IN THIS ISSUE:
CRMSE Welcomes Ricardo Nemirovsky
Physical Sciences Curriculum Adopted by California
George Feher Awarded Wolf Prize in Chemistry
Recent Publications, Professional Accomplishments
Recently Funded Projects
CRMSE Hosts its First AERA Reception
Alumnus Participates in Science for Monks Program
Alumni Ellis and Knuth on Demystifying Math
Dogs and Geometry
Celebrations
IN FOCUS

CRMSE Welcomes Ricardo Nemirovsky

By Donna Ross

In September 2006, Ricardo Nemirovsky became CRMSE’s director, following Kathleen Fisher who served CRMSE for six years. He joined the faculty as a professor in the Mathematics and Statistics department at SDSU in September 2003. Prior to coming to San Diego, Ricardo was senior scientist at TERC in Massachusetts. TERC is a non-profit organization designed to improve math and science education through research, development, and collaboration.

Ricardo is bilingual, originally from Argentina, where he earned a degree in Physics. He later became interested in science education and earned his Doctor of Education degree at Harvard in 1993. While in Argentina, he began working for ORT, a non-governmental organization, founded in Tsarist Russia in 1880 that supports education, economic, and social development throughout the world, particularly among Jewish communities. He served as the Science Education Coordinator in Argentina and then went on to become the director of ORT in Mexico, before moving to the US in 1987.

Ricardo’s research program focuses on the investigation of the embodied nature of cognition, and on the study of how learning situations are experienced by students. Proponents of embodied cognition hold that cognitive processes are deeply rooted in the body’s interactions with the world and with others and that perceptuo-motor activity is embedded in the use and production of tools and symbols. His focus on how situations are and influenced by the strand of philosophy identified as “phenomenology”. He has developed together with many other colleagues a body of work that supports the creation of a longitudinal strand on the mathematics of change across educational levels, highlights the centrality of bodily and kinesthetic activities in the learning of mathematics, and articulates a perspective on the role of tools for students’ learning. In addition to research papers, he has co-authored curricular units, and has designed numerous mechanical devices and software to enrich the learning of mathematics, including several math-oriented exhibits for science and technology museums. In the last few years he become involved in the use of video-based multimedia as an avenue for research publication, and as a tool for pre-service and in-service teachers’ professional development; in this regard, he co-led the development of an authoring tool (“VideoPaper Builder”) for the creation of videopapers and explored its use in different contexts.

Ricardo’s research on the embodied nature of cognition and on the creative use of mathematical artifacts has been published in a wide variety of journals for different audiences, including Cognition and Instruction, Educational Studies in Mathematics, Journal of Mathematics Teacher Education, Journal for Research in Mathematics Education-Monographs, Research in Collegiate Mathematics Education, Teaching Children Mathematics, and The Journal of Mathematical Behavior.

Ricardo is delighted to work at SDSU where he has the opportunity to teach and work with graduate students while continuing his research activities. In his role as CRMSE director, Ricardo has already introduced several new programs, including a once-per-month video club, a CRMSE reception at the annual AERA meetings, and the redesign of the CRMSE website with the eventual aim of making it the hub for mathematics and science education events in San Diego County. He has also sought to form CRMSE’s first-ever local Advisory Board, and is currently seeking funding to invite mathematics education faculty to CRMSE to discuss common goals and direction for mathematics education in the state. Please join us in warmly welcoming Ricardo to SDSU and CRMSE.

About CRMSE...

The Center for Research in Mathematics & Science Education (CRMSE) is an interdisciplinary community of scholars who seek to advance mathematics and science education at local, state, and national levels by providing leadership in research, materials and program development, and evaluation. Its members include faculty from the departments of mathematics and statistics, biology, physics and psychology in the College of Sciences, and from the School of Teacher Education and the Department of Policy Studies in the College of Education. For more information, please visit our website at: http://www.sci.sdsu.edu/crmse/new_site/index.html
By Judith Leggett

On November 9, 2006, InterActions in Physical Science, a middle school science program, was adopted by the California State Board of Education. InterActions is a one-year middle-school program created by the Physics Learning Research Group within San Diego State University’s Center for Research in Mathematics and Science Education. Fred Goldberg and Sharon Bendall headed up the tight-knit SDSU development team, and Patricia Heller of the University of Minnesota and Robert Poel of Western Michigan University were co-PIs on the project. The development was funded by grants from the National Science Foundation.

