The Third R

Michigan Technological University • Department of Mathematical Sciences

Winter 2010–11

Teaching the Teachers

For some master's and PhD students, the prospect of leading their own classes may be the most daunting challenge of graduate school. Grad students in the Department of Mathematical Sciences, however, benefit from a robust program of teacher training and ongoing support that gives them confidence—and competence—in the classroom.

About ten years ago, under the direction of former chair Al Baartmans and now the current chair, Mark Gockenbach, the department began to implement an entire suite of strategies to teach graduate students how to teach math.

It begins with a weeklong orientation for prospective graduate teaching assistants held each fall, before the semester begins. All students are assigned faculty mentors to work with them throughout the year. "We start talking about what makes a good teacher," said Beth Reed, a senior lecturer and assistant to the department chair. By the end of the week, the

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Michigan Tech

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Dear Friends,

Greetings from the Department of Mathematical Sciences at Michigan Tech! I hope this issue of *The Third R* finds you well and prospering.

The department continues to be productive and to touch the lives of almost everyone at Michigan Tech. One of the great pleasures of being on the faculty here is the quality of student that we attract: enthusiastic, hard-working, and passionate about mathematics. In this issue of our annual newsletter, you will meet some of our graduates and faculty and learn how the department is working to improve the education we offer to our students.

If you would like to support the department, remember that you can designate your gift to Michigan Tech for the Department of Mathematical Sciences. You can give online at https://www.banweb.mtu.edu/mtu/mtf/gift/give.xsql.

Another great way to support the department is to let us know what you're doing. Our students are eager to know more about our graduates and what they have done since finishing a degree in mathematics. I hope that we will soon have a web page dedicated to alumni profiles. Please contact us (mathdept@mtu.edu) with news about your current activities, mathematical and otherwise.

All the best,

Mark Gockenbach
Professor and Chair

Teaching the Teachers *(continued from page 1)*

grad students are preparing short lessons and getting feedback from the math faculty.

After orientation comes MA 5901. In 2001, Assistant Professor Shari Stockero, the former director of first-year math programs, launched the course to prepare new teachers for the rigors of the classroom.

Except for experienced teachers, all graduate students assigned to teach math are required to take MA 5901, Teaching College Mathematics I. The course is offered in the fall, and once students complete it, they can begin teaching in the spring. "Since we have started to do this, the grad students' teaching evaluations have gone up dramatically," said Ann Humes, the current director of first-year math programs. "And complaints have diminished greatly."

In addition to their classwork, MA 5901 students shadow experienced teachers and take over their classes several times, under supervision. They also hold office hours. When the grad students begin teaching on their own in the spring, teachers stop in to observe their classes and provide feedback.

Undergraduates can weigh in as well. They evaluate their grad student teachers in mid-semester, and based on that information, the teachers receive additional direction.

"One particular GTA had a few complaints, and I've been working with this person," Humes said. "A student from that class came in today, and before he left, he told me that the teaching has really improved, that the GTA couldn't be doing a better job. I can't tell you how rewarding that is."

The department has also instituted a program that K-12 teachers take for granted: ongoing professional development.

"We meet weekly to talk about what's going good and what's not going so well," Humes said. "We come together as teachers, to hear what others are doing and share our struggles."

In addition, the department has introduced a common curriculum for first-year math courses, so the graduate students are quite literally on the same page as they work through their teaching challenges and develop exams. Through these talks, the students become part of a learning community of teachers.

"The TAs aren't dictated to," said Reed. "They work as a team. We try to make sure they are comfortable in class and have a support system. It's been very successful."

"I like the fact that they don't think they are perfect, that they want to do better," Humes said. "It also gives us a chance to share ideas; I am always learning things from my TAs. I say, 'Come share your ideas, because we all benefit from each other's insights.' We have some amazing GTAs."

PhD student and GTA David Clark expanded the concept by initiating Teaching Teas. Participants discuss particularly thorny topics, such as managing group work or dealing with troubled students.

