assessment, homework, large group discussions, small group work, lecturing, mathematical content, assessment, student difficulties, and student presentations, and any other concerns that do not fit these categories. We use logs completed over a period of two years by 54 instructors who had different levels of expertise with the IBL method and taught different types of courses. Using constant comparative analysis of these log entries, we have identified several areas of concerns that cut across the different aspects of IBL teaching (e.g., students' resistance to IBL, limitation in available resources) and some that are particular to the different teaching strategies teachers use (e.g., managing group work, dealing with student engagement). In addition we contrast these concerns by instructors' level of expertise with IBL and by the type of courses they were teaching.

Grand Ballroom 2

3:00 **Larissa Schroeder**, University of Hartford, *Is $D_x f(g(x)) = f'(g(x))$?*

This activity is a graphical exploration of the derivatives of composite functions. It is implemented prior to the formal introduction to and statement of chain rule in an inverted Calculus I course. The functions in this activity provide students with a concrete and accessible set of counterexamples demonstrating that the derivative of $f(g(x))$ is not equal to $f'(g(x))$. The activity begins with a true or false classroom voting question: $\frac{d}{dx} \sin 8x = \cos 8x$. Students then use the app PocketCAS on class iPads to compare and contrast the derivative graphs for sine and cosine functions of the form $y = \sin(ax)$ and $y = \cos(ax)$ for $a > 0$. PocketCAS allows the students to graph the derivative without finding its equation. Finally, students make and test hypotheses about derivatives of functions such as $y = \sin(ax \pm b)$ or $y = \cos(ax^2 \pm b)$.

Tower Court A

How the session will be active and engaging for participants: The session will begin with the classroom voting question. Participants will have an opportunity to complete the investigation using personal

technology. Time will be provided for a discussion around how this activity might help students with their understanding of the chain rule and/or possible modifications.

3:00 **Alessandra Pantano**, University of California, Irvine, *Embracing Beauty: Learning Symmetry Through Art in Grade School and Beyond*

This workshop is devoted to a mathematical exploration of the isometrics that preserve a beautiful periodic pattern, and how they can be combined to form a wallpaper group. (Surprisingly enough, only a very limited number of groups of symmetries exist.)

Different questions can be posed, depending on the age of the participants. Middle schoolers may be asked to find a smallest region that generates the entire pattern under translations, and to identify *all* the elements of symmetry within this tile (rotocenters, mirror lines, lines of glide reflection). High schoolers may be challenged to find an even smaller region that generates the entire pattern using *all* the symmetries, and to think about the orbifold that results from gluing together the boundaries of the unit cell that are identified by the symmetries. Mathematics majors can be guided through the task of identifying which of the 17 possible wallpaper groups arises from a given periodic pattern.

In each case, groups of students carry on the mathematical investigation on art work printed on poster size paper. The instructor may guide the discussion through a slide presentation, showing the students how to perform similar tasks on one of the beautiful Escher's periodic drawings.

3:00 **Brian Bowen**, West Chester University, *Building Our Conceptual Understanding of Formulas for Volume*

For several semesters I have taught geometry class designed for pre-service middle grades mathematics teachers (PSTs). During this time an issue that has continued to surface is the way in which these PSTs speak about their past experiences learning mathematics during their middle grades experience. For many, the use of rote memorization was often the primary way in which content was conveyed from teacher to student. For example, when the PSTs were asked to describe the way in which they learned formulas related to volume many described being "handed a piece of paper and told to memorize." Research suggests that these experiences may not only have a negative effect on the mathematical knowledge held by the PSTs, but also on the pedagogical approaches they will choose once they themselves become classroom teachers.

In response to the disjointed knowledge of volume held by the PSTs I have established series of inquiry based lessons that use concrete learning experiences to discover connections between the volumes of the figures. Discovering these connections allowed the PSTs to derive the formulas, building conceptual knowledge of content that was prior relegated to memorization.

Participants of the session will engage in two activities comparing the relative volume of cylinders to cones and cylinder to spheres. We will use these comparisons to make sense of the traditional formulas for the volume of cones and spheres.

3:00 **Kenneth Gross**, University of Vermont, *The Vermont Mathematics Initiative: Inquiry-Based Learning for Elementary Teachers*

Mathematics is a cumulative discipline and the mathematics taught at the middle and secondary levels and in college is based on the mathematics learned in the elementary grades. The role of the elementary teacher, therefore, is of paramount importance in laying the foundation for success in later mathematics courses and instilling in the student a love of mathematics that may later translate into a scientific or technological career. Unfortunately the vast majority of elementary teachers are ill-prepared in and fearful of mathematics, and do not find teaching mathematics a pleasant experience.