The adoption is significant for two reasons. Along with an Earth Sciences program from the same publisher and similarly adopted in November, this is the first time a reform-based middle school science curriculum has succeeded in meeting the rigorous standards for California schools. Second, because of those rigorous standards it is often true that where California leads, other states follow. The California adoption is likely to lead the way to truly national distribution of this innovative program.

This pioneering program is grounded in years of research in the teaching of physical science and how students learn. The pedagogy of InterActions is based on guided inquiry, with direct instruction occasionally used to extend the ideas covered. The program is hierarchical, with topics and skills developed in a structured progression, organized around the central themes of interactions and energy. Students develop target ideas through active learning experiences such as hands-on experiments and computer simulations.

The program is published by “It’s About Time”, the educational publishing division of Herff Jones. In addition to a lavishly-illustrated textbook (available in English or Spanish), materials for students include a science fiction reader and a lively website. Students use the online simulators to model physical processes, examine relationships between variables in ways not easily duplicated in labs, and visualize abstract concepts such as forces. For teachers, there is a three-volume Teacher Guide and a comprehensive online resource. There is an extensive professional development program of workshops and online tutorials.

Says Jeff Vanhoeven, a teacher with nearly 20 years of teaching middle school science, ‘I have never been a part of a curriculum that even comes close to InterActions in Physical Science in terms of student learning and involvement. My students love it because so much of it is “hands-on” and they feel valued...’
Leland Beck (PI) and Alexander Chizhik (Co-PI), Cooperative Learning Methods for Java-based CSI Courses, funded by the National Science Foundation, CCLI.


This goal of this project is to account for: (a) the ways in which features of classroom environments influence what students attend to mathematically; (b) the particular mathematical focus that emerges in a classroom; and (c) how attention-focusing interactions are related to the ways in which students generalize or “transfer” their learning experiences. In order to pursue these theoretical goals, a series of empirical studies are being conducted in San Diego and in Madison, Wisconsin involving middle school and high school students learning about the topics of linear functions and quadratic functions. It is anticipated that this research will result in benefits for teachers and their students, by demonstrating how the durable concepts that students take away from instruction are influenced by many subtle and often unintentional aspects of teaching practices involving the nature of how certain mathematical properties come to be the object of focus when multiple sources of information compete for students, attention. Project personnel include Joanne Lobato (PI, Associate Professor in the Department of Mathematics and Statistics), Amy B. Ellis (Co-PI, MSED Graduate and Assistant Professor in the Department of Curriculum and Instruction, University of Wisconsin at Madison), Ricardo Munoz (Research Assistant), and Bohdan Rhodehamel (Research Assistant).


Cheryl L. Mason (Co-PI), Dennis Sunal (PI) and Cynthia Sunal (Co-PI), University of Alabama; and Dean Zollman (Co-PI), Kansas State University, STEEP (Science Teacher Education and its Effect on Practice), funded by the National Science Foundation.

This 5-year project (2006-2011) focuses on critical needs in the undergraduate preparation and long-term professional development of K-6 teachers of science. The goal is to investigate the impact on these students of undergraduate, standards-based, reform undergraduate science courses developed by faculty in the NASA Opportunities for Visionary Academics (NOVA) professional development model. Thirty reform and 30 comparison undergraduate science courses from a national population of 101 diverse institutions, stratified by institutional type, will be selected and compared in a professional development impact design model. CRMSE’s Dr. Cheryl Mason and MSED first-year doctoral student, Corinne Lardy, will serve as the western region research team for STEEP, collecting data from study institutions within the Western United States, as well as helping to coordinate larger aspects of the project as a whole.
**Recently Funded Projects, continued**

**Ricardo Nemirovsky, SLC Catalyst: Research on Embodied Mathematical Cognition, Technology, and Learning.**

The goal of this SLC Catalyst activity is to bring together leading researchers in the fields of education, neuroscience, psychology, sociology, and mathematics to develop plans for a Science of Learning Center that pursues research on embodied mathematical cognition, technology, and learning. The Center will develop theory and empirical research that can encompass (a) the rapid emergence of new technologies and types of professional work that involve mathematical description and analysis, (b) the challenges of providing all students with equitable access to powerful forms of mathematical thinking, and (c) the need to prepare learners for the increasingly unpredictable demands of work and public life.

