

MATH MATTERS

CENTER FOR MATHEMATICS EDUCATION + COLLEGE OF EDUCATION



THIS YEAR education continues to be front-page news on a regular basis with many disruptive innovations in the air. The roll-out of the Common Core State Standards is a regular topic of conversation in schools; folks continue to wonder what the assessments will be like and whether they might even potentially derail the process. Meanwhile, districts are gearing up to assess classroom climate using the Standards for Mathematical Practice. When it comes to teacher education, universities and colleges of education are under continued pressure to compete with teacher residency programs and other teacher education providers. For practicing teachers, the state is considering whether masters' degrees should be required for Advanced Certificates and districts are reconsidering the role masters' degrees in the determination of salary increases.

CfME is engaging this time of turmoil and change. With funding from the Carnegie Corporation, as well as PGCPs funds, we have started new partnership mechanisms with Prince George's County Public Schools that will allow us to work on the implementation of the Common Core Standards, as well as to provide professional development to teachers. We call this project the Standards for Mathematical Practice Project (StaMPP). We continue to work with PGCPs on MSMaRT, our alternative certification program, as we seek funding to continue the program beyond the US Department of Education grant that initially funded it. To support both of these initiatives, we've joined the 100kin10.org network that seems to move forward the Obama administration's plan to support the increase of supply and retention of excellent mathematics and science teachers for the country. In addition, along with colleagues in the College of Computing, Mathematical, and Natural Sciences we are exploring the UTeach model for our undergraduate certification program.

And, we continue to work on and refine existing programs. The new undergraduate middle grades certification program will graduate its first cohort in 2014; we're working with colleagues in Engineering to recruit broadly across the campus. With Montgomery County Public Schools, we started our fourth cohort of a masters program focused on middle grades mathematics teaching. This fall we have the first cohort of practicing MCPS elementary school teachers studying for a Master's degree in STEM education created together with colleagues across the campus. As we move toward a new doctoral specialization in the Department of Teaching and Learning, Policy and Leadership, Senfeng Liang, Toya Jones Frank, and Emily Yanisko-Maloney graduated this past summer. We welcome Angela Stoltz and Diana Bowen who are joining us as new Fey-Graber fellows.

For nearly 50 years, the
**CENTER FOR
MATHEMATICS
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in the College of Education
has served as a scholarly
voice for excellence and
innovation in mathematics
education, while nurturing
the next generation of
mathematics educators
and researchers.

Professional Development Embracing the Common Core



Teachers learning about curricular resources and instructional strategies that promote student learning of number concepts.

STATES ARE MAKING SIGNIFICANT SHIFTS in their mathematical curriculum and instruction as a result of the adoption of the Common Core State Standards (CCSS). The CCSS calls for fewer mathematical concepts to be “covered” per year in order to promote “Coherence, Focus, and Rigor.” For example, number concepts will now play an even more significant role in the elementary years as CCSS aims to establish a solid foundation for algebraic reasoning in the middle grades. In order to assist teachers with this transition, the Center for Mathematics Education has integrated CCSS-related research, resources, and assessment materials into many of its Outreach courses for practicing teachers. In Prince

George’s County Public Schools, several cohorts of elementary and middle school teachers have participated in a sequence of graduate courses with the funding from two Improving Teacher Quality grants from Maryland Higher Education Commission. These courses are aimed at supporting their deep understanding of Number and Operations aligned with the expectations of CCSS.

Activities in these Outreach courses introduce teachers to extensive research on the teaching and learning of number concepts, as well as powerful instructional strategies for differentiating instruction for all students. Assignments require teachers to conduct one-on-one interviews with students to develop a comprehensive understanding of students’ mathematical reasoning in a specific content area. They then collaborate with colleagues to create subsequent lesson plans that are aligned with the expectations of CCSS and that consider appropriate adaptations for students with special needs. Ultimately, teachers conduct analyses of their own teaching in order to assess how much they have developed professionally and what they need to continue to develop. These assignments have proven powerful and rewarding for the participating teachers as they adapt to the changing landscape of their profession, while also learning valuable knowledge and skills to improve their mathematical instruction. In the coming year we will work closely with a few schools developing their capacity to improve the quality of their mathematics education.



Teachers collaborating to create innovative lesson plans aligned with the Common Core State Standards.