The Vermont Mathematics Initiative (VMI) is a highly successful statewide program that trains elementary teachers to be mathematic leaders in their schools. This presentation focuses on the inquiry

based instructional strategies developed and employed by VMI which are instrumental in transforming math phobic teachers into strong mathematical thinkers who view themselves as mathematicians, view mathematics as part of their lives, see the world around them in a mathematical light, and are enthusiastic about teaching mathematics.

3:00 **John Paul Cook**, University of Science and Arts of Oklahoma, **Brian Katz**, Augustana College, and, **Milos Savic**, University of Oklahoma, *Guided Reinvention of Rings*

We are developing classroom materials that support students as they reinvent basic definitions from ring theory and explore the challenging concepts in this new mathematical setting. These materials elicit fascinating student thinking, and they are carefully designed to leverage that thinking. In this talk, we will discuss pivotal moments in the students' reinvention process. This project is part of a larger project at the intersection of IBL and RUME (research in undergraduate mathematics education).

Parallel Sessions

4:00 – 5:35 **Reflections, Calculus, Technology, Assessment, Math Ed**

4:00 **Stephen L. Jones, Esq.**, *Personal Observations and Reflections on the Teaching Methods of RL Moore*

The author took 11 courses from RL Moore in the 1960s before receiving his PhD under RH Bing. In reporting his personal observations, this presentation will discuss teaching methods depending upon the particular goals of the class in which they are to be used. Such goals may be (1) practical goals for engineers and applied mathematicians; (2) in depth goals which emphasize the underlying theories; and (3) a general history goal. Classes in each of these categories should be taught in a different manner. In the author— experience, there is much discussion about the best teaching techniques to get students from point A to point B, but not enough discussion in the first place about where point B is or should be. The above three goals apply to any discipline or department. But only in mathematics is there a fourth category (4) teaching precise thinking. Moore's method was solely related to this last category. Moore believed the importance of a mathematics class was not the goal, but the journey. And the journey was to get his students to think for themselves, deeply and precisely. The presentation will discuss his methods to accomplish this. They were somewhat different from today's IBL.

4:00 **Karl-Dieter Crisman**, Gordon College, *IBL Drops In: Activities for a One-Semester Applied Calculus Course*

External expectations for "coverage" and the necessity of making courses fairly similar between sections taught by different people can make it hard to do as much inquiry-based pedagogy as many of us would like. Perhaps nowhere is that more true than in calculus, with its many campus constituencies. It can be especially challenging to use IBL techniques only on a replacement basis while sticking with a typical text.

The time of introducing new concepts (like the derivative and integral) is one place to start trying to do so, because many standard curricula now take extra time for this. This session will introduce various IBL "drop-in" activities used successfully as group work over five years in a one-semester applied calculus course in such a context. Participants will get the chance to pretend they are the students, as well as to discuss what concepts might fruitfully be introduced with this sort of approach.

4:00 **Cindy S. York**, Northern Illinois University, *Utilizing Web 2.0 Technology Tools for Inquiry-Based Learning*

Much of learning no longer takes place in a common classroom with a chalkboard. To better engage the new generation of students in inquiry-based learning, the integration of simple technology tools can

Grand Ballroom 2

Tower Court A

Tower Court B

Tower Court C

Tower Court D

help meet student needs in a variety of content areas. Being that IBL is student-centered, we want to show how to put the technology in the students' hands. Students involved in critical thinking can utilize free online support tools to help them express themselves and the ideas they form in their minds. Students need to be able to communicate their thinking to others and collaborate with each other, as well as experts, to help them problem solve. When the students can easily communicate with others, reliance on the instructor lessens. Free online technology tools (e.g., concept maps, blogs, wikis, social bookmarks, and polling/survey, whiteboards, website creation) can help facilitate different implementations of IBL. We would like to discuss and demonstrate some easy ways to implement Web 2.0 tools into your IBL. Each phase of IBL can use different tools. No matter how many phases or how you label them, technology can be utilized to enhance your IBL classroom, make it more efficient, and more effective.

Audience participation will include interacting with online tools and the discussion presentation by utilizing personal devices (smart phones, iPads, laptops). Some of the specific tools we can discuss are Diigo, Google docs, Polleverywhere.com, Gliffy, and more. Devices with Internet connection will be useful for audience participation during this presentation.