**Randy Philipp and Vicki Jacobs, Studying Teachers’ Evolving Perspectives (STEP): A Cross-Sectional Snapshot of Teachers Engaged in Sustained Professional Development Focused on Children’s Mathematical Thinking, funded by the National Science Foundation.**

In this 5-year (2005–2010) Teacher Professional Continuum project, the researchers seek to map a trajectory for the evolution of elementary school mathematics teachers engaged in sustained professional development related to children’s mathematical thinking. Four cohorts of 30 teachers each are differentiated on the basis of the length of their participation in such professional development: initial participants (in the beginning stage), advancing participants (completed 2–3 years), teacher leaders (completed at least 4 years and assumed leadership roles), and prospective teachers, a critical anchor for the initial participants’ evolutionary trajectory. Using a cross-sectional design to investigate teachers at distinct points along the trajectory, the researchers will design and employ beliefs surveys, noticing instruments to assess teacher interpretation of classroom interactions, observation protocols for professional development and classroom instruction, and content assessments to answer their research question: What are the similarities and differences among elementary school teachers at three points during sustained professional development in terms of their knowledge, beliefs, and practices? Additionally, a longitudinal analysis of six cases will provide important information about the changing needs of teachers while they evolve from initial participants to advancing participants. Secondary to the central research question is a formative assessment of the relevance and application of the research findings to providers of disparate models of professional development for both prospective and practicing teachers.

**Rafaela Santa Cruz, The San Diego State University Mathematics Science Teacher Initiative (MSTI).**

MSTI is a comprehensive program to double the College of Education credential enrollments in mathematics and science. The first component of the program focuses on expanding numbers of candidates seeking other credentials who also obtain mathematics or biology credentials. The second component creates a new pathway for community college transfer students interested in mathematics and science credentials. The third component seeks to add new pools of students by identifying and mentoring high school students interested in teaching mathematics or science.
**Professional Accomplishments**

**Nadine Bezuk**
was the 2005 College of Education Recipient of a Faculty Alumni Award (also known as the Monty) for Outstanding Contributions to the university.

**Randy Philipp**
received the 2006 Excellence in Teaching in Mathematics Teacher Education Award from the Association of Mathematics Teacher Educators (AMTE). He was a featured speaker at their annual conference, where he received this award. The award is designed to recognize a colleague for a unique contribution to the pedagogy of mathematics teacher education. In addition, he is the first recipient of what will be an annual award, so others have big shoes to fill.

**Chris Rasmussen**
was awarded the 2006 Annie and John Selden Prize for Research in Undergraduate Mathematics Education by the Mathematical Association of America. He formally received the prize at the 2006 MAA's Summer MathFest.

**Bonnie Schappelle**
was awarded a 2006 Frea E. Sladek Outstanding Service Award. She was nominated by Randy Philipp and Judy Sowder for her exemplary service, initiative, competence, and contribution to several major initiatives housed at CRMSE.

**Nadine Bezuk**
is the first President of the newly formed California Chapter of AMTE, November 2006 – November 2008 and the Executive Director of the Association of Mathematics Teacher Educators (AMTE) through Jan. 2010.

**Vicki Jacobs and Donna Ross**
earned sabbaticals to conduct and complete research projects.

**Joanne Lobato**
is the Editor of the Transfer Strand of *The Journal of the Learning Sciences*, 2006-09 and an Editorial Board Member for *Mathematical Thinking and Learning* and for *The Journal of the Learning Sciences*.