The First-Year Math programs do not come without a commitment of time and resources. But the outcomes are well worth the effort, said Reed: happier, better-educated undergraduates and skilled grad student teachers who are confident in the classroom. "At this university, you need math for everything," she said. "It's critical that our undergrads be successful, and for that, our TAs must be successful."

ALUMNI *Profiles*

Erik Westlund

"I once invented an elaborate machine within a four-foot cube, made out of wood, steel, and PVC piping," Erik Westlund recalls. "The machine opened a factory-sealed carton of milk in the most deliberately complicated way possible, designed in the fashion of the ridiculously over-engineered devices designed by cartoonist Rube Goldberg in the early 1900s."

It is this type of abstract thinking that led Westlund to his chosen field.

"I have always loved mathematics immensely," he says. "I find unparalleled beauty in its structure and depth and stand in awe of its ubiquitous presence in our universe."

It is this passion that perhaps contributes best to Westlund's work, first as a PhD candidate at Michigan Tech, and now as an assistant professor at the University of Wisconsin–Marshfield/Wood County. Beginning in the summer of 2011, Westlund will be moving to Kennesaw State University near Atlanta, Georgia, where he will be employed as an assistant professor in the Department of Mathematics and Statistics.

Westlund's dissertation research was in algebraic graph theory, working with a thirty-year-old conjecture on whether the edge sets of certain types of graphs whose structure is based on a finite algebraic group can be partitioned into large cycles. In short, he used a combination of programming, computational, and theoretical approaches to obtain partial results, resolving a number of long-standing and open mathematics cases.

"When I chose to come to Michigan Tech for my graduate work, I had applied all over the country," he explains. "After visiting Tech at the invitation of Dr. Mark Gockenbach, I was really impressed and excited to come. The faculty and graduate students really seemed like my kind of people: extremely knowledgeable and very approachable."

The opportunity to teach was, for Westlund, one that couldn't be passed up. "After being offered a teaching assistantship, I was completely sold," he says. "Plus, the UP is absolutely beautiful."

Westlund plans to continue his career within the academic sector, working to gain a broad working knowledge of combinatorics, graph theory, and areas of abstract algebra. Opportunities to work with colleagues in mathematics and in other disciplines will contribute to his research and to the field. And research is only one part of the allure of academia: "I also very much enjoy teaching," he says. "In my work as an academic, I hope to refine my techniques to become an even more effective and seasoned instructor."

"Thus far, my most significant accomplishment would have to be committing to my research and finishing my PhD," Westlund says. "But I also consider it a great accomplishment when I have students telling me that they learned a lot in my class and really enjoyed having me as an instructor."

Beyond his professional life, Westlund enjoys drawing and sketching, collecting and listening to music, woodworking, and traveling.

"I also love to cook," he adds.

Westlund is grateful for the people he got to know during his time at Tech. "Over the course of the six years I spent at Michigan Tech, I became close with people who opened up entirely new ways of thinking to me and helped me to learn an enormous amount about myself," he says. "Some, undoubtedly, helped to make me a better scholar and mathematician, and others, I feel, helped to make me a better person in general."

"For a long time, I measured success in the standard manner: secure job, number of papers published, respectable salary, nice home," Westlund adds. "Now, I unquestionably measure success only in whether an individual is happy doing what they are doing."

Xiaoqi (Heidi) Cui

Born in Dandong, China, a small and beautiful city in Liaoning Province, Xiaoqi (Heidi) Cui says she is accustomed to cold weather. "Winters in Houghton were not a big shock to me," she says. "There is not as much snow in my hometown as there is in Houghton, though. I love how white and pure the snow in Houghton is."

Cui arrived in Houghton in 2004 to study statistics as a doctoral student, after completing her bachelor's degree in applied math at Dalian University of Technology in Dalian, China. Cui's dissertation research focuses on developing efficient statistical and computational methods to identify gene-to-gene interactions that affect certain complex human diseases. Her research moves on to locate gene regulators that are critical in a biological process.

"The field I am most interested in is human health, and I work to apply my mathematical and statistical knowledge to help find critical factors that can affect complex human diseases," Cui explains. "My goal is for my research to contribute to the development of effective drugs to treat those diseases."