4:00 **Timothy Whittemore**, University of Michigan, *Assessment Methods in IBL Courses*

This study seeks to investigate the practices instructors report using to assess their students' learning and how these assessments affect the instruction in their classrooms. Using data collected from 23 instructors using inquiry-based learning [IBL] methods, I discuss the instructors' goals for the students, the ways they measured the students' progress towards these goals, and the feedback they gave students. The analysis of this data uses open coding of the transcripts, a coding of the documents (e.g., syllabi, notes, homework assignments, exams) that the instructors gave to the students, and an analysis of the online logs that the instructors completed to reflect on their use of IBL methods. Findings suggest that instructors use both formative and summative assessment methods, pay particular attention to both student-led presentations and end of semester examinations, use assessment methods to aid the students' learning of the material, and are uneasy about the need to grade students.

4:00 **Dana Olanoff**, Widener University, **Amy Hillen**, Kennesaw State University, **Eva Thanheiser**, Portland State University, **Rachael M. Welder**, Hunter College CUNY, **Ziv Feldman**, Boston University, and **Jennifer M. Tobias**, Illinois State University, *Modifying Children's Mathematical Tasks for Use in IBL Content Courses for Prospective Elementary Teachers*

Opportunities to learn mathematics are heavily influenced by the tasks in which learners are engaged and the way in which these tasks are implemented (e.g., Stein & Lane, 1996). IBL is one way to provide students with opportunities to engage in high-level thinking and reasoning. As such, educators who teach mathematics content courses for prospective teachers are faced with the challenge of designing and implementing meaningful IBL tasks that will help their students develop deep mathematical content knowledge (Watson & Mason, 2007).

The facilitators of this session are all university teacher educators who have been collaborating to develop meaningful mathematical tasks for prospective elementary teachers. In the session, we will describe our task design and modification cycle by sharing our work in modifying a fraction-comparison task from *Investigations*, a well-known elementary curriculum, and implementing it in our content courses for prospective elementary teachers. We will highlight how we used IBL in order to support our students' high-level thinking. Throughout the session, participants will be asked to think about aspects of our modification process, and how they could incorporate aspects of it into their own IBL-driven mathematics content courses.

Grand Ballroom 2

Tower Court A

4:35 **Brad Bailey**, University of North Georgia, *How Much 'Moore' Do My Students Want?*

In this talk we will describe a style of Modified-Moore Method (MMM) used at our institution in Precalculus classes as part of a two-year research project to study the impact of such inquiry-based practices on students' performance, and students' attitudes about mathematics and the learning of mathematics. Varieties of both quantitative and qualitative methods were used to measure and study these impacts. One of the instructors involved in the study will briefly describe our teaching method, including highlighting some ways in which it differs from Dr. Moore's original method and provide some rationales for these departures. We will briefly detail the daily classroom activities—meaning what the students and the instructor did on a typical day. After describing the teaching style and the instruments used to study its effects, we will share preliminary results from both the qualitative and quantitative components of the study. Though the data analysis is on-going, the results thus-far indicate that the MMM students tended to have higher achievement on some measures, but also tended to prefer direct instruction. We will share ideas for new directions of study based on our finding. (This research is funded by a grant from the Education Advancement Foundation.)

Tower Court B

4:35 **Yun Lu**, Kutztown University, *Projects for Calculus Classes*

During this talk, I want to share my experience of using projects to enhance students' learning in my calculus class of the previous semester. I will talk about my motivation, problems encountered, success received, as well as students' feedback. I would also like to get some suggestions and comments from the audience about more techniques that I may use for my future teaching.

Tower Court C

4:35 **Annika Denkert**, University of Nebraska Lincoln, *Replicating IBL Strategies in an Online Mathematics Course for Teachers*

University of Nebraska--Lincoln's Department of Mathematics has been offering courses for teachers for professional development or for pursuing an advanced degree with a focus on mathematics education. The face-to-face sections of these courses are highly interactive, with participants working in groups on problems during class time and sharing/discussing different solution strategies as a whole class. This presentation will discuss how these features of the in-person course have been transferred to an online setting. The successes and challenges of various approaches to address course features will be shared, and will include feedback from teachers enrolled in the past sections of the courses.

Tower Court D

4:35 **Nina White**, University of Michigan, *Informal Student Presentations in IBL Courses: To Assess or Not Assess?*

In many IBL courses much of class time is spent on students making informal presentations of problems. The goal of this session is to discuss what role, if any, such presentations should play in the summative assessment of students. Further, if we choose to assess student presentations, what should be the foci of such assessments and how do we implement them in real time?