Faculty Focus by Hollie Young

Ann Ryu Edwards



Dr. Ann Edwards we will miss you! We would like to highlight the work of Dr. Edwards an assistant professor in the Department of Teaching and Learning, Policy and Leadership who had a focus on mathematics teacher learning and development and equity in mathematics education. She

collaborated with a group of graduate students, using care theory to examine the practices that three African American teachers enact as they work to support their predominantly African American students as learners and doers of mathematics. Using this framework of caring affords the opportunity to better understand teacher-student relationships en route to supporting students' experiences as math learners.

Dr. Edwards was also involved in the recent work being done in the College on high leverage teaching practices, or HLPs. With collaborators, Dr. Edwards is working to apply this framework to address the issue of bridging coursework and practice. Together they identified several HLPs to focus on in the elementary methods course and re-designed a capstone portfolio, the purpose of which is to (1) support the development of core competencies and (2) document teacher candidates' growth in the core practices.

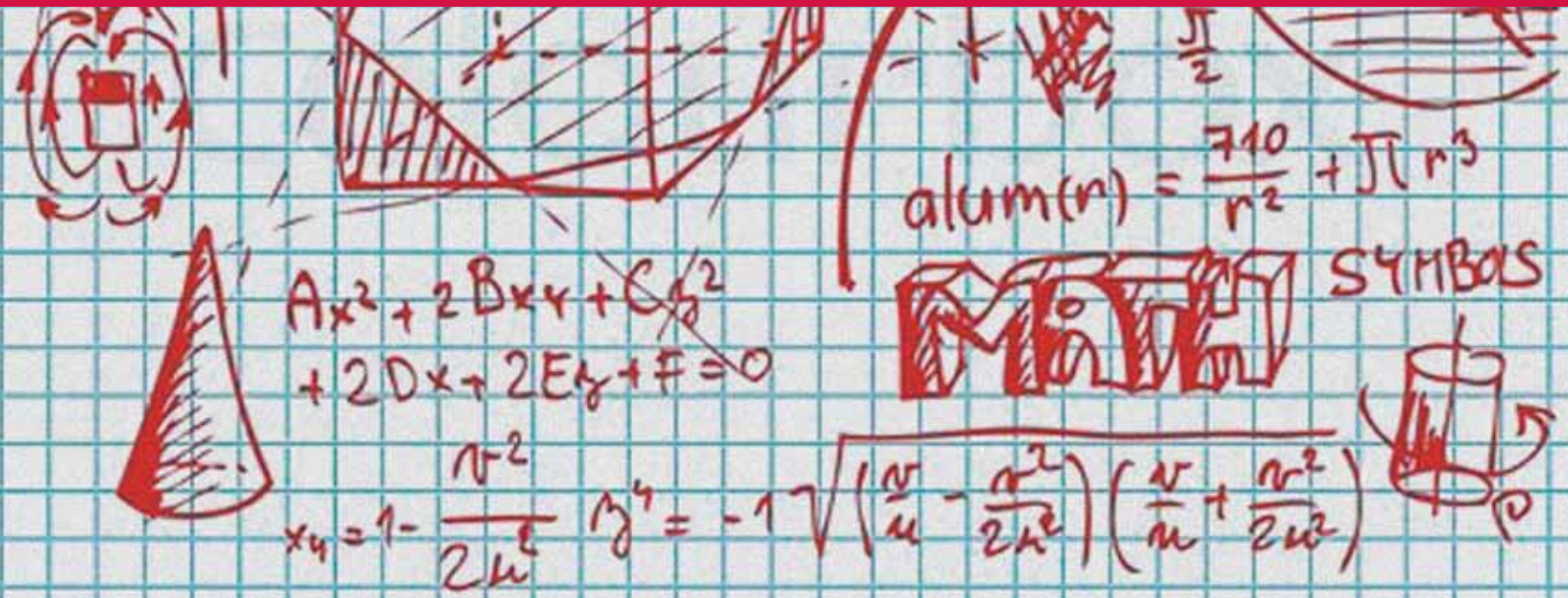
Dr. Edwards was also examining how the press for data-driven instruction impacts teachers' thinking about their teaching, and their students' learning of mathematics. In

addition, she was involved in ongoing work with colleagues from the Diversity in Mathematics Education (DiME) Center for Learning and Teaching investigating and promoting attention to issues of equity in the field of mathematics education.

