

WISDOM^e: The QRaMM Research Theme

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Background

The Wyoming Institute for the Study and Development of Mathematics Education (WISDOM^e) is a virtual center with the purpose of stimulating and supporting collaborative research among global alliances of participating scholars in specified domains of study in mathematics education. The current research domains (and team acronyms) are:

- QRaMM: Quantitative Reasoning and Mathematical Modeling
- DIME: Developing Investigations of Mathematical Experience
- TTAME: Technology Tools and Applications in Mathematics Education

Each of the three research teams works independently within WISDOM^e to establish their own research focus and agenda. They also collaborate and work within the Institute vision. Each research team has co-leaders who coordinate the team's efforts to establish research goals, create opportunities to work collaboratively through virtual and face-to-face meetings, and establish means of disseminating the research team's work. The focus of this monograph is the QRaMM research theme, so we will describe the current state of the work being done by this team.

A short chronology of activities and developments in the QRaMM research theme provides a brief history of where we have been, setting the stage for where we are going:

- Fall 2010 – The inaugural WISDOM^e conference was organized and conducted at the University of Wyoming: Shader discussed computational science and data-intensive science as new paradigms for STEM that are intensively quantitative; Thompson's theoretical presentation analyzed the act of quantification as an essential starting point for QR.
- Spring 2011 – Mayes organized and led an online doctoral seminar at the University of Wyoming for "QRaMM in the Sciences:" Seventeen (17) scholars from eleven universities presented and led discussions virtually (their papers were subsequently published in the 2012 WISDOM^e Volume 2 monograph); a major focus was on the potential interdisciplinary nature of QR and the outcome of scientifically and quantitatively literate citizens who can make informed decisions about STEM grand challenges.
- Fall 2011 – A new Working Group on QR was proposed and approved to meet at PME-NA (Reno): Over 20 researchers attended and shared current work and identified possible research areas in QR, including professional development in QR, quantification as a keystone for QR research, and interdisciplinary aspects of using QR in STEM.
- Spring 2012 – A QR session was conducted at the NCTM Research Pre-session (Philadelphia): Led by Moore the focus was the role of quantitative reasoning in engendering coherent mathematical experiences for secondary mathematics students which place foundations for calculus reasoning.

- Summer 2012 – A STEM Research Symposium on QR in Mathematics and Science Education was organized and conducted in Savannah Georgia: Hosted by Georgia Southern University and the University of Wyoming, eleven experts representing each of the WISDOM^e research strands and learning progressions researchers focused on QR from their perspective; invited experts presented commissioned papers and led working groups with the 80-plus attendees. A list of attendees appears in Appendix A.
- Fall 2012 – The PME-NA (Kalamazoo) QRaMM Working Group met for a second year: Discussions were focused on the NSF-supported Pathways¹ project research into QR in environmental science; collaborative development of learning progression for QR and QR assessments for quantitative act, quantitative literacy, quantitative interpretation, and quantitative modeling occurred.

Highlights of Future Initiatives

We are pleased and excited by the growing involvements and commitments of the developing global community of scholars in mathematics education, science education, mathematics, and the sciences who have begun to collaborate around the QRaMM Research Theme. This thematic focus, which mirrors important ways that powerful technologies and computational methods are transforming all quantitative mathematical sciences, appears to be receiving an increasing attention within the broader goals for improving the mathematical and sciences education of all students. It will become increasingly important that a stronger, clearer knowledge base related to conceptualizing and reasoning with quantities and models serve as an informed basis for possible transformations of educational curricula and instructional practices at all levels. Working collaboratively toward that goal is a core purpose for the WISDOM^e QRaMM group.

Future activities of the QRaMM Research Theme include a third PME-NA (Chicago) Working Group in Fall 2013; those sessions will focus on collaborative development of QR assessment items. Research within the NSF-supported Pathways project will continue in the last stages of that work; a variety of publications from that are planned or pending. Additionally, we have submitted, and are planning, several proposals to NSF for funding future QR work, some of which are still pending. In June 2013 the third WISDOM^e co-sponsored conference, “Epistemic Algebra Students,” will be conducted with a strand focused on QR; the commissioned papers will be published as the Volume 4 monograph.

In keeping with the Institute goal of stimulating, fostering, and supporting new research, the articles in this monograph indicate areas and problems needing research and development, such as Duschl’s call for QR in a systems thinking and model-based approach to teaching science, Stohl Lee’s propositions concerning technology and QR, and Steffe’s grounded theories into QR elements of children’s constructions of quantification. As an open collaborative community, we welcome those with interests and commitments to explore new directions for needed scholarship related to quantitative reasoning and mathematical modeling. Please consider this monograph to be an invitation to join us!

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