Participants will discuss some of the following questions:

- (1) Why would we choose to assess or not assess informal student presentations in an IBL course?
- (2) If we choose to assess, what do we focus our assessment on?
- (3) How would these assessment goals vary by type of course?
- (4) What are the challenges (and solutions!) to actually implementing such an assessment?

The main activity of the session will be to watch videos of student presentations in a variety of IBL courses, discuss features of student presentations, and to jointly create various "presentation rubrics" for different courses and to test them on the videos.

Grand Ballroom 2

4:35 **Milos Savic**, University of Oklahoma, **Gulden Karakok**, University of Northern Colorado, **Gail Tang**, University of La Verne, **Molly Stubblefield**, University of Oklahoma, and **Houssein El Turkey**, University of Oklahoma, *Utilizing a Research-Based Rubric to Assess Students' Creativity in Proof and Proving*

Assessing students' learning in IBL courses includes, but is not limited to evaluation of students' development of content knowledge, of learning skills, and of habits of mind of the discipline. Tracking students' development of habits of mind may be difficult, and requires careful exploration. In our project, we focus on creativity as one of the important features of habits of mind for the mathematics discipline. When teaching, avoiding the acknowledgment of creativity may "cause them to give up the study of mathematics altogether" (Mann, 2005, p. 239). Furthermore, not exposing students to creative proofs or solutions to problems could lead them to believe that the study of mathematics is about procedures and recollections of a correct proof technique. Despite the importance of thinking creatively in mathematics, there currently is no assessment tool that measures students' mathematical creativity or their growth in thinking creatively with regards to proof. Our research group developed a creativity-in-proof rubric by aligning items from a creative thinking rubric (Rhodes, 2010) along with another rubric by Leikin (2009). Workshop attendees will use this rubric to assess students' proof processes captured by Livescribe pencast. Participants will be able to make suggestions for revisions to the rubric based on ideas presented.

Tower Court A

5:10 **Wayne Tarrant**, Rose-Hulman Institute of Technology, *Taking IBL to New Communities*

Most of us have taught a point-set topology, introduction to proofs, or real analysis course using IBL, and this is a great thing. I submit that we can take IBL to colleagues beyond mathematics in order to enrich student learning and experiences in more areas. When I encourage students to be as active in other classes as they are in mine, I have run into trouble with a few colleagues for such meddling. And this is an opportunity to have dialogue with colleagues.

I have run a semester-long workshop on IBL for an entire undergraduate faculty and attempted IBL teaching in Paris, both thanks to support from AIBL. In addition I have taught MBA courses using IBL, introduced IBL to some in the homeschooling community, and now use IBL at an undergraduate science and engineering college, among many other attempts. Each of these endeavors has had varying degrees of success, but every instance has given its own lessons. In this talk I will recount my experiences. I will admit my failures and speak of what has worked. I am hopeful that someone will learn from my tries and will decide to spread IBL to new audiences.

Tower Court B

5:10 **Amanda H. Matson**, Clarke University, *IBL in Calculus, Number Theory, and Abstract Algebra*

Here Dr. Matson will share her amateur IBL experiences in upper level math major classes and the introductory calculus sequence. These include but are not limited to: adventure themed problem sets and exams, boisterous discussion control techniques, colored pens, homework bookmarks, TeX, and proud problems.

Tower Court C

5:10 **James "JC" Price**, University of Arkansas - Fort Smith, *Transforming Calculus with Technology and IBL*

If lecture is removed from the classroom, then what should replace it? This is the question we faced this year when we put screencasts of our calculus lectures on YouTube at www.youtube.com/user/drprice765. In this talk we will discuss how we incorporated IBL techniques and transformed our traditional homework sets to create an active learning environment, in which students could openly discuss mathematics, compare and contrast ideas, and work together to solve problems.

We will have the participants cluster together into groups of five at the beginning of the talk, in order to simulate our classroom. Each cluster will watch a screencast and receive a packet comprised of three different problem sets (traditional, discussion-based, and theoretical) that were used to replace lecture.

Tower Court D

5:10 **Kathi Crow**, Salem State University, *Using Points to Customize Student Participation*

In an inquiry based classroom, students have multiple opportunities to show their understanding of the material including presentations, written assignments, and exams. Some students are quick to prove theorems and thrive on presenting their work to their classmates while others take longer to fully engage with the content or are too shy to present often. A points-based grading system can provide the flexibility to grade some students more heavily on their presentations while allowing other students to exhibit their mastery of the material through exams.

