

# Intersection Points

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Mathematics Learning

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The Research Council on Mathematics Learning seeks to stimulate, generate, coordinate, and disseminate research efforts designed to understand and/or influence factors that affect mathematics learning.

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## President's Column



### Roots

by Kay Wohlhuter

I am a roots person--I am fascinated and energized by the connections I have with members of my family tree: Welcome High School graduates and alumni of Augustana College- a college celebrating its 150<sup>th</sup> anniversary. Be it the discovery of a common great-great grandfather or the celebration at an all-school reunion, I feel a connection to these people with whom I have a shared history. I feel the same way about our

organization.

When I moved to Duluth, Minnesota, I inherited a mathematics education office full of books and other educational materials. While perusing the shelves, I came across *Error Patterns in Computation* by Robert Ashlock, *Today's Mathematics* by James Heddens and William Speer, *Diagnosis and Treatment in Arithmetic: Beliefs, Guiding Models, and Procedures* by John W. Wilson, and *Diagnosing Mathematical Difficulties* by Bob Underhill, Ed Uprichard, and Jim Heddens.

As I read the titles, I felt an instant connection to my new office because these authors were part of my RCML family. How did I become a part of this family? My first

conference was in Oklahoma City in 1997. I was invited to be a part of this organization by Melfried and Judy Olson, who became involved because of Judy's major professor, Helen Neely Cheek. Helen became a part of this group because of her major professor Jon Engelhardt -- one of our RCML founders.

Many of our members have a similar story. Others have established their roots because they responded to a posted call to present at a conference and after completing the conference experience extended the invitation to others. No matter the story, we are all connected by and rooted in our mission: *RCML seeks to stimulate, generate, coordinate, and disseminate research efforts designed to understand and/or overcome factors that inhibit maximal mathematics learning.* As seen by the titles of books on my shelves, talks at our 2011 conference (e.g., *Write is Right: Students Using Graphic Organizers to Improve their Problem-Solving*

*Skills and Abilities; Geometry: What High School Mathematics Teachers Believe about Teaching it; Assessment and Complexity of Non-Routine Problem Solving Involving Proportional Reasoning of Middle School Students*) and articles in recent volumes of *Investigations in Mathematics Learning* (e.g., *Mathematics Achievement and African-American Students in Urban Schools; Pattern Problems in Middle Grade Mathematics Curricula; Fostering College Students' Autonomy in Written Mathematical Justification*), we are a group of professionals committed to making a difference in mathematics education. The mission and the people make this a valuable and special organization. As we move forward with our mission and continue to add to our history, our challenge is to share the RCML story with others and to invite them to become a part of our family tree.

### Conference Evaluation Survey



Please visit this [link](#) and complete a conference evaluation!



## ELECTION: Call for Nominations

Please consider running for office! Self-nominate or nominate someone else for the RCML elections in 2012. Open positions include:

- President Elect
- VP for conferences
- Treasurer
- Conference Committee (two positions)

# 38<sup>th</sup> Annual Conference of the Research Council on Mathematics learning

by Bob M. Drake & Lynn Columba

10-12 March 2011

Cincinnati, Ohio

RCML members converged on Cincinnati from March 10-12, 2011 for the 38th annual meeting at the Hilton Cincinnati Netherland Plaza Hotel. The conference scheduled 80 sessions with 118 speakers, an RCML record in the memories of everyone present, with sessions ranging alphabetically from Altering Emphasis: Changing Practices to Zone of Optimal Learning: Building More Effective On-Line Learning Objects in an Age of Information Overload.

In addition to the many sessions, the conference opened with an evening reception on Thursday. Members met friends, both old and new, and shared their current activities, research, and general newsworthy stories with one another from 6:30-9:00 pm during the opening reception, with fabulous fare from the Hilton Cincinnati Netherland Plaza's 5-star rated kitchen.