In another project, Dr. Edwards was collaborating with an assistant professor in the iSchool, Dr. Mega Subramaniam, who conducts research on the use of school libraries. Together they carried out an exploratory study to examine the nature of professional collaborations between middle school math teachers and media specialists in the integration of technology into mathematics classrooms. While school librarians and school administration were very positive about the prospect of supporting the better use of technology in mathematics instruction, there were significant barriers to these collaborations and, therefore, none were occurring in the schools they visited. Together, Dr. Edwards and Dr. Subramaniam have submitted a grant proposal to fund a pilot professional development project to engage school administrators, librarians, and middle school math teachers in content based activities related to the Common Core standards on Ratios and Proportions for grades 6 and 7, and at the same time to explore an array of different technologies that can support mathematics learning of this content.

We have all enjoyed having the opportunity to work with Dr. Edwards and wish her luck at the Carnegie Foundation in California.

EDITORS NOTE: At time of printing, Dr. Edwards accepted a position at the Carnegie Foundation in California. We wish her and her family the best of luck in their new home.



For instance, the middle school CCSSM assumes that students will master almost all fraction concepts and skills in grades K-5 and be ready for introduction to ratio and proportion in grade six. Proportional thinking has always been the core of the CMP curriculum for grade seven, and we have long begun work on that theme from a geometric perspective with a unit called Stretching and Shrinking. Adjusting to the CCSSM scope and sequence has required introduction of ratio concepts in grade six number units of CMP3. But we have retained the connections between numeric and geometric settings for proportional reasoning in grade seven, because our experience has convinced us that this development is important mathematically and insightful for students.

The CCSSM take a very traditional approach to elementary algebra, not the approach via functions that has been prominent in both CMP and CPMP algebra strands. Nonetheless, we believe we have found a way to approach algebraic concepts like variables, expressions, and equations in a style that is compliant with CCSSM expectations and, at the same time, true to our belief that focusing on quantitative reasoning, functions, and graphs is an appealing and insightful way to develop those topics.

The CCSSM for middle school grades give only limited attention to geometry, statistics, and probability, and that national curriculum position has posed a significant challenge for the CMP authors. Reports from current and potential CMP customers have brought a consistent message that schools and teachers are focusing literally and exclusively on the content objectives that are explicit in the CCSSM. So we have struggled in negotiations with our publisher to retain material in geometry, statistics, and probability that our judgment suggests is still important. At the high school level, the prominent Core-Plus attention to topics in discrete mathematics is not supported by CCSSM. So, again, we have struggled to retain topics we judge to be timely and important, but not endorsed by the highly traditional national standards.

While much textbook author attention has focused on simply guaranteeing CCSSM compliance by covering topics when and how they are prescribed, the Common Core also calls for development of student skills and dispositions in mathematical practice. For both CMP and CPMP, this required focus on mathematical habits of mind is a welcome recognition of broad goals we have had since the beginning of each project. We have incorporated explicit attention to the CCSSM version of mathematical practices in latest editions of each curriculum, and now cross our fingers in hopes that the two assessment consortia find ways to effectively and efficiently measure student knowledge in that realm.

EXPLORING E-LEARNING OPPORTUNITIES

As if modifying scope, sequence, and presentation of curriculum materials were not enough of a challenge, the CCSSM-driven transformation of U. S. school mathematics comes at a time when students, teachers, and curriculum developers are struggling to figure out the best ways to use ubiquitous communication and information technology for teaching and learning. Thus working on revision of Connected Mathematics and Core-Plus Mathematics has also involved designing instructional materials that take advantage of electronic textbook formats. The learning curve is steep, but some very interesting e-book features are being developed and tested.