In this talk, I'll give an overview of the system I use in my real analysis and abstract algebra courses. We'll then break into groups to create points-based system based on course goals and objectives.

Grand Ballroom 2

5:10 **Ali S. Shaqlaih**, University of North Texas at Dallas, *Inquiry-Based Learning in Discrete Mathematics*

In this presentation, I will present some IBL activities that I implemented in a discrete mathematics course. A qualitative analysis of students' preference will be presented. Attendees will be engaged in a discussion regarding the students' achievement and the course assessment.

Saturday, June 21, 2014

Parallel Sessions

Tower Court A

8:15 **William "Bill" McKenna**, University of Texas at Austin, *Working Hard is Better Than "Being Smart": Research and Incorporation of a Growth Model of Intelligence*

A person's belief about whether intelligence is a fixed quantity or an attribute that can grow holds major implications for persistence, learning, and achievement. This session will begin with a short presentation on the history of the research and recent findings, and then move to a discussion on how beliefs about intelligence relate to IBL classroom practices.

- Presentation:
 - The history of fixed versus growth mindsets of intelligence (cf. Carol Dweck, Stanford; David Yeager, UT Austin)
 - Recent studies in which even brief exposure to the growth mindset idea can have lasting effects on mathematical ability
- Group Discussion:
 - Describe how the growth mindset is directly related to IBL
 - Share classroom experiences with this phenomena and discuss ways to incorporate it into our teaching practices
- (If time) See how the institutionalization of the fixed mindset (i.e. math ability is innate ability) attenuates learning and entry into the field of mathematics.

Tower Court B

8:15 **Jacqueline Jensen-Vallin**, Lamar University, *Grading in an IBL Course*

When I began using IBL more than a decade ago, I was concerned with how to assign grades to students in a student-centered course. What percent of the grade should be based on presentations? How can I grade presentations? How can I grade the course with most of the work being done at the board? In this talk, I will share successful (and not-so-successful) grading policies, including suggesting a rubric for grading presentations which has been helpful for me and well-accepted by my students.

Tower Court C

8:15 **Steven Greenstein**, Montclair State University, *Broadening School-Based Conceptions of Inquiry to Cultivate Critical Consciousness and Develop Mathematical Knowledge*

Fundamental to the concept of "Social Justice Mathematics" (SJM) is the idea that mathematics can be used to better understand complex social, political, and economic in/justice issues, as well as the idea that mathematics can be better understood through the investigation of these social justice issues. Thus, there is a point of convergence in the recognition that the development of mathematical literacy – broadly conceived – and the cultivation of critical consciousness are both processes pursued through inquiry. In this presentation I'll elaborate on these ideas, talk about the ways in which an orientation to SJM can inform our work, and engage participants in the analysis of SJM activities to identify opportunities to leverage and honor their students' mathematical, community, and critical knowledge. Such engagement illustrates an image of inquiry that is expanded beyond the walls of classrooms to include opportunities for students to make sense of – and possibly influence – social, political, and economic dynamics in their own schools and communities and in the world around them.

Tower Court D

8:15 **Betty Love**, University of Nebraska Omaha, and **Cindy Corritore**, Creighton University, *Using the Flipped Classroom for Inquiry-Based Learning*

The flipped classroom is one approach to implementing inquiry based learning and is becoming increasingly popular at all levels. In this presentation, we will discuss our experience in implementing the flipped classroom in university-level linear algebra and programming courses. We will explore several aspects of the flipped classroom including the following: (1) marketing - our approaches to "selling" students on the flipped classroom concept, the pros and cons of no marketing at all; how is this influenced by the experience and confidence level of the instructor? (2) engaging students - our strategies have included paired problem-solving at the board, problem-solving in groups at tables, games, electronic polling with peer instruction and just-in-time teaching; and (3) assessment - we insisted that students prepare before coming to class by administering a short quiz either before class or during the first five minutes of class; we'll talk about the types of questions included and how we used the results.