Cui has always been good at math and logic, and even as a child she earned several honors and awards in math competitions at school. While at Michigan Tech, she developed an interest in statistical genetics as a way to contribute to solving human health problems. "Whether working in academia or industry, I want to be able to use my mathematics and statistics knowledge to help people solve real-world problems," Cui emphasizes.

Cui strives to make a difference in the world. Since completing her doctoral work at Michigan Tech, Cui has been employed at Abbott Laboratories, a pharmaceutical company located north of Chicago. Her work in the Biostatistics and Data Management Department focuses on exploring new statistical methods to support Abbott's pharmaceutical research and development.

"My graduate work at Michigan Tech has helped to build a strong foundation for my research and work," Cui says.

But research wasn't the only thing that drew Cui to the University. "Michigan Tech's math department provides graduate students with opportunities to teach, not as just a teaching assistant but as an instructor," she says. "This was an exciting experience for me as it helped to improve my confidence in my English communication."

Outside her professional and research life, Cui enjoys participating in aerobics and running, as well as cooking. Her family is a strong support to her as well, "My husband, my grandma, and my parents always give me boundless love and support. I owe them a lot."

"Whatever I'm doing, I believe, 'Small changes make a big difference,'" Cui says. "This belief works well in both my research and in my everyday life."

ALUMNI *Profiles*

Christine (Goering) Lally

"I've always liked math," says Christine (Goering) Lally, "except for those timed multiplication tests in elementary school."

"One of my high school friends really hooked me when he showed me that you don't just have to believe mathematical theorems, they can be proven," Lally says. "Deciding to major in math at college just seemed to be the obvious choice for me."

Lally chose to attend Michigan Tech for several reasons, not the least of which was the combination of the quality of the education and the natural beauty of the Keweenaw. As she puts it, "Where else can you see a bear cross the road on the way from the airport to the campus?"

Community involvement is also important to Lally, and the opportunities to get involved in the University community outside of her department were also a draw. "I played the clarinet in the Michigan Tech Pep Band and in a local band, went on an archaeological dig, and worked in the archaeology lab on campus," Lally says. When asked what advice she would give to students, she says, "Join the Pep Band!

You'll have fun and make some great friends."

After completing her bachelor's degree in mathematics in 1999, Lally went on to earn a Master of Science in Mathematics from Rensselaer Polytechnic Institute in 2000. Following completion of her master's degree, Lally began working at the New York Independent System Operator, the administrator of New York's wholesale electric markets.

"It was amazing to me to learn how much complexity is behind the electric outlets that I used to take for granted," Lally says. She then moved to the New York Power Authority, the state agency that, among many things, operates the hydroelectric power plant at Niagara Falls. Lally is currently employed as a senior business planner for the New York Power Authority, maintaining the company's financial forecasting model and creating forecasts that are used by management to analyze business strategies.

"To some extent my job involves mathematical calculations," Lally says. "But the most important skill I developed is the ability to be logical and organized. Those traits are an asset in almost any career."

Lally lives with her husband, Adam, and their Scottish terrier, Maggie, in Cold Spring, New York. In addition to spending time outdoors, Lally enjoys scrapbooking and swimming. Lally was even able to combine her enjoyment of swimming with her interest in community involvement. "This past summer I swam across the Hudson River in support of the Hudson River Pool, a free public swimming area in the river," she says.

When asked about her goals, she says, "My goal is to continue learning and to always work in a job where I can make a positive impact."

Exploring New Ways to Teach Math's Middle Child

Of the three courses in the calculus sequence, Calculus II has traditionally been the most problematic, says Todd King.

Unlike Calc I and Calc III, Calc II is neither fish nor foul. It must be all things to all students: a terminal math course for some and a bridge to Calc III for others. "It's not a novel," says King, an associate professor of mathematical sciences. "It's a series of short stories."

Thus, it can be challenging to teach and challenging to master, a statement borne out by the letters: it has the highest number of grades below C in the calculus sequence. So Mark Gockenbach, chair of the mathematical sciences department, was concerned. He asked King, a veteran teacher with experience in online instruction, to take a crack at developing course work that might give Calculus II students a better chance to succeed.