**April Maskiewicz**
Congratulations to April Maskiewicz (MSED graduate, 2006)! April was offered and accepted a position as an Assistant Professor in the Biology Department at Point Loma Nazarene University as a Biology Education Specialist. She was delighted to accept the position because she will be able to implement her research-based strategies in non-major biology courses, conduct research, and work with inservice biology teachers as an advisor for their masters’ theses. April will join 2003 MSED graduate Dianne Anderson in the Biology Department. Dianne now serves as the director of the MA/NS program in general biology. The program is designed for working teachers to develop academic and pedagogical content knowledge in biology.

**Steve Reed**
is writing a book called *Thinking Visually* that will help launch a new series (New Directions in Cognitive Science) by Lawrence Erlbaum Associates.

**Judy Sowder**
led a Mathematics Education Delegation to China in December of 2005. The program was organized by the People to People Ambassador Program. In January, Judy was also part of a 3-person team invited to Taiwan to help mathematics education researchers revise papers for submission to international journals.
Publications – 2005-Present

Note: CRMSE members in red text, Current and former graduate students in orange text.


Continued, page 7


Publications – 2005-Present, continued


Did you know?

Three of San Diego State University’s CRMSE members authored or co-authored chapters in the prestigious Second Handbook of Research on Mathematics Teaching and Learning (Frank K. Lester, Jr., editor). SDSU faculty wrote more chapters than faculty at any other university, providing evidence of CRMSE members’ influence and distinction.
CRMSE Hosts First Ever AERA Reception

Under the direction of Ricardo Nemirovsky, CRMSE hosted its first reception at AERA, held in April 2007 in Chicago. About 50 researchers, practitioners, and graduate students attended the event, including Mathematics and Science Education (MSED) doctoral program graduates and former SDSU faculty.
Wolf Prize awarded to UCSD’s George Feher

George Feher, a physics research professor at UCSD, was awarded the prestigious 2007 Wolf Prize in Chemistry. He will share the $100,000 prize with Ada Yonath of Israel’s Weizmann Institute of Science. Feher won the prize “for ingenious structural discoveries of the ribosomal machinery of peptide-bond formation and the light-driven primary processes in photosynthesis.” He uncovered the basic mechanisms for how plants and bacteria use photosynthesis to convert light into chemical energy.

According to the Wolf Prize jury, Feher “pioneered the structure/function relations of the simplest reaction center in photosynthesis, revealing the basic principles of light energy conversion in biology.” It added: “Feher’s impressive work in research on photosynthesis rests on his extraordinarily vivid imagination and on the sustained discipline with which he forced himself to master the underlying biochemistry in a brilliant and systematic manner. His work is seminal for the construction of synthetic and semi-synthetic molecular energy converters, which may have profound implications in an energy-demanding world.”

The Wolf Prize has been awarded annually since 1978 to living scientists and artists for “achievements in the interest of mankind and friendly relations among peoples ... irrespective of nationality, race, colour, religion, sex or political views”. The prize is awarded in Israel by the Wolf Foundation, founded by Dr. Ricardo Wolf, a German-born inventor and former Cuban ambassador to Israel. It is awarded in six fields: Agriculture, Chemistry, Mathematics, Medicine, and an Arts prize that rotates annually between architecture, music, painting and sculpture. Each prize consists of a diploma and USD$100,000. The Wolf Prizes in physics and chemistry are often considered the most prestigious awards in those fields after the Nobel Prize.

Congratulations to George Feher!

Dogs and Geometry

Test your recognition of transformations. Can you identify the rotations and translations in the pictures?

Thanks to Judy Sowder for contributing the photographs of her talented canines, schnauzers Cody (black) and Winner (salt and pepper).
Andy Johnson was the first graduate of CRMSE’s Mathematics and Science Education Doctoral (MSED) program. He is now an associate professor at Black Hills State University.

BHSU professor participates in Science for Monks program

By Mary Garrigan, Journal staff

Reprinted with permission from the Rapid City Journal

Teaching Buddhist monks about science has provided Black Hills State University physics professor Andy Johnson with a few spiritual lessons of his own.

Black Hills State University physics professor Andy Johnson works with a group of Buddhist monks during a science workshop at a monastery in India.

Johnson is a physics educator with a passion for improving the way science is taught. That’s why he came to be standing in a Buddhist monastery in India last month, teaching 50 gar-gnet-robed monks about magnetism.