A major feature of the conference was two special sessions hosting this year's guest speakers. Friday's Wilson Memorial Lecture featured Linda Sheffield, Ph.D., Regents Professor Emerita of Mathematics Education from Northern Kentucky University. Dr. Sheffield's keynote address was "Race to the Top with the Next Generation of STEM Innovators," a topic at the forefront of mathematics education interests. She discussed reports on the state of mathematics education in the US, and elaborated on where we were headed during the next several years.

Saturday's Founder's Lecture was provided by RCML's historian, founding member, Professor of Mathematics Education, and Dean of the College of Education at the University of Nevada Las Vegas, Dr. William Speer. Speaking about "The Nature and the Roles of Desirable Difficulties in Mathematics Teaching and Learning," Dr. Speer talked about the need to engage students in deeper thinking about mathematical questions, and the benefits thereof.

Beyond the sessions and special guest speakers, RCML published twenty articles totaling 174 pages on CD. The *Proceedings of the 38th Annual Meeting of the Research Council on Mathematics Learning 2011* were distributed to conference attendees. The papers were organized into five major categories:

- Preservice Teacher Preparation
- Problem Solving
- Mathematics Teaching Methods and Practice
- Teacher Beliefs and Efficacy
- Teachers of Mathematics

On behalf of Lynn Columba and me, the 38th Annual Meeting seemed tremendously exciting. It's unfortunate that we couldn't attend every session, and that sentiment was shared frequently by everyone with whom we spoke. Our thanks to everyone who helped

make this conference so enjoyable, and especially to those who participated in making presentations to this distinguished group of mathematics education researchers.

## RCML Conference Proceedings

The Proceedings for the 38th Annual Meeting of the Research Council on Mathematics Learning (2011) involved the work of 21 reviewers across the nation who reviewed more than 20 manuscripts. Each manuscript was blinded and reviewed by at least two reviewers. The result of this effort is a Proceedings publication comprised of outstanding articles we hope will contribute to the ongoing conversation in mathematics education. Stacy Reeder, University of Oklahoma, served as the proceedings editor and would like to thank all the reviewers for their time and willingness to serve RCML, as well as Rachel Province for her help as the assistant editor. Watch for information regarding submission of papers for the proceedings for the 39th Annual Meeting of the Research Council on Mathematics Learning (2012).



### Wilson Lecture: Dr. Linda Sheffield

*A synopsis by Sarah Ives*

Math students deserve outstanding coaches, cheerleaders, fans and challenges they are passionate about, just as much as our gifted and talented athletes. Virtually no money is spent on gifted and talented (2 or 3 cents for every 100 dollars spent on remedial and/or at-risk students).

Gifted students are often under-motivated because they are not challenged on a regular basis. Chinese students at the 50<sup>th</sup> percentile are equivalent to the US 90<sup>th</sup> percentile. In Finland, children start school at age seven, have the fewest number of hours in the classroom, 75-minute recess, no more than half-hour of homework in high school, and their teachers are required to have masters degrees from highly selective programs. So even though high school students in Finland spend hours online, like our teenagers, they outperform US students on PISA.

So what can we do for our gifted and talented students? Should we enrich (more topics) or accelerate (move up a grade)? What is the purpose of acceleration? To escape boredom, achieve early completion of mathematics, meet state requirement of 4 years of high school math, attain early entry into AP college level courses, or preparation for high-level STEM studies?

Many gifted students test out of college math, or complete it while in high school. We must provide them opportunities for excellence, and support them. Mathematical promise is a function of ability, motivation, belief that you can be smart -- self-efficacy, experience and opportunity. We need to add depth and complexity, to let them slow down a bit and be able to think. Instead of enrichment, add connections. Instead of acceleration, give

them appropriate pacing.