Grand Ballroom 2

8:15 **Katie Wanek, Oscar Castillo, Josiah Krutz, Kayla Timm, Dylan King, Marissa Gigantelli, and Angie Hodge**, University of Nebraska Omaha, *Student Adventures in Calculus, IBL Style*

As students we witnessed first hand one professor's journey in incorporating IBL into the calculus sequence. When she started to incorporate IBL strategies into teaching the calculus sequence, every year she taught a little differently. As she learned more about what worked and what did not work and gained ideas about better ways to use more student-centered strategies, her teaching style edged closer to the discovery end of the continuum and away from the lecture end. Each of us has experienced a different active calculus learning experience and each of us has a unique perspective on inquiry-based learning. We have seen IBL from a teacher just starting to implement student discovery in her calculus classes, and we have seen IBL from the same teacher a few years later. We offer a students' perspective on inquiry-based learning and how it has impacted our understanding of calculus, our success in future coursework, our future teaching styles, our ideas on what it means to learn and teach mathematics, and even our career choices.

We will have a panel of four students who will begin by briefly sharing their experiences. The remainder of the time will engage the audience with a question/answer session for the panel of students.

Tower Court A

8:55 **Nissa Yestness**, Colorado State University, and **Kitty Roach**, University of Northern Colorado, *Learning Progressions and Teaching Experiments: IBL in Science Classrooms (Grades 6-12)*

In a recent large-scale project, teaching experiments based on learning progressions (a collection of activities that are inquiry-based science experiments) were developed focusing on the carbon cycle, water cycle, and biodiversity, each with a quantitative reasoning component. They have been

implemented in middle and high school science classrooms across the country. I will share a snapshot of what these activities look like in the classroom, possibly including student work, video from the classroom implementation, interviews with students and/or teachers about their implementation and participation in the teaching experiments, and content assessment data from the students and/or teachers.

Last year, 16 middle and high school teachers participated in a case study to investigate the nature of the implementation of these teaching experiments. Their use of the materials varied as their needs dictated. We coded these classroom videos for eight Learning Progression Teaching Strategies, including 'Engage students in guided or open inquiry with authentic events and experiences.' We will encapsulate the process tools used in inquiry within this teaching strategy to give a picture of how this worked in these classrooms. In this talk, it is our intent to share a snapshot of something similar to IBL that is happening in science classrooms.

8:55 **Dan Goldner**, Boston Public Schools, *Reading Skills for IBL Mathematics*

Many IBL classes require close and careful reading of problems and theorems. Students encounter clear, but terse writing that mixes new concepts and vocabulary with symbols and unfamiliar word order. Strategies developed for teaching academic reading across subjects can help both English Language Learners and native English speakers access and engage with IBL course notes, raising energy levels, productivity and enthusiasm in class.

8:55 **Violeta Vasilevska**, Utah Valley University, *Engaging High School Students in Discovery*

In the last seven years I have been involved in various outreach programs and activities with high school students. In this talk I will present a few projects that I have used frequently in outreach setting. All activities that will be discussed are designed to engage high school students in hands-on, discovery based activities that spark their curiosity and show them that math is fun, interesting, and exciting. Each project is created as a guided discovery activity that leads students in discovering new mathematical truths using their previous knowledge. During the guided activities, students are prompted to discuss their findings with their group, to explain their findings, to ask questions, and to answer questions about their conjectures. The high school students are generally not asked to prove the conjectures but rather the emphasis is put on just discovery. Possible project topics that will be discussed include: coloring different surfaces, Hamiltonian circuits, graph coloring and origami, and truncated polyhedra.

8:55 **Paul Stephen Prueitt** and **Jim Leverett**, Second School, Inc., *Deep Learning Methods, a Modified R. L. Moore Learning Methodology*

Big data analytics uses computer algorithms to create and then sort into structured information data that is available from some measurement process. A measurement process imposes structure on the response of individuals to something. Our innovations include a topic enumeration of a "universe of discourse". This enumeration then allows the individual to self-select elements from this universe of discourse, and to make written responses only involving elements that are self-selected. Hand written responses are used because our universe is that body of knowledge that has been selected by educators to be the core of K-16 mathematics training. The messaging of students, within a peer-to-peer social media, uses handwritten symbols needed to express concepts about functions, set theory, the real number line and geometry. A modified R L Moore learning methodology is then realized within a social media. The neuroscience associated with deep learning is integrated with both in-class activities as well as within the proposed social media.

Tower Court B

Tower Court C

Tower Court D

Grand Ballroom 2

8:55 **Matthew Cole, Jennifer Robillard, Nicole Trommelen, and Julianna Stockton**, Sacred Heart University, *An IBL Proofs Course: Student Perspectives, One Year Later*

A panel of students from an Introduction to Proof course taught using Inquiry Based Learning in Spring 2013 will share their perspectives on the effects the experience has had on subsequent courses in math and other disciplines. Students will briefly review the general design of the proofs course including depiction of a typical class session, and will discuss what they each perceive to be the primary benefits and challenges of being a student in an IBL course. The students will elaborate on how the proofs class has affected their thinking and performance in other courses throughout the year following the course.