Science for Monks is a program initiated by the Dalai Lama, the exiled spiritual leader of Tibet. It exposes monks who live in isolated eastern monasteries to western scientific thought. Johnson has spent his semester breaks from BHSU in India with the Science for Monks program since 2004.

“The Dalai Lama began the science workshops based on the twin ideas that Tibetan Buddhism can learn much of value from Western science, and that the Western world can gain much from Tibetan Buddhism,” Johnson said.

As part of the program, monks hear lectures by top scientists worldwide, but they also participate in inquiry-based teaching workshops with science educators, like Johnson, where they conduct experiments and develop their own theories about the “big questions” of science.

Remarkably, their theories are always close to the scientific explanations found in textbooks, Johnson said.

Buddhist spiritual development has some striking similarities to scientific thought, Johnson has noticed. Meditating monks study the internal world of their minds. Scientists study the external world around them. But their methods have much in common.

“Studying Buddhism involves investigations that are similar to science but which focus on the inner spiritual world rather than on the external material world,” he said. “Buddhism is fundamentally different than any Western religion, all of which are based on faith and the idea that you must believe something you can’t know.”

Buddha, Johnson said, was more like a scientist than a spiritual leader, telling his followers to test before they believe.

“Essentially, he said ‘try it yourself, and if it doesn’t work for you, do something different,’ ” Johnson said.

Johnson is not a Buddhist, nor does he practice meditation, although he says he might start, given the benefits that medical research has attributed to it.

“I’m starting to think I should learn meditation because it seems really beneficial. They’ve proven you can make yourself happy just by meditating,” he said.

He recounts one research project that put a meditating monk inside an MRI machine. His brain scan revealed that the pleasure centers of the monk’s mind “lit up like they had never seen before,” Johnson said.

Johnson is finding, after three years of exposure to Eastern religious thought, that it holds spiritual lessons for Western cultures. Here in the West, we have some funny ideas about happiness, he said.

“They may not know much science but they’re very smart about the nature of reality and about the human relationship to the world,” he said of the monks. “I’m starting to see how the Buddhist emphasis on spiritual development, rather than on material wealth, could substantially help us here in the U.S. They have some wisdom that the world desperately needs right now.”

While enough food to eat and a decent house to live in are important components of happiness, the latest video game is not, Johnson said. “We just keep looking for happiness in our pickup trucks and our trophy homes.”

Johnson also enjoys the teaching challenge of bringing scientific concepts to monks who may not even speak English. About one-third of the monks he taught spoke some English, but he used a translator, too.

As the associate director of the Center for the Advancement of Math and
Science Education, Johnson is on a mission to improve math and science education in South Dakota and in the wider world.

He has a doctorate in physics education, but apologizes for a “culture of science that is elitist” and a profession full of scientists who never learned how to be good teachers.

“It’s extremely possible for normal people to understand science,” he said. “And there are these big ideas of science that people should understand.”

He uses new approaches to teaching physics in his college classrooms, and they work equally well with Buddhist monks, he said.

Monasteries educate many monks who come to them as children, but science education is lacking. Some of the monks in the workshop had the equivalent of a doctoral degree in monastic studies and most had at least some exposure to basic Western science.

This year, Johnson taught about the magnetic properties of materials, using some of the usual elementary school science lessons involving nails, magnets and metal filings. Last year, he taught a course on color addition and subtraction, which turned out to be a pivotal science topic for Buddhist monks.

Because vision and color perception are right at the interface between the internal and external worlds, the monks were very interested to get to the heart of a scientific understanding of it.

The monks, Johnson said, took their science lesson about color to a higher level than most students. Maybe even to a spiritual one.

For additional information, go to:
http://www.scienceformonks.org

Contact Mary Garrigan at 394-8410 or mary.garrigan@rapidcityjournal.com

Amy Ellis is a 2004 graduate of CRMSE’s Mathematics and Science Education Doctoral (MSED) program. She is now an assistant professor at the University of Wisconsin-Madison.

