

Quantitative Reasoning for Business is an inquiry-based learning course for business majors. Student learning is assessed in a variety of ways, including portfolios, unit capstones, and mastery-learning assignments. In this talk, I will discuss these assessment tools and any changes under consideration.

2:15pm **Kathleen M. Shannon**, Salisbury University BCC 349

It's Not the Moore Method But...: A Student Driven Textbook supported Approach to Teaching Real Analysis.

I will describe a student-driven method which allows movement through the standard course material with differing depths but the same pace. I have used this methodology in classes for over 25 years and have seen considerable student success. It has also worked successfully with four very different textbooks. We use a combination of boardwork followed by class discussion, on-demand brief lecture, written homework and exams, and a course portfolio.

3:00pm **Stan Yoshinobu**, Cal Poly San Luis Obispo BCC 247

Using Inquiry-Based Learning in Courses for Prospective Elementary Teachers

As schools transition to the Common Core State Standards, one way to prepare prospective elementary school teachers for the Common Core Math Practice Standards is to provide an immersive math experience. Such an experience includes deep engagement in rich, inquiry-based math tasks, opportunities to collaborate with peers, engaging in video lesson study, and journal writing to address attitudes and beliefs. This talk will provide an overview of an "all-inclusive" course structure, materials, and available resources.

3:20pm **Michael Starbird**, University of Texas at Austin BCC Ballrooms

Effective Thinking and Mathematics I&II, 4th Floor

Habits of effective thinking and creativity can be taught, learned, and mastered; and mathematics provides a wonderful vehicle to convey these techniques. Anyone who practices them will inevitably create new insights, new ideas, and new solutions in mathematics and life.

4:15pm **William T. Mahavier**, Lamar University BCC 349

Two sets of Moore-Method Analysis notes and two websites that support them
(Abstract unavailable)

4:55pm **Robert W. Vallin**, Slippery Rock University BCC 349

Gently Introducing IBL in Advanced Calculus

Many potential users of Inquiry-Based Learning are unsure as they desire to not completely convert the class over. Instead they desire a way to make only part of the class IBL. A couple of years ago, I got the chance to run such a hybrid class when I was given the second semester of our Advanced Calculus sequence while not having taught the first. The students' first semester was the usual lecture/homework model, not one that I wanted to continue. My desire was to have them work on atypical problems and develop their ability to create counterexamples and communicate mathematics. However, I did not want the transition to my style to be too abrupt. So I developed our Presentation Fridays. Monday and Wednesday the professor lectures as usual and we followed the prescribed text. On Friday the students themselves did the presenting, solving exercises designed to expand their collection of examples and to extend the topics beyond just what was in the book. In this talk I will introduce the circumstances of the class, show a wide selection of the problems/examples from class, and share some students comments on Presentation Fridays.

Thursday January 16, 2014

9:00 – 11:50am

BCC 307

Edward Burger, Southwestern University;
J. Michael Pearson, MAA;
Stan Yoshinobu, Cal Poly San Luis Obispo;
Jodi Cotten, Westchester Community College, Valhalla, NY;
Sandra Laursen, University of Colorado Boulder;
David Bressoud, Macalester College

MAA Invited Paper Session on Mathematics and Effective Thinking, I

10:30am

Scott Beaver, Western Oregon University

BCC 348

An IBL Approach to Advanced Calculus that Incorporates Proficiency

Fluency with the relevant definitions and theorems is a necessary condition for student success in Advanced Calculus, as is the ability to quickly solve problems which require little more than straightforward application of a definition or theorem. This is the notion of proficiency, an approach that is well-established in second-language instruction and which has recently gained traction in broader K-12 education. I offer the architecture that I use in an IBL Advanced Calculus course to ensure such fluency, including an appropriate IBL/proficiency ratio.

10:40am

Rachel Esselstein, California State Univ. Monterey Bay

BCC 339

Successes and Failures of Inquiry-Based Learning in an Introduction to Proofs Course

Inquiry Based Learning (IBL) is a pedagogy consisting of little or no instruction through lecture or readings, rather students are provided with structured problem sets that lead them to discover the material on their own. Over the 2012-2013 academic year, the author implemented an IBL Introduction to Proofs course over two semesters.

The author collected surveys on student attitudes about the course material and their learning in both the IBL version of the course as well as in a traditional lecture version of the course previously taught. Samples of student work were also compared.

In this presentation, the author will share some of the strengths of her IBL Introduction to Proofs courses (e.g. students demonstrated improved problem solving and independence of thought) as well as some of the issues that arose in the IBL courses (e.g. student anxieties about what they did not understand). The author will then outline steps being taken to create a hybrid lecture/IBL course that encompasses the best of both teaching styles.

10:40am

Nina Juliana White, University of Michigan

BCC 340

Holistic Diagnostic Grading Rubric for Student Presentations in an IBL Geometry Course

I developed a checkmark grading rubric that assessed students' success in several aspects of their presentations: Exposition, Clarity, Correctness, Justification, and Responsiveness to audience concerns. In this talk I'll discuss

- the rubric,
- the nuts and bolts of using the rubric (including how I selected students to present, how I used the rubric in real time, how I got feedback to the students, how I augmented the feedback with in-class discussion, how I assigned final grades, etc.),
- and, most importantly, how student presentations evolved during the semester in reaction to the feedback.

