THE LEGACY OF R.L. MOORE Newsletter

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Inquiry Based Learning at Michigan:

An Opportunity "to Grapple with the Material Yourself and Make It Your Own"

The following is excerpted from a recent article by Professor Ralf Spatzier, a member of the mathematics department at the University of Michigan, Ann Arbor. The full article appeared in the departmental newsletter *ContinuUM* for 2011–2012.

As at the other three IBL centers supported through the Legacy of R.L. Moore Project (see side note p. 2), UM allows discovery, or reconstruction through rediscovery, to be a part of the learning experience in undergraduate mathematics.

We offer two freshman seminars as IBL courses. The first is an **introduction to cryptology**, taught in the Fall. The students get to understand basic number theory, combinatorics and their applications to coding and decoding messages. They also learn to argue, write and explain precise mathematical arguments. We consider this class a grand training ground for students' analytical skills. Also, this course has attracted quite a few students to the mathematics major. In the Winter term, we offer a follow-up class

Please see *Michigan,* p. 2.

INSIDE

Congratulations to Stan Yoshinobu, Director of the Academy of Inquiry-Based Learning, on receiving a $540,000 NSF grant to support IBL workshops!

The 2012 IBL/Legacy Conference

The annual Legacy conference returned to Austin in June 2012 after a very successful 2011 meeting in Washington DC.

Thirteen plenary talks, including four panel discussions, were interspersed among breakout sessions and roundtable discussions devoted to specific areas of interest relating to the use of inquiry-based learning in the classroom.

Most of the 220 attendees were mathematics professors at the beginning of their careers, with about a third attending their first Legacy meeting.

The meeting continues to be co-sponsored by the Mathematical Association of America who provides valuable advice on program planning and help with logistics.

Please see *Conference*, p. 3.

The16th Annual IBL/Legacy of R.L. Moore Conference will be held in Austin TX, 13-16 June 2013. Details will be announced on the Legacy website given below.

Michigan from page 1

exploring **analysis and topology of the real line**. This is a bridge back to our calculus sequences, and it again emphasizes mathematical thinking, this time about **calculus**. We also offer our Calc I and II courses in small classes to thousands of students. In these, we intersperse short lectures with in-class group work. Our way of teaching calculus has proved very successful in national assessments, for example in the Calculus Inventory Test. Additionally, we train many young instructors in our way of teaching calculus, giving them an edge in their job search later.

Our math majors have several IBL classes to choose from: **real analysis, topology, probability** and a very special class exploring **mathematical research**. The latter is an intense experience with groups of students working on open ended problems. It has fewer class meetings but instead the groups meet with the instructor and assistants extensively during lab hours. Students prepare a written report and give a talk about their findings. The problems come from diverse areas of mathematics, and are accessible to students early on.

In our third and possibly most important effort, we have reformed our **pre-service teacher education** in mathematics to include IBL courses which emphasize mathematical thinking and understanding over rote learning of algorithms. We very much hope that these future teachers will incorporate both their improved understanding and also the IBL methodology in their future K-12 classes.

Centers for Inquiry-Based Learning are associated with mathematics departments at:

University of California, Santa Barbara

University of Chicago

University of Michigan, Ann Arbor

University of Texas at Austin

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www.math.lsa.umich.edu/ibl

Remarkably, IBL ideas have also found their way into more **traditional lecture courses**, for example via special IBL days or projects and other work led by the students. Interestingly, the positive engaging atmosphere of the IBL component often spreads to the lecture part and makes the students much more comfortable interacting and asking questions.

This is a critical time in higher education. Many forces are pulling on the standard model of lecture based courses, mostly trying to make education more “efficient” or “cheaper.” Will this actually educate our students, and make them into thinking individuals who can solve problems at their future workplace? While there is a place for communicating information in the most efficient way possible, this is different from understanding it and being able to use it actively.

At the Michigan Mathematics Department, we plan to address this concern by offering a substantial number of IBL courses aimed at very different students and interests. This will complement traditional lectures and other types of learning and allow our students to acquire the critical thinking skills so much needed.