## Founder's Talk:

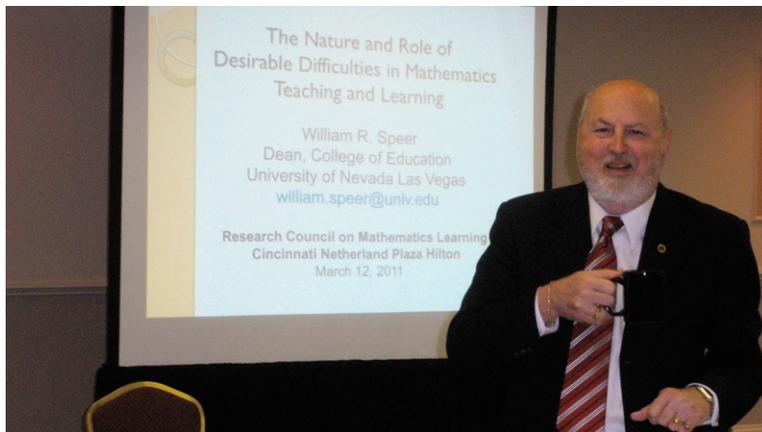
### Bill Speer

A synopsis by Lynn Breyfogle

Dr. William Speer gave a talk entitled "The Nature and Roles of Desirable Difficulties in Mathematics Teaching Learning". Bill gave us plenty of opportunities to consider using "desirable difficulties" with school aged children as well as during the preparation of mathematics teachers and mathematics teacher educators.

What exactly are "desirable difficulties"? They are opportunities, problems, or situations which create cognitive dissonance for the learner. In other words, the learner thinks she knows the answer but not necessarily know why the answer works, or it may be inconsistent with what she may have formerly believed. To exemplify his point, Bill posed the following situation: *If my class list consists of the following names, what comes next? ANN, Brad, CAROL, Dennis.* This situation prompted all sorts of answers, including "KATHY" (a female's name written in black capitalized letters). But further suggestions included a "name with 7 letters beginning with the letter E". Bill thought all of these suggestions were viable, but we didn't "know" the rule, so we don't know what will actually follow, and he actually suggested that there were no more names because his class only included 4 students!

I was struck by another example (see top left): The problem posed was "What fraction is represented in the figure?" This problem introduces desirable difficulties because it prompts some very different fractions. What



one person sees may not be the same as what her neighbor sees. For example, I immediately noticed  $\frac{9}{16}$ , but someone else offered  $\frac{3}{4}$ . It took me a moment to understand that what I saw as a white square in the middle, he interpreted as a "hole" in the "donut". Other suggested fractions included  $\frac{3}{5}$ ,  $2\frac{1}{4}$ , and  $\frac{5}{4}$ . (Can you see those? What other fractions can you find?)

Three weeks ago, I used this problem with my future elementary teachers to create a desirable difficulty around the idea of the importance of "the whole" when working with fractions.

An example that I had used before that Bill shared was "Does  $.999\dots=1$ ?" Often though, I stop at just looking for the algebraic proof, using the process of converting a repeating decimal into a fractional equivalent.

Let  $n = .9999\dots$   
Then  $10n = 9.999\dots$

$$\begin{array}{r} \text{So } 10n = 9.99999\dots \\ - n = - .99999\dots \\ \hline 9n = 9 \\ n = 1 \end{array}$$

His suggestion encouraged students to think about other ways to justify this, such as using fractions and division (e.g.,  $9 \times 1/9 = 1$ ) or infinite series. Later this semester, I intend to have the students consider these other ways to justify this fact.

Other examples confronted notions about probability (e.g., black/red card shuffling problem picking 2 cards at a time), percents (e.g., 16% of 25 can be thought of as 8% of 50, or 4% of 100, or 25% of 16), and number theory (Wendy's ticket game where the sum had to be 100). For someone who studies classroom discourse and is an advocate for finding ways to increase classroom conversation around substantive mathematics, I love this idea of desirable difficulties and will be following Bill's lead to encourage others to integrate them into their teaching.

## SCENES FROM THE CONFERENCE



Smiling faces



Hands-on





Fantastic food, great conversations and yummy desserts!



Full attendance at presentations



New faces at RCML—doctoral students!