11:00am **Susan Crook**, Loras College

BCC 339

How Important is the Final Answer? Using Inquiry-Based Learning in an Introductory Proofs Course

Students enter their introductory proofs course accustomed to being able to check their final answers with others and in the back of the book. One of the greatest difficulties encountered in teaching proofs is helping students adapt to the idea that there are many correct answers. While in computation-based courses, most students can memorize algorithms and do satisfactorily on tests, a certain level of understanding is required to create a correct proof. While teaching my first intro proofs course and my first inquiry-based learning course, I often fought with when to assist students and when to let them struggle just a bit longer on a proof. The line between frustration and giving up can be hard to see until your students have crossed it. In inquiry-based learning classes it can be especially hard to figure out how to give input without positioning yourself as the authority on the subject. I will discuss my observations on the issue and what worked for my class.

11:20am **Jim Fulmer** and **Tom McMillan**, University of Arkansas at Little Rock BCC 339

Using an Inquiry-Based Learning Approach in Introduction to Proofs and Advanced Calculus Course

This presentation describes using an inquiry-based learning approach in two mathematics courses at the University of Arkansas at Little Rock, Intro to Proofs and Advanced Calculus. Two mathematics department faculty members were involved in developing these courses with the IBL approach. Our talk will cover warm-up activities (challenge problems to get the students comfortable working together), and the approaches we used in class to encourage students to write their proofs and work problems in a group setting, and to gain confidence in their abilities to communicate with others. The primary textbook for both courses was a set of class notes, one on Intro to Proof and the second on Advanced Calculus. Both courses represented a trial run, which proved successful. As a result, Introduction to Proof, is now required at the sophomore level for all mathematics majors and Advanced Calculus is required for some of our degree programs.

1:00 – 4:00pm

BCC 307

Paul Zorn, St. Olaf College;
Katherine Socha, Math for America;
Deborah J. Bergstrand, Swarthmore College;
Carol Schumacher, Kenyon College;
Francis Edward Su, Harvey Mudd College

MAA Invited Paper Session on Mathematics and Effective Thinking, II

Friday, January 17, 2014

8:45am

BCC 348

Fabiana Cardetti, University of Connecticut;
Nicole DeMatteo, Providence College;
Jonathan Dollar, Emory University;
Gabriel Feinberg, Haverford College

An Inquiry-Based Approach to Teaching Parameterization

Parameterization of curves has been identified as a challenging topic for students in multivariable calculus courses. Encouraged by the positive research results of inquiry-based learning (IBL) on student performance and attitudes, our team composed of mathematics professors and undergraduate math students conducted a research study to develop curricular materials aimed at supporting student understanding of this topic. For this study we conducted an extensive literature review, studied popular multivariable calculus textbooks, and consulted with experienced instructors to create an original IBL

Saturday, January 18, 2014

1:45pm **Mark L. Daniels**, University of Texas at Austin BCC 347

Creating a Dual-Credit/Dual Enrollment "OnRamps" Precalculus Course to Enhance the College Readiness of High School and Community College Students

The creation of a dual credit or dual enrollment "OnRamps" Precalculus course for High School or Community College students is discussed. Such a course is intended primarily to enhance the calculus and college-readiness of high school students. The course stresses "college level thinking" and is designed to be taught in a discovery way using inquiry-based teaching methods. An online component that accompanies the course will also be detailed.

2:00pm **William T. Mahavier**, Lamar University BCC 340

How About a Free Set of IBL Calculus Notes that Covers all of Calculus I, II and III?

Calculus is fertile recruiting ground for mathematics majors, although far too many calculus courses treat the subject as a set of rules and techniques to master. In my experience, those who enjoy such rote work often turn out to be poor majors and those who have the potential to be mathematicians are often turned away by such an approach. We discuss a set of calculus notes that began as an NSF project more than a decade ago. These may well be the only set of notes that are freely available, problem-based (IBL) and cover all of Calculus I, II and III.

2:30pm **Padmanabhan Seshaiyer**, George Mason University BCC 314
Jennifer Suh, George Mason University

Inquiry-Based Problem Solving Strategies through Interactive Approaches for Engaging Students in Mathematics

In this session, we will share how students can be engaged and challenged in inquiry-based learning through interactive approaches with mathematics, scientific investigation and critical analysis. Such opportunities with rich mathematical tasks require students to use higher-level critical thinking strategies and self-monitoring problem solving skills when engaged in real-world problems that require complex reasoning, communication and a hands-on approach. In this session, we will engage the participants in open-ended exploration with mathematical problem solving and introduce them to some novel interactive problem-solving approaches and opportunities that will benefit students.

3:00pm **Gabriel Feinberg**, Haverford College; BCC 347
Lily An, Williams College;
Victoria Lewis, California State University Sacramento;
Fabiana Cardetti, University of Connecticut

Resources to Aid the Transition into an IBL Mathematics Course

We conducted a study to support both instructors and students who are transitioning to an IBL course. The creation of these resources was guided by extensive review of the literature and was informed by instructors with experience teaching lower level undergraduate mathematics courses and students who had both positive and negative experiences in IBL courses. These methods, along with our own expertise as mathematics professors and undergraduate mathematics students, helped us identify specific aspects that are most challenging for an instructor and the difficulties students would face in transitioning to an IBL course. In this talk we will present the results of this study that consist of teacher's and student's guides that address

those difficulties, provide guidance for each audience, and contribute suggestions to achieve the desired learning outcomes.

3:15pm

Ali S. Shaqlaih, University of North Texas at Dallas

BCC 347

Inquiry-Based Learning and Hybrid Inquiry-Based Learning in College Geometry

Hybrid Inquiry Based Learning (HIBL) is a modified version of the Inquiry Based Learning model (IBL). It integrates the traditional teaching approach with the Inquiry Based Learning approach. A comparison of the two approaches (HIBL and IBL) will be presented and students' engagement, assessment and achievement in college geometry will be discussed in both approaches.