Tower Court A

9:45 **Elizabeth Thoren**, University of California, Santa Barbara, *Inquiring Minds Want to Know (I)*

As educators, we are trying to change our students by equipping them to generate and explore novel questions after they leave our courses. And yet, we rarely think actively about the nature of the questions we expect students to generate and explore or how we will teach them to participate in this inquiry. We believe that the first step in helping our students develop this complex skill is to articulate a rich description of the skill in experts so that we may purposefully design our courses around reaching this goal. In part I, we will reflect on our own question-generating skills and begin classifying the questions experts ask when exploring new mathematical phenomena.

Participants will engage with a fertile mathematical phenomenon by generating a large number of questions they would explore about this phenomenon, share some of those questions, and work as a group on categorizing these questions into types of inquiry moves we make

Tower Court B

9:45 **John W. Neuberger**, University of North Texas, *Moore, Calculus and a Search for Research Mathematicians*

Moore had three highly related goals for his many calculus classes:

- (1) To teach a good liberal arts course.
- (2) To prepare his students well for courses using calculus.
- (3) To search for research mathematicians.

I will try to describe how he routinely managed to achieve these goals.

Tower Court C

9:45 **Jane Cushman**, Buffalo State University, *Greater Upstate New York Inquiry-Based Learning Consortium Activities*

IBL Outreach at its best! A small group of like-minded mathematicians in Upstate New York started meeting for dinner and discussing IBL and its use in their classrooms. More nearby mathematicians were gaining interest, so what did they do? Apply for a grant to encourage more IBL use in local mathematics classrooms! Come find out about the process of applying for a large grant from the Education Advancement Foundation.

Tower Court D

9:45 **Lee Mahavier-Peterman**, Goose Creek Memorial High School, *An Analysis of Inaccuracies in Grades 5-12 Assessment Questions*

Professors R.L. Moore and H. S. Wall placed high importance on accuracy in the written and spoken word. There is no doubt that language plays a critical role in mathematics teaching. We will argue that educators should model the highest standards of correctness in inquiries presented to students; and we will demonstrate with real examples, that, sadly, this is not always done. Would you be shocked to learn that our children's high-stakes tests contain multiple-choice questions with no accurate answer choice provided? What are the consequences of giving students ambiguous or meaningless test questions? We will discuss these issues, and we will invite the participants to consider and evaluate actual samples at the secondary school level.

Grand Ballroom 2

9:45 **Annie Selden and John Selden**, New Mexico State, *What Kinds of Comments Do Students Make About Other Students' Proof Attempts?*

We report the results of a study of the proof validation abilities and behaviors of sixteen undergraduates after taking an inquiry-based transition-to-proof course. Students were interviewed individually towards the end of the course using the same protocol that we had used earlier at the beginning of a similar course (Selden and Selden, 2003). Results include a description of the students' observed validation behaviors, a description of their proffered evaluative comments, and the, perhaps counterintuitive, suggestion that taking an inquiry-based transition-to-proof course does not seem to enhance students' validation abilities. We also discuss distinctions between proof validation, proof comprehension, proof construction and proof evaluation and the need for research on their interrelation.

Tower Court A

10:25 **Brian Katz**, Augustana College, *Inquiring Minds Want to Know (II)*

In part II, we will think about the big phases of mathematical inquiry and how we might help students become aware of and use this structure. Part II is accessible without having attended part I, though we expect the two parts to enhance each other.

Tower Court B

10:25 **Melissa Tolley**, Wingate University, *A Try and Re-Try of Class Flipping Calculus*

Flipping classrooms is becoming more and more popular, and proving to be very successful. As a first year instructor, I attempted to flip Calculus I. Here, I talk about my first and second attempts, discussing the successes and failures of each. I will show participants a clip of the videos that I use for Calculus, and then do a mock "random day of calculus." This involves a mini summary of the video, with questions to the students, then group work.

Tower Court C

10:25 **David A. Cusick**, Marshall University, *Breaking the Silence*

Why do students clam up? In a *Psychology Today* webpage, Preston Ni reports that fear of public speaking is the number-one fear in America, ranking above fear of death. Professor Ni adds further that this is a fear of emotional death, to be inflicted by audience rejection.

For 18 years my students have been speaking and putting problems on the board even though some students dislike it. Respecting the students and valuing their actions has repaid me with lively and productive classes.