# RCML Business Meeting Minutes

11 March 2011

Anne Reynolds called the general business meeting to order and welcomed all in attendance. Seasoned conference attendees were recognized. Conference attendees who have been to two or three conferences (several conferences) were recognized. First time attendees were recognized and encouraged to return each year and join the RCML community. Anne Reynolds introduced and welcomed the new president, Kay Wohlhuter, and turned the business meeting over for her to conduct. Kay Wohlhuter introduced the rest of the new officers: Megan Che, Secretary; Conference Committee Members, Bob Drake & Keith Adolphson.

Approval of Minutes: Juliana Utley, outgoing Secretary, presented the minutes from the RCML 2010 conference to the membership. The minutes have been posted on the website and were also distributed in the newsletter. Pat Jordan moved to approve the minutes, seconded by Keith Adolphson. No discussion. Motion carried.

Treasurer's Report: Mary Swarthout, Treasurer, presented the budget report for 2010. She reminded us that there are two accounts: a general, regular account and a publication account. The regular account is for membership dues and conference types of monies. The publication account is for monies associated with publication of the journal. Mary noted that we are on the right track with the RCML accounts; membership is supporting \$2300-\$2400 of the cost of the journal (about 1/3 of the cost for publishing the journal) and outside subscribers support the rest of the cost of the journal. Mary said RCML is in good financial shape and sees this continuing going forward. Mary also pointed out that the journal is now fiscally healthy. Pat Jordan moved to approve treasurer's report. Sue Brown seconded. No discussion. Motion passed.

Membership Report: Mary Swarthout, Membership Chair, delivered the membership report. RCML had 81 members at the end of 2010. As of today, we have 70 members. She encouraged those present to see her to get memberships current and up to date. She reminded us that members are supporting the journal, so it is important to keep memberships up to date. Memberships are \$35, with \$29 of that going to support the journal. Student memberships are \$29. Mary reported that there will be a form on the website for membership, so there will be no necessity to print off the membership form and send in the mail. She is also preparing a proposal for the executive board for getting membership dues and conference registrations paid through PayPal online. She will be getting this proposal to the executive board in May. Mary is looking for help in increasing membership. An Ad Hoc Membership Committee will be formed to help with increasing membership and improving our marketing. Mary asked people who are interested in serving on this committee to contact her. We do not currently have a logo, for instance, and if people have other ideas about how to get RCML's name out, see Mary and she will take their contact information for possible service on the Ad Hoc Membership committee. This committee will be finalized at the Saturday meeting of the executive board.

Publications Report: Sheryl Maxwell, VP for Publications, has extra copies of one issue of the journal. Because new members for this year do not receive the journal until Volume 2 in October, she will mail new members a copy of Volume 3 No. 3 if they give her their contact information. Sheryl recognized Jean Schmittau for her continued and valued service as Investigations editor. Sheryl encouraged members to submit articles for peer review. Sheryl reminded us that membership dues are on a calendar year, but the journal is on an academic year (3 issues per year). Sheryl also encouraged members to check with their libraries to see if they subscribe to the journal. Elaine Young, Intersections editor, was recognized for her service. Sheryl noted that the

transition from Gabriel Matney to Elaine Young had been very smooth. Sheryl encouraged any items of interest to the organization to be submitted to Elaine Young for the newsletter. Sheryl noted our membership goal is to get to 100 or 125. \$29 of the membership dues goes to the journal. Sheryl noted that the color of the cover of the journal changes slightly with each issue. Anne Reynolds, past-president, recognized Sheryl Maxwell and Jean Schmittau for their efforts in getting the publication up and going. Sheryl and Jean are both treasures to RCML for their work and service on the journal.