King accepted and almost immediately recruited PhD student Jason Gregersen, who has a bachelor's in math education from Northern Michigan University and is known for his teaching ability.

Between the two of them, they are now crafting a blended learning course, part in-class lecture, part online video. They kept the textbook and all the classroom hours but put regular homework assignments online.

"We're pretty excited about it," says Gregersen. "Hopefully it will be effective."

In particular, they turned the traditional math teaching model on its head. Before the lecture, students view a short, YouTube-length video relating to the upcoming lesson. It's akin to prepping for a meeting, King says. "It gets them ready for the recitation. Students already have the basics and are better prepared to understand the lecture." After class, they can review the video for help with difficult concepts.

"By studying first, we hope they get more out of the recitation section," says King. "It lets us spend less time on elementary material and more on understanding concepts."

King and Gregersen are building the new course this year, incorporating the beta version into Gregersen's Calc II class. They expect to roll it out officially in fall 2011. So far, the students say it works. "They really enjoy being able to go back and access the videos," says Gregersen. "It helps them work on things they are having trouble with, and it lets them hear the instructor talk through the example again." Gregersen also incorporates Mathematica and other software, as well as YouTube videos posted by other math instructors. "It teaches students to explore on their own," he says.

Homework is done online and needs to be completed by 8:00 AM. Students can try for the right answer up to four times. "If they do it right, they get a green check," says King. "If they do it wrong, they get a red cross and try again." The completion rate is over 90 percent, and it gives students and professors instant feedback on where the problems lie.

The new online course isn't a smart pill. Students who don't do the work can still fail, and bright, highly motivated students will likely get As no matter what the pedagogical format. The majority of students, who occupy the middle, are the ones who stand to benefit the most, King said.

It's for these students that the department is investing additional resources into the hybrid course. "Students will be getting more, not less," said Gockenbach. Ideally, that new investment will give more students a solid foundation for their engineering and science course work. It may even keep students on track for a timely graduation by boosting the percentage of passing grades.

How is the new hybrid course working? Just a few months into the school year, it's too early to tell if students are learning the material better. But so far, it has received positive reviews. The only complaints have come from students who want more videos.

"We are very early in the process, but most comments we've received from students have been positive," King said.

FACULTY *Profiles*

Ethan Smith

"I like discovering how things work. I like it when a lot of intricate details fit together in some beautiful harmony. That is not to say that math is always clean. In fact, it can be quite exciting when there is a touch of dissonance in the music, when things only very nearly fit. At first it can be quite annoying, but then you learn to appreciate that the dissonance creates a richer structure," Ethan Smith, assistant professor of mathematical sciences, explains about his attraction to his discipline.

"We like being able to prove very clean, simple formulas, but it is often more interesting when the answer is not so very clean," he says.

Smith arrived at Michigan Tech in fall 2009, having completed his PhD from Clemson University earlier that year. When interviewing for the position, his colleagues at Clemson were very encouraging.

"When I told people that I was interviewing at Michigan Tech, they all seemed to have really good things to say about it," he says. "When I visited the campus, the math department felt very similar to the one back at Clemson. So, it sort of felt like home."

He does admit to one concern, however. "I was a little nervous about winter in the UP," he smiles. "I survived the first one, though everyone keeps telling me how mild it was."

As a researcher, Smith works on problems in number theory related to elliptic curves, modular forms, and the distribution of primes. "The area is the meeting ground for a lot of interesting mathematics, from algebra to geometry to complex analysis," he explains. "This is a very exciting area. Applications to cryptography have generated some renewed interest in these topics. Two of the several 'million-dollar prize problems' fall into this general category, and elliptic curves and modular forms both played a major role in the proof of Fermat's Last Theorem."

Smith is also a dedicated instructor, with a teaching philosophy that involves viewing himself as a "guide" to students as they learn the course material.