Last year I began to present this problem and my solution. Partway through the talk I planned a pause for a few questions. The audience response was more than gratifying. The questions and answers consumed the entire time remaining. Now I'd like to tell the rest of the story and to hear the rest of the questions.

Tower Court D

10:25 **G. Edgar Parker**, James Madison University, *IBL Workshops*

In this talk, the presenter will discuss exercises he has used in conducting workshops with peers considering an interdisciplinary course, in-service teachers at both the secondary and elementary/middle school levels, and pre-service teachers. These exercises are designed to promote the possibilities for IBL.

Grand Ballroom 2

10:25 **Jeffrey Ford and Frank Sturm**, Auburn University, *IBL Teaching Methods in an Advanced Class on Vietoris Homology*

Algebraic topology is typically considered difficult to teach using a Moore method approach since it is heavily motivated by examples. This differs from the more axiomatic approach of general topology. For this reason there appears to be a clear division in teaching style when students familiar with learning from the viewpoint of Moore method begin a course in algebraic topology.

In the 1920s, Vietoris developed a homology theory for compact metric spaces. The subject of Vietoris homology, and subsequently simplicial and singular homology, was studied via inquiry by three advanced graduate students over the course of a semester.

Although algebraic topology can be difficult for the student to proceed via inquiry, without structured guidance, we will show how the inquiry based approach was used effectively in this course. By beginning with fundamental concepts of algebraic topology, and moving towards the more advanced theories, the students were able to build an intuition for the subject. This led to effective inquiries regarding some of the deeper aspects of the course. We will outline the theory behind the course and the methods used in the teaching.

11:15 **Dale Oliver**, Humboldt State University, *IBL Episodes in K-12 Teacher Education and Professional Development*

How does completion of an IBL mathematics course influence future teaching in K-12 classrooms? I'm not sure we know. My own experience indicates that new teachers who were former students of IBL math courses are quick to adapt to the teaching norms of the schools in which they work. For most, school culture is still dominated by teacher-centered methodologies that value training students to be procedurally fluent and maintaining quiet and orderly classrooms. Even when former students describe their IBL course learning experience as "transformative," school culture often defines their practice with their own students. The professional learning community (PLC) movement in K-12 schools, gaining momentum over the past two decades and currently fueled by the transition to the Common Core State Standards, is helping to transform school culture to focus more on student learning and student-centered teaching. At their best, PLC's are models of inquiry-based learning, where teachers, faculty from higher education, and others engage in collaborative inquiry to improve student learning. In this session we will explore what mathematics faculty and math teacher educators might contribute to and learn from involvement in such collaborations. The session would be built around two or three brief "episodes" of collaborative inquiry - at least one of which might help prospective teachers sitting in our MM or MMM courses think about the transition to teaching, and at least one of which is for engaging current teachers (in the context of professional development, or professional learning communities). In other words, the audience will be forced into "collaborative inquiry".

Grand Ballroom 2

Paul J. Sally, Jr (1933–2013)



Known for his contributions to the field of harmonic analysis and his passionate commitment to teaching, Prof. Paul J. Sally, Jr. built a legacy of love for mathematics at the University of Chicago for nearly 50 years. Professor Sally died on Dec. 30, 2013. He was 80 years old.

Sally taught at the University since 1965 and served as chairman of the mathematics department from 1977 to 1980. He was resident at the Institute for Advanced Study in Princeton, N.J., in 1967-68, 1971-72, 1981 and 1984. His many professional affiliations

included service as chairman of the board of trustees of the American Mathematical Society.

“Paul had a fierce belief in mathematics and in people,” wrote Professor Shmuel Weinberger, chair of mathematics, in a note to faculty. “I will miss him deeply.” Sally’s impact in the classroom was legendary. He produced 19 PhD students and was director of Undergraduate Studies in the Mathematics Department for decades. He pioneered outreach programs in mathematics for elementary and secondary teachers and students. From 1983 to 1987, Sally served as the first director of the University of Chicago School Mathematics Project, home of the nation’s most widely used university-developed mathematics curriculum. In 1992, he founded Seminars for Elementary Specialists and Mathematics Educators (SESAME), a first-of-its-kind program for elementary school teachers from Chicago Public Schools.

(From news.uchicago.edu.)



The Educational Advancement Foundation

327 Congress Avenue

Austin, Texas 78701

(512) 236-8211 ♦ (512) 469-1790 (fax) ♦ EduAdvance.org