Eric Knuth is a 1994 graduate of San Diego State University’s Master of Arts program in Mathematics. He earned his Ph.D. in 1999 from the University of Colorado-Boulder, and is now an associate professor at the University of Wisconsin-Madison.

Excerpts reprinted with permission of the editor of Campus Connection: For Alumni & Friends of the University of Wisconsin-Madison School of Education, The University of Wisconsin-Madison, Winter 2007, pp2-5

UW–Madison scholars maintain focus on effective teaching, learning

Demystifying Math

Many people still see mathematics as a difficult subject that only a select group of students with special abilities can master. Learning math, they believe, consists of memorizing facts and mastering the application of complicated concepts and procedures.

“That’s simply not true,” says Thomas Carpenter, who has plenty of research to justify his succinct rebuttal.

A pioneering cohort of education researchers at UW-Madison—led by Carpenter, Thomas Romberg, and Elizabeth Fennema, all emeriti professors in the Department of Curriculum and Instruction—have shown, for instance, that children of all abilities enter school with an informal base of mathematical knowledge that enables them to learn more substantive material than traditionally taught.

For more than 30 years, these researchers have put the learning of mathematics under the microscope in search of ways to improve teaching and student understanding. They’ve found, for instance, that math instruction can be strengthened by tapping into children’s informal knowledge, by teaching them to use the same practices as mathematicians, and by engaging them in real-world problem-solving instead of rote drills on abstract skills.

By making math more accessible to students of all ages and abilities, they hope that more people will recognize mathematics as they do—as a language for thought.

Having established a solid foundation, the trailblazing cohort led by Carpenter, Romberg, and Fennema in recent years has been passing the torch at UW-Madison to a new generation of scholars.
New faces, same focus

Effective mathematics instruction, explains Eric Knuth, involves three key components: understanding how children learn, preparing teachers who can tap into and build upon that knowledge, and having a curriculum that supports these efforts. Like the pioneers who preceded them, Knuth and his mathematics education colleagues are engaged in all three parts.

Like Carpenter and others, Knuth and Amy Ellis—who joined the faculty in 1999 and 2004, respectively—are interested in promoting the development of algebraic reasoning. Math researchers describe algebra—which introduces students to the use of symbolic representations as the gatekeeper between the concrete calculations of arithmetic and higher levels of mathematics.

“A lack of success in algebra means losing opportunities for advanced studies...”
—Eric Knuth

algebra. The seeds of algebraic reasoning need to be planted and nurtured in the elementary and middle school grades, they say.

“We want students to move beyond solving one problem,”
Ellis says.

In studies funded by the National Science Foundation (NSF), Knuth and Ellis are looking at the development of key practices used by mathematicians and scientists—generalization, modeling, and proof/justification—that are seldom emphasized by traditional instruction.

Algebra marks the first time that students are encouraged to generalize patterns, relations, and functions, says Ellis, adding “it’s fairly common for them to struggle with this.”

Ellis, whose work on generalization is funded by a three-year NSF Research on Learning and Education (RoLE) grant, describes generalization as “a sophisticated mathematical activity that involves extending the range of reasoning beyond one specific problem.”

She has found that the development of the abilities to make generalizations and to construct arguments to justify mathematical claims seem to go hand in hand. She also has seen that grounding abstract lessons in measurable situation enhances students’ abilities to generalize.

In a five-year, longitudinal study funded by an NSF Career grant, Knuth has been examining how middle school students acquire and develop third understanding of what constitutes evidence and justification and how such understandings can be refined and extended. Traditionally, students first encounter—and struggle with—justification and proofs in high school geometry.

Knuth and Ellis also have been working with Charles Kalish, professor of educational psychology, to study the relationships between student reasoning inside and outside of math. Understanding how children develop their reasoning abilities, especially those related to mathematics, can lead to instructional practices that support and foster their development.

Influencing practice

“The research has to impact more than just the academic community,” says Knuth.

He and his colleagues underscored the importance of working directly with classroom teachers and connecting their research to the preparation of new teachers. The bridge between research and classroom instruction includes curriculum development and effective teacher education and professional development.

“The kind of research we do has us engaged in the local schools,” explains Ellis. In addition to advancing the research, this benefits the school community and helps teachers address current needs.