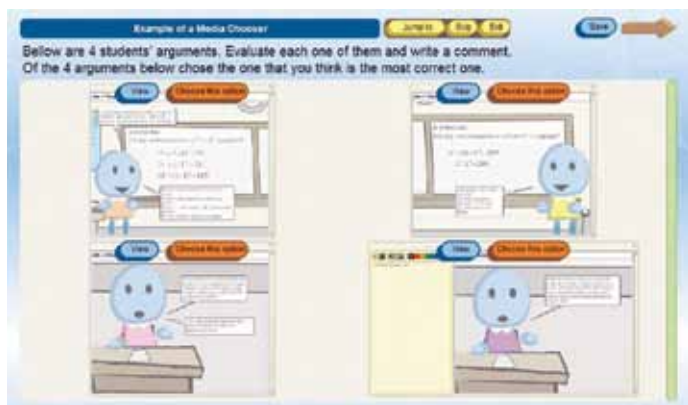
For example, the teacher resource materials for CMP3 will come only in the form of an electronic document that is structured like an interactive web site--accessible through any computer, iPad, or notebook device. Navigating with touch screen or mouse alone, teachers can view student text material and lesson objectives, alignment with CCSSM, hints for teaching, homework tasks and solutions, mathematical background essays, sample quizzes and tests, and short video clips and animations for launching students into lesson work. Each of those electronic resources can be annotated with teacher notes, and sharing of ideas in the community of CMP teachers is facilitated as well.

CMP teachers whose students are using the ACTIVE-book format of the text will have access to elaborated versions of the text that are produced when individual students add problem solutions and other notes as they work through the problem-based curriculum. Students can enhance their study of the problem material by using relevant simulations like an electronic chip model for integer operations, a dynamic demonstration of volume relationships for common solid figures, and algebra tiles. They can also make use of an electronic drawing utility, a coordinate graphing app, standard calculator functions, and a tool for inserting typed and hand-drawn notes in the e-text. While the current copyright up-date for the Core-Plus Mathematics Project will not result in a complete interactive electronic student text, CPMP authors have developed some sample units in that style—fully integrating a suite of powerful mathematical tools including a function grapher, a computer algebra system, a spreadsheet, data analysis software, and discrete mathematics tools for studying vertex-edge graphs.

Simultaneously adjusting to the CCSSM scope and sequence of mathematical topics and the new possibilities of electronic instructional resources is a daunting challenge. But, it is also an exciting opportunity. Fitting much loved ideas into the sometimes-awkward straightjacket of CCSSM constraints is often frustrating. But exploring the new possibilities of interactive electronic textbooks is a fascinating endeavor.

Working Towards a More Practice-Based Teacher Education

by Orly Buchbinder & Elizabeth Fleming



Choose among possible actions.

RECENT TECHNOLOGICAL DEVELOPMENTS have made it possible to represent classroom interactions in the ways that go beyond watching video recordings or reading written cases. LessonSketch.org is a free online rich-media environment created as a part of NSF-funded project administered jointly by the University of Maryland and the University of Michigan. LessonSketch allows teacher educators to create multimedia experiences around classroom scenarios realized with cartoon characters in the form animations and slideshows.

LessonSketch is built on the idea that representations of mathematics instruction – that is, depictions of interactions between a teacher, their students, and the content – can anchor discussions about teaching and learning and provide grounds for practice-based teacher development. In addition, LessonSketch has a variety of tools that allow teacher educators to create and share online experiences with their students. In these experiences, pre-service teachers can be asked to compare several possible teacher actions and rank-order them, to flag and comment on important moments in a classroom animation, to post their own thoughts and slideshows in discussion forums, among many other options.

This spring, Daniel Chazan, Orly Buchbinder and Alice Cook-Henke from ThEMaT (Thought Experiments in Mathematics Teaching) project ran four workshops to introduce LessonSketch and its resources to teacher educators in the University of Maryland community. The goal of these workshops was to foster awareness of what resources LessonSketch can provide for teacher education and professional development. In particular, each of the four sessions was focused on a particular set of High Leverage Practices, a framework of fundamental

teaching practices developed by University of Michigan researchers. In each session, the teacher educator participants went through a hands-on activity in LessonSketch, and then practiced creating activities for use with their own students in the future. The activities they experienced used materials that were created by teacher educators at the University of Maryland, such as Rick Hollenbeck, Orly Buchbinder and Dan Levin, as well as the colleagues at the University of Michigan: Wendy Rose-Aaron and Karl Kosko. These materials are already being used in classes with prospective teachers. For example, eliciting and interpreting individual students' thinking was one of the High Leverage Practices being focused on in that workshop session. The participants looked at science educator Dan Levin's slideshow in which a teacher and students discussed the evolution of the black pepper moth in England. The slideshow took the format of a "choose your own adventure," in that viewers could choose between different teacher actions and see how the students in the animation responded next.



Control users interact with video.