We will also train many new instructors in IBL techniques, with the expectation that they will be able to implement these ideas at their future homes. This puts Michigan once again at the forefront of an important movement in education.

Conference continued from p 1.

Six members of the MAA Committee on the Undergraduate Program in Mathematics took part in a panel discussion at the 2012 Legacy Conference. From the left: David Bressoud, Beth Burroughs, Carol Schumacher, Michael Starbird, Martha Siegel, Michael Pearson.

Altha Rodin (left), University of Texas at Austin, facilitator at a Mathematics Teachers Circle demonstration.

Mathematics educators in conversation: Greg Foley (left) from Ohio University with Annie and John Selden of New Mexico State University.

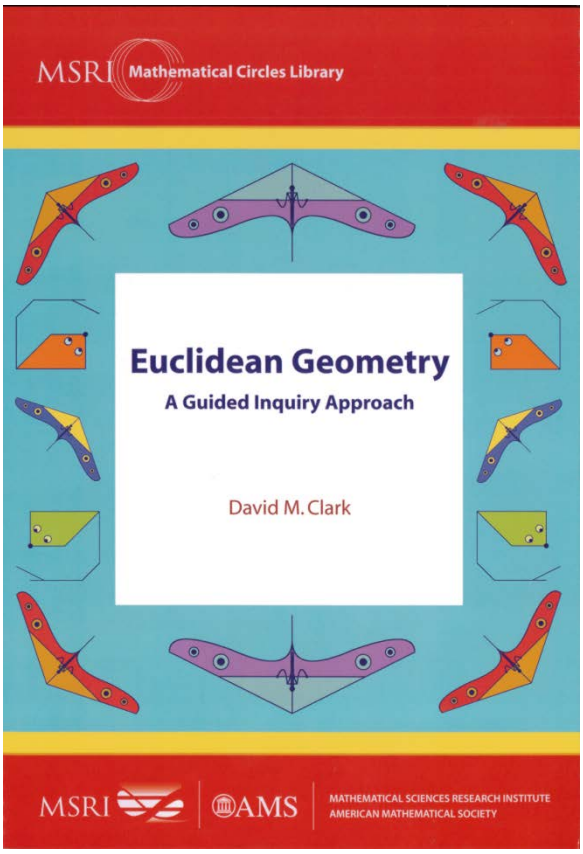
Left: Paul Sally, a leading member of the Chicago University Inquiry-Based Learning Center.

Right: Jonathan Hodge of Grand Valley State University, a researcher in mathematical voting theory, gave a well-received after-dinner talk entitled "Inquiry, Authority, and Democracy."

"*A Final Conjecture*: Inquiry-based learning does not just make better students or better mathematicians; it makes better people."

Video of the 2012 conference may be viewed at www.LegacyRLMoore.org/video.htm

Featured Publication



David Clark, professor of mathematics at SUNY New Paltz, has prepared a Euclidean geometry text suitable for high school and undergraduate courses. He has chosen a new set of axioms that allow a development of the standard content of Euclidean geometry with the mathematical precision of Hilbert's foundations of geometry. In particular, the book covers all the topics listed In the Common Core State Standards for high school synthetic geometry.

The presentation uses a guided inquiry, active learning pedagogy. Students benefit from the axiomatic development because they themselves solve the problems and prove the theorems with the instructor serving as a guide and mentor. Students are thereby empowered with the knowledge that they can solve problems on their own without reference to authority.

Euclidean Geometry: A Guided Inquiry Approach was published in 2012 by the American Mathematical Society and the Mathematical Sciences Research Institute in their Mathematical Circles Library series.

A Gift to the Future

The Foundation is grateful for recent contributions from individuals. Such gifts help to shape our response to the urgent need to improve student performance in science, technology, engineering, and mathematics. Guided inquiry, as part of the total learning environment, improves students' creativity and problem solving abilities. Your support will help us increase the impact of our existing programs and extend efforts to new initiatives.

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