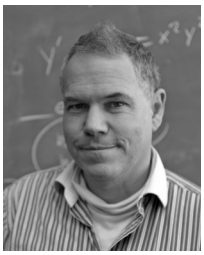
"It's enjoyable to share something you have worked very hard to understand—to explain it to someone, and then watch their faces light up when they understand it, too," Smith says. "I had some wonderful professors throughout my college years. They helped shape me into who I am today. I hope to have a similar impact on my students."

In fact, Smith continues a strong mentoring relationship with his PhD advisor, Kevin James. "We have a lot in common in terms of what is important to us, and I really trust his advice," he says.

Outside his professional life, Smith enjoys playing classical guitar and reading, and he volunteers at his church. "But mostly I enjoy spending time going to parks and playing with my son in the evenings," he says. "I am very proud of my family. Somehow I convinced a very smart and beautiful woman to marry me, and we have a wonderful little boy."

When asked how he defines success, his answer is simple: "I define success as loving my family."

Allan Struthers



Hailing from Glasgow, Scotland, Allan Struthers once sailed on a small boat with his parents from Greece to Sicily. When asked, he describes himself as, "stubborn, curious, and active."

"I chose this discipline partly due to inertia and partly because I was good at it," he says.

When interviewing for faculty positions, Struthers had the choice between Baille Altha Claithe (Dublin City University) in Ireland, the University of Texas at San Antonio, and Michigan Tech. "Michigan Tech was the best fit," he says. "And I love winter! It was over 80-some degrees in San Antonio on my birthday when I interviewed there."

Struthers arrived at Michigan Tech in 1991, having earned his PhD in Applied Mathematics from Carnegie Mellon. His research is wide ranging, from reinterpreting and developing algorithms for standard mathematical procedures, like optimization and root-finding, to commodity parallel programming hardware GPU.

"I believe one key is to relax the synchronization requirements of algorithms," he explains. "In early days, when computers were people—and in World War II, mainly women—real computations were naturally parallel and asynchronous. In other words, they used a room full of people for computations, and it is fascinating to me that some of these algorithms may be revivable."

Struthers is happy with his decision to come to Michigan Tech. "Tech has provided the facilities I need to pursue the mathematical and computational topics that have attracted my attention," he says. "It has also provided students to teach and has made it possible for me to learn new things through my teaching and research."

Teaching is particularly important to Struthers, not only for the opportunity to share his knowledge, but also to help him see knowledge in new ways. "Teaching is important for many reasons," he says. "I learn things teaching new classes and sometimes when teaching old classes. Sometimes I learn new ways of thinking about things, sometimes I learn new ways to use technology."

"Students who are working with you provide an audience that knows—or maybe should know—what you are talking about and can give you new ways to see things," he adds. "The saying 'Two heads are better than one' is true when it comes to teaching and learning."

In addition to his professional life at Michigan Tech, Struthers enjoys kayaking, sailing, hiking, and both cross-country and downhill skiing. Community service and spending time with his family are also important to him.

"I had a 4-H club for a while," he says. "But now I mostly take kids for archery, kayaking, and hiking."

With his strong work ethic, a rounded sense of curiosity, and a persistent nature, Struthers defines success simply: "Theodore Roosevelt once said, 'Far and away the best prize that life has to offer is the chance to work hard at work worth doing,'" Struthers says. "To me, success means having fun doing something worthwhile."

FACULTY *Profiles*

Donald Kreher

Donald Kreher arrived at Michigan Tech in 1991, having previously been employed at the University of Wyoming and at the Rochester Institute of Technology. He earned his PhD in 1984, in the joint program of computer science and mathematics at the University of Nebraska–Lincoln.

"Currently in my research, I'm looking at computational and algebraic methods for determining the structure and existence of combinatorial configurations, such as designs, graphs, error-correcting codes, cryptographic systems, and external set systems," Kreher says. "Generally this means the construction of combinatorial objects to which there is no known good algorithm. Examples would include t-designs with large t, Ramsey graphs, and extremal set-systems."

"This has many applications," he explains. "We can apply combinatorial configurations to computer science and information theory. Really, I'm looking at the design and analysis of combinatorial algorithms for problems that are considered almost intractable."

When asked how he chose his profession, he explains, "I don't think I did choose this discipline."