ThEMaT researchers plan to conduct more of these workshops, and will use feedback from these sessions to improve the workshops. Future workshops will continue to work with teacher educators in using LessonSketch as a tool to support pre- and in-service teachers as they learn about, develop, and rehearse High Leverage Practices. The Common Core State Standards call for increased rigor and more ambitious teaching practices, but do not specify how to achieve these goals. The combination of the framework of High Leverage Practices and the tools of LessonSketch aims to help translate these teaching goals of the CCSS into concrete actions and practices for pre- and in-service teachers.

MSMaRT Helped Launch the Drew Freeman STEM Academy



“Five, four, three, two, one...”

A group of Drew Freeman Middle School students leads the countdown to each rocket launch. The excitement of the students is contagious as each rocket shoots into the air.

These students are part of the Drew Freeman Summer STEM Academy and have learned and applied the fundamentals of Newton’s Third Law. The rockets, built by the students, were just one of the many hands-on engineering projects that the students worked on during the summer experience.

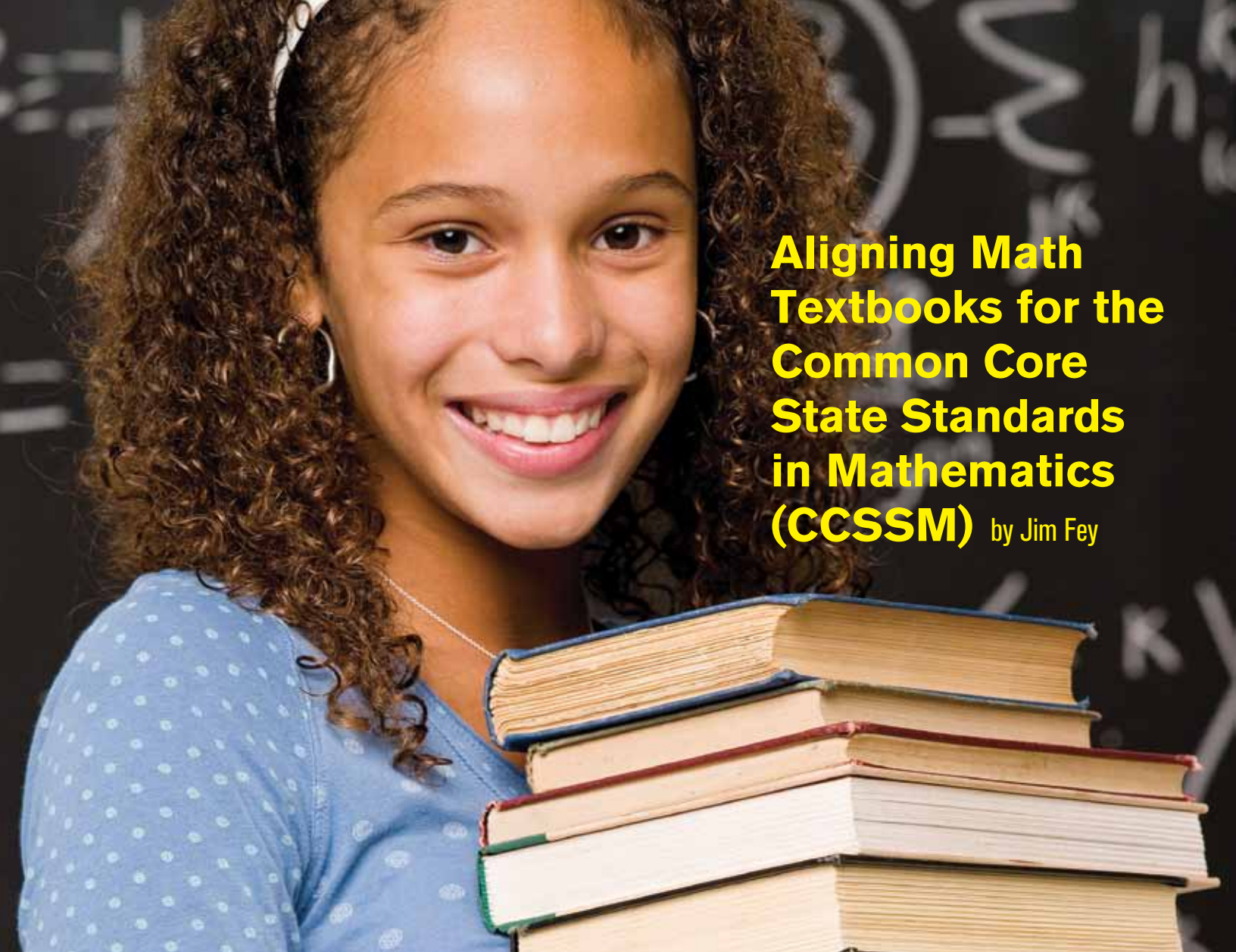
Drew Freeman Middle School in Prince George’s County, a recent turn-around school, created the STEM Academy with the assistance of the College’s Maryland Science and Math Resident Teacher Program (MSMaRT). MSMaRT serves high needs districts in Prince George’s County by recruiting career changers and recent college graduates who are committed to and have the potential to effectively teach middle grades mathematics and science to a diverse student body. The incoming cohort of MSMaRT students served as the teachers for the STEM Academy, providing them with an immediate hands-on experience of their own.