Conference Report: Stacy Reeder, VP for Conferences, recognized Bob Drake as conference chair and Lynn Columba as program chair for their work in getting this 2011 conference together, especially given the short time line frame with which they had to work. Bob Drake thanked Stacy Reeder and Lynn Columba for the pleasure of working with them. Stacy recognized Proceedings authors. Every person registered for the conference received a CD with the conference proceedings. Stacy recognized reviewers for proceedings paper submissions. Stacy noted that a call for proceedings for next year will be coming out. Next year's conference is in Charlotte, NC, hosted by Kerri Richardson and Megan Che. Kerri Richardson presented the Hilton University Place in Charlotte as the venue for RCML 2012, which will be held from February 23-25. Kerri presented that Charlotte is an easy place to fly in and out of, and that many arrangements had already been made. Proposals are due Sept. 19, and manuscript submissions for Conference Proceedings are due Oct. 17. Kerri Richardson is preparing a conference website for electronic proposal submissions and other conference related items. The address for the conference website will be shared in upcoming newsletters, along with more information. Reminders of due dates will be sent out. Stacy Reeder pointed out that, due to the publication of proceedings, sticking with these due dates is important. A suggestion was made that Stacy ask for interest in future conference sites. Stacy shared that 2013 will be Tulsa and 2014 will be in Texas.

Anne Reynolds, Past President, encouraged members to self-nominate or nominate someone else for elections for 2012. Positions include President Elect, VP for conferences, Treasurer, and 2 positions for Conference Committee. Anne also presented the following with acknowledgements of service: Juliana Utlely for her service as Secretary; Bob Drake for his service as Conference Chair; Lynn Columba for her service as Program Chair; Gabriel Matney for his service as Newsletter Editor; Mikhail Turegun and Megan Che for their service on the Conference Committee

Kay Wohlhuter presented Anne Reynolds with an acknowledgement for her service as President. Old Business: Alan Zollman requested that we recognize Stacy Reeder for her work.

New Business: none

Meeting adjourned.



## *How High School Students Use the Word Like*

by Sean Yee

Doctoral Candidate in Mathematics Education Curriculum  
and Instruction at Kent University, Ohio

High school teachers regularly hear students use the word *like* in various forms. This is of little surprise as the word *like* takes on every form of speech from adjective to conjunction (Merriam-Webster, 2007). The common application by teenagers in the proverbial hallway resembles the phrase “I was like, ‘No way!’” In a pilot study, I analyzed how high school students used the word *like* in a mathematical, problem-solving setting and was surprised to find consistent patterns that contributed to, or hampered, their ability to solve mathematical problems. As a result, there are strong indicators that the use of the word *like* in the mathematics classroom can be interpreted by teachers to better understand student’s learning of mathematics.

Concisely, the theoretical design of my study originated in cognitive science with an inherent need for interdisciplinarity. The foundation of cognitive science is the belief that human knowledge can be explained (Gardner, 1987). Specifically, if I perceive someone learning, then I can explain it. The epistemic consequences of such a statement are broad, but necessary when attempting to interpret how the word *like* is a tool, or handicap, for students in mathematics. Phenomenologically, linguistics (considered

a branch of cognitive science) plays a significant role in the interpretation of the word *like* because language is vital for cognition, not just communication (Lakoff & Johnson, 2003; 1980). Mathematical problem solving was used because these linguistic seeds already began to sprout in Polya’s (1954) study of analogies. Yet, a more current linguistic study of heuristics (Schoenfeld, 2011) could help such understanding burgeon for teachers in the classroom. This was the premise of my study.

Nine students at a suburban high school in Ohio volunteered: three freshman, two sophomores, and four juniors. Each student met with the researcher individually after school for an hour. The students were given the same three mathematical problems and manipulatives. These problems required little prior knowledge and were designed to be metaphorically limited so as to evoke metaphors from the students. The techniques and justification for each problem varied mathematically (contraposition, inductive and deductive reasoning, and visuospatial recognition) to identify differences or similarities in problem-solving techniques and metaphorical conceptualization. To

minimize the assumptions of the researcher and maximize the metacognitive expressions of the student, Reynolds' (1993) design was applied where the student would attempt to solve problems (primary video) and then immediately watch themselves solving the problems with explicit instructions to explain their thought process (secondary video). Thus students worked with the researcher on the above problems for 30 minutes and then watched the video of their problem-solving process with the researcher for 30 minutes. The names of the students were coded according to the first nine Greek letters of the alphabet (alpha to iota).