"I do what I find interesting," he says. "This is simply the path life took me on: when I am pointed at something I find interesting, then that is the direction I go."

A certain amount of patience and understanding contribute to his success. "Success is the favorable or prosperous termination of attempts or endeavors," he says. "Outside of my education, it took perseverance to get where I am today."

Outside of his professional life, Kreher is an avid fisherman and volunteers as a board member of the Copper Country Chapter of Trout Unlimited.

"I mostly fish the inland streams in the Copper Country," he says. "I've found the best rivers in the local area are the Pilgrim, the Elm, and the Montreal. On streams, I am usually fly-fishing or spin-casting."

"I also will fish for crappie and perch on Portage River, Otter Lake, Roland Lake, or Lake Sainte Kathryn," he says. "For these spots, I either cast soft plastic with ultralight tackle, or I use the fly rod."

Kreher also volunteers as a 4-H leader for the Keweenaw and Houghton County 4-H. His wife, Carol Kreher, is the Keweenaw and Houghton County 4-H associate and the owner of Fiber Whims, a supply and gift store for spinning, weaving, and felting enthusiasts.

2010 Faculty and Student Awards

Faculty

Outstanding Teaching Award—Junior Level
David Olson
Wenjun Ying

Outstanding Teaching Award—Senior Level
Renfang Jiang
Gilbert Lewis

Outstanding Research Award—Junior Level
Ethan Smith
Fabrizio Zanello

Outstanding Research Award—Senior Level
Don Kreher

Graduate Students

Outstanding Teaching Award
Jason Gregersen
Melanie Laffin

Outstanding Research Award
David Clark

Undergraduate Students

Norman E. Scholz Award
Jizhou Li

Charles Knobloch Award
Ryan Dood
Dustin Larson
Jie Zeng

Mathematics Achievement Award
Ben Fedorka
Molly Hyrkas
Jennifer Liu

Departmental Scholar
John (Jack) Kelly

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Internship Introduces Math Major to the Workplace

Andrew Grow, a mathematical sciences senior with a concentration in statistics, spent last summer as an intern for Mercer. He agreed to share some of his experiences working in Kentucky for the global consulting firm, which specializes in human resources and related financial services.

An internship interested me because I wanted to learn more about an industry that I might work in, but more importantly I wanted to learn more about myself. Opportunities beget more opportunities, and it's no secret that internships often lead to full-time job offers. I wanted to see if I fit the career, and I wanted to know if it was something that I would enjoy and be fairly good at.

As a junior I attended Michigan Tech's Career Fair and interviewed with Mercer for an internship as an actuarial analyst. Later that winter, I was offered the summer internship position and relocated to Louisville, Kentucky, for the summer.

I was unsure how I would fit into the corporate culture. I quickly found that corporate culture varies and that the people in the Louisville Retirement Service Center were a relatively younger crowd. I found the atmosphere warm and welcoming. We frequently met outside of work for fun. I even met with a superior on the weekends to practice kung fu. At work I was treated with patience. I was given ample time to learn and the freedom to find my way.

We worked on teams of roughly thirty in an office of somewhere around 160. This was nice, as Mercer is a global company and one of the largest in its market.

I worked a full-time schedule. I was trained as thoroughly as if I were a permanent hire, given real work on real projects, both to get my feet wet and to contribute to the team. I was also given special projects based on my skills, abilities, and interests. I was able to make a unique contribution, and all this as an intern.

I was responsible for varied tasks. I was given data sets that represented a company's pension plan and prepared that data to a level of integrity needed for calculations. I generated reports from data. I performed liability valuations and checked the calculations to verify their accuracy. I also performed government filings.

Skills that were important were data manipulation, effective communication, organization, time management, and programming in order to personalize spreadsheet and word-processing applications. I found that although I have learned plenty in college, they weren't as interested in what I knew as they were in what I could learn.

I found that I could thrive in a corporate atmosphere as long as I can be a part of a smaller, tighter knit group in a very large company.

I learned a tremendous amount about the industry in a short amount of time. I soon felt that, though I hadn't yet been offered a full-time position, there could be a place for me at Mercer where I would be of value.