The STEM Academy was created to provide a vehicle for helping middle school-level students make connections between the four areas of STEM (science, technology engineering and

math) learning. The activities incorporated all three learning domains — cognitive, affective and psychomotor — to create an extension of the academic curriculum in which students can apply these subjects through engineering to create an integrated whole.

Learn more about the MSMaRT Program here:
<http://ter.ps/MSMART>





Aligning Math Textbooks for the Common Core State Standards in Mathematics (CCSSM) by Jim Fey

Schools in almost all states are busy adjusting grade-by-grade curricular expectations in mathematics to comply with the very explicit scope and sequence of objectives specified in the CCSSM. That work is proceeding with an eye on the assessments being developed by the Partnership for Assessment of Readiness for College and Careers (PARCC) and the Smarter Balanced Assessment Consortium (SBAC). Both of these forces are requiring that developers of both core and ancillary instructional materials revise their own resources for support of teaching and learning.

The task of designing instructional materials (especially textbooks) that are compatible with school curricula is not a new challenge in mathematics education. For many years the work of commercial publishing companies has been influenced strongly by the grade placement of various mathematical topics in large state and local school districts. But differences among expectations of the many state and local systems always allowed curriculum developers some flexibility in content and

presentation style. However, the highly prescriptive CCSSM and the differences between the new national curriculum and ‘traditional practice’ in U. S. schools have forced developers of instructional materials into significant changes of their preferred presentation of mathematics—especially in the elementary and middle school grades.

DEVELOPING CCSSM COMPLIANT INSTRUCTIONAL MATERIALS

For over 20 years, Maryland faculty, graduate students, and teachers have been active contributors to the Connected Mathematics (CMP) and Core-Plus Mathematics (CPMP) projects. So the challenge of adjusting to a new national mathematics curriculum has engaged us in major rewriting of the instructional materials from those projects. In many cases this has meant developing core ideas at new grade levels, in new mathematical progressions, and with new presentation styles.



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The MSMaRT Program: Improving Educational Outcomes in Middle School Math and Science by Brie Morettini



IN THE UNITED STATES TODAY, mastering mathematics and science has become more important than ever. Students with a strong foundation in math and science have an advantage in academics and in the job market. Middle school is a critical point in mathematics and science education. Achievement at this stage clears the way for students to take rigorous high school courses – keys to college entrance, success in the labor force and overall improved critical thinking skills. However, many middle school students lag so behind in the classes they take that getting on the road to college is difficult.

Faculty in the College of Education have mobilized to meet this need in several ways, one of which is the innovative Maryland

“I was looking for a program that would allow me to make the transition into the classroom easier and sooner than going the traditional route. I wanted to teach to give back . . . because teaching has shaped who we are, and I wouldn’t be who I am without teachers.”

– MSMaRT candidate

Science and Mathematics Resident Teacher (MSMaRT) program. Working in high needs schools in Prince George’s County, the MSMaRT program recruits individuals with a mathematics or science background who are looking to change careers and make a difference in public school classrooms. Our resident teachers have backgrounds in pharmacy, engineering, finance, and more.

The MSMaRT program continues to grow with each passing year. This year, we worked with PGCPs to prepare 12 teachers for middle school mathematics and science classrooms. Next year, we plan to prepare 25 math and science teachers who will make an impact on students in middle school classrooms. Currently the MSMaRT Program is recruiting individuals to be a part of our fourth cohort, and so far we are thrilled with the quality and quantity of people who want to become middle school math and science teachers.