How the students used conceptual metaphors (Lakoff & Nunez, 2000) to solve mathematical problems was the focus of the initial study. Yet, a second quantitative result yielded a negative correlation with the student's use of the word *like*. Students who used the word *like* more often were unable to solve or justify the problems while students who did not frequent the word *like* were able to solve and justify the problems. This led me to reanalyze the data from a qualitative (normative) stance from which I discovered that, despite the plethora of uses of the word *like*, only four were demonstrated by all nine students in the study. The first three align with cognitive psychologist George Miller (1993) and most linguistic perceptions of the word *like*, yet there was a fourth use that had not been categorized. Exemplars of each used by actual students are demonstrated below:

**Beta (ANALOGY):** "Adding rational and irrational numbers is kind of like mixing oil and water"

**Gamma (LITERAL COMPARISON):** "I will treat one side of the triangle like it was fixed"

**Delta (SIMILE):** "This triangle problem is like extending the rectangle proof"

**Iota (????):** "Consider a vector space like three dimensions"

Surprisingly, the fourth uncategorized use of the word *like* was most abundant. It was prevalent among all the students' use of the word *like*. In the above exemplar, Iota's use of the word *like* could be replaced with the words *for example* or *such as*. So why hasn't this been studied so far in education and what are the ramifications?

First, let us identify the significance of the fourth use by Iota. Throughout my entire study, the use of the word *like* compares two objects. Either the objects are compared directly or aspects of the objects in question are compared (Miller, 1993). Yet the fourth use of the word *like* references the broader concept of vector space through an example of a vector space. In fact, the student focuses on their exemplar; three dimensional vector space. This focusing could explain the negative correlation in performance because if a student focuses on the examples, it is harder to focus on the deductive reasoning necessary in solving, or justifying solutions to, problems. Such results are buttressed by Tall and Vinner's (1991) development of concept image versus concept definition. The students are focusing on the concept image, the prototypical example, limiting their understanding of concept definition. As focusing occurs metaphorically with lenses, I suggest that this fourth use of the word *like* in mathematical problem-solving be referred to as the *myopic like*. Myopia, nearsightedness, refers to the choice of the student to focus on examples which are conceptually closer than the generalized,

often intangible mathematical object from which the student must operate.

Second, the myopic like has not been studied before primarily because it is not proper English. The myopic like, has been replaced in writing by *such as* or *for example*. Thus academicians have not used it and have not been aware of its significance. Moreover, as it is pervasive within high schools, the word is rarely noted by teachers. Yet, this only increases its value because it offers a metaphorical bridge between how students cognitively interpret problems and how they solve problems. Hence, a teacher becoming aware of the student's use of the myopic like will allow the teacher to intervene so that the student can look beyond examples to properties of

the given problem that need to be addressed.

In sum, my study categorized how students use the word *like* and in the process discovered a new use, the myopic like. It is the intuition and hope of this researcher that future studies will reveal that students use the myopic like for the cognitive purpose of connecting inductive reasoning (empirical understanding) to deductive reasoning (logical understanding). This connection can be an asset to mathematics education for novice and veteran teachers alike. By being attentive to the myopic like in the classroom, teachers have the opportunity to give students a more clear direction on their heuristic designs within mathematical problem solving.

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# INVESTIGATIONS IN MATHEMATICS LEARNING

Sheryl A. Maxwell, VP for Publications

[smaxwell@memphis.edu](mailto:smaxwell@memphis.edu)

What a pleasure it was to report to the general membership at the annual conference of RCML that the subscriptions to *Investigations in Mathematics Learning* continue to increase this past year so that we are **solvent!** The production of three issues per volume continues with a sufficient number of manuscripts being reviewed each cycle so that production of each issue is on time. Volume 3 Number 3 is in production and will be in your hands in April. Can you believe that we have produced nine quality issues of our journal? That's success!

This month I will be distributing invoices, (due in June 2011), to various institutions to pay for Volume 4. It would be helpful if you would contact your institution's library to inquire if *Investigations in Mathematics Learning* is one of the journals that is part of your institution's listing. In two cases last year, the local RCML member professor was instrumental in securing a new institutional subscription. If they do not subscribe to our journal, just have a librarian contact me at [smaxwell@memphis.edu](mailto:smaxwell@memphis.edu) and I will e-mail an invoice for \$75.

If you as a mathematics educator need a classroom set of a journal issue, let me know about two months prior to it being printed/received (September, January, April) and I will be able to assist you. One member used an issue of *Investigations in Mathematics Learning* as part of a classroom assignment when she received a set. Later, she even purchased a RCML membership as a gift for a workshop attendee. Now she's what I call a dedicated RCML member!

Are you a member of RCML for the calendar year 2011? Often we pay our membership dues at the annual conference. However, if you didn't attend this year in Cincinnati, OH, you may have forgotten to pay your RCML dues. So, just send Mary Swarthout, RCML Treasurer, a check for \$35 for RCML dues for 2011 and there won't be a lapse in distribution of the journal issue (Vol. 4, No. 1) in September 2011. Volume 4 is connected to the 2011 Annual Calendar dues . . . what a bargain for only \$35.

# MEMBERSHIP

Currently there are 78 members of RCML. We only need 17 more previous or new members to hit three digits! Membership is due on **1 January 2011**. To renew your membership please send **\$35** to Mary Swarthout at the address below. Please direct those wanting to join RCML to our website <http://www.unlv.edu/RCML/memberform.html>

Dr. Mary B. Swarthout, Treasurer  
RCML  
Sam Houston State University  
Math and Statistics Dept., PO Box 2206  
Huntsville, TX 77341-2206

## RCML 2010 Officers

### **President, 2011-2013**

Kay A. Wohlhuter  
University of MN Duluth  
Duluth, MN 55812  
[kwohlhut@d.umn.edu](mailto:kwohlhut@d.umn.edu)

### **Past President**

Anne Reynolds  
Kent State University  
Kent, OH 44242  
[areynol5@kent.edu](mailto:areynol5@kent.edu)

### **VP Conferences, 2010-2012**

Stacy Reeder  
University of Oklahoma  
Norman, OK 73019  
[reeder@ou.edu](mailto:reeder@ou.edu)

### **VP Publications, 2009-2011**

Sheryl Maxwell  
University of Memphis  
Memphis, TN 38152  
[smaxwell@memphis.edu](mailto:smaxwell@memphis.edu)

### **Secretary, 2009-2011**

Megan Che  
Clemson University  
Clemson, SC 29634  
[sche@clemson.edu](mailto:sche@clemson.edu)

### **Treasurer, 2010-2012**

Mary Swarthout  
Sam Houston State University  
Huntsville, TX 77341  
[Swarthout@shsu.edu](mailto:Swarthout@shsu.edu)

### **Membership Chair**

Mary Swarthout  
Sam Houston State University  
Huntsville, TX 77341  
[swarthout@shsu.edu](mailto:swarthout@shsu.edu)

### **Investigations Editor**

Jean Schmittau  
SUNY-Binghamton  
Binghamton, NY 13902  
[Jschmitt@binghamton.edu](mailto:Jschmitt@binghamton.edu)

### **Intersection Points Editor**

Elaine Young  
Texas A&M University-Corpus Christi  
Corpus Christi, TX 78412  
[elaine.young@tamucc.edu](mailto:elaine.young@tamucc.edu)

### **Webmaster**

Ryan Speer [speer99@yahoo.com](mailto:speer99@yahoo.com)