AC 2012-5379: NEW TOOLS FOR RESEARCH: USING THE VIDEO MOSAIC COLLABORATIVE

Dr. Suzanna Schmeelk, Rutgers University

Suzanna Schmeelk is a Research Associate at the Robert B. Davis Institute for Learning at Rutgers University, where she completed an Ed.D. in mathematics education. Her research interests include representation research and evidence research of students' understanding of mathematical content.

Robert Sigley, Rutgers University

Robert Sigley is a researcher at the Robert B. Davis Institute for Learning at Rutgers University, as well as a Ph.D. student in mathematics education. His research interests include developing computer supported collaborative learning environments for mathematics education and the study of in-service teachers' beliefs and content knowledge and how it affects how they help their students' develop problem solving strategies.

New Tools for Research: Using the Video Mosaic Collaborative

Suzanna Schmeelk[1] and Robert Sigley[2]

Abstract – In this research paper, we present resources from a unique repository, the Video Mosaic Collaborative (VMC), developed by Rutgers Library in collaboration with the Robert B. Davis Institute for Learning at Rutgers University. The VMC (http://videomosaic.org/) is a resource that houses an extensive video collection made possible by National Science Foundation funding that provided longitudinal and cross-sectional studies of the development of mathematical ideas and ways of reasoning. The VMC resources and tools provide a user friendly, accessible website designed for use by teachers, teacher educators, students and researchers. It draws its content from research from the Robert B. Davis Institute for Learning (RBDIL). The VMC makes available videos, transcripts, student work and other metadata from the extensive video collection of students working on mathematical strands in rural, suburban, and urban settings. Collaborative tools such as the VMC Analytic, an online video editing and annotation tool [1], invite users to create analytics from videos hosted on the VMC for use in their classrooms. Educational interventions involving the VMC have showed significant change in-service teachers' recognition of students' reasoning as well as their beliefs about what children can learn and what teachers can do to support student learning [2][3] when used in professional development [4].

Keywords: Student Learning, Mathematics Education Research, Video Mosaic Collaborative, VMC.

INTRODUCTION

The Video Mosaic Collaborative (VMC) Repository has been built as a resource for teachers, educators and researchers. More recently, it has been a key resource to support pre-service teaching and professional development in New Jersey [2, 4]. Maher, Landis and Palius (2010) showed that the VMC was used to support mathematics middle-school teacher development in interventions that made user of a modified lesson-study model (Palius & Maher, 2010). The studies revealed changes in teachers' beliefs about student understanding and learning. A key component of the intervention is the studying of videos in the VMC Repository. Results from pre and post tests showed signification growth in teachers' recognition of student reasoning as well as in teachers' beliefs about what students can do and how they can create learning environments that facilitate student collaborative problem solving and growth in reasoning in supporting solutions to problems. The post-session data collected from course evaluations and material as well as analysis of data from online postings supported these findings (Sigley , Maher, Hmelo-Silver & Palius, 2012). These findings suggest that teachers found their participation both valuable and relevant. Currently, with the inclusion of the new VMC Analytic tool, the VMC can be used to tailor professional development for individual teacher, teacher educator, and student needs. They can now use the tool to create and examine their own personal research and interventions.

VIDEO MOSAIC COLLABORATIVE DESIGN

The Video Mosaic Collaborative (VMC) was designed to preserve the unique video collection of research, now in its 25th year by Maher and colleagues at the Robert B. Davis Institute for Learning (RBDIL) at Rutgers University. The video collection has been amassed from grant funding from private contributions as well as from the National Science Foundation. The videos stored in the repository show the reasoning of students from elementary through

[1] Rutgers University, New Brunswick, New Jersey, and sschm@rci.rutgers.edu

[2] Rutgers University, New Brunswick, New Jersey, and robert.sigley@gse.rutgers.edu

high-school. Repository users can remotely search for specific strands of problems to consistently examine student learning in detail. The repository can be used to facilitate teacher education and examine cross-national or cross-global populations of student learning.

RESULTS

The research presented is based on the view that the building of a solid understanding of the mathematics required for success in later courses such as discrete mathematics, probability and pre-calculus is fundamental to success in later mathematics studies within engineering education programs around the globe. For example, Stanford University and MIT openly published the mathematics covered in their engineering courses (Stanford University, 2012; Massachusetts Institute of Technology, 2012). The VMC collection illustrates student learning topics in pre-algebra, algebra, statistics, probability, geometry and calculus. NCTM (2000) also provides a national discrete mathematics standard for grades 9-12. They require a mathematics curriculum to include learning to represent problem situations using discrete structures. Additionally, NCTM (2000) provides a national counting, probability and problem solving in general. These fundamental requirements are essential for later durable college-level and industry engineering education.

The paper provides results from studies of teachers and graduate students who have made use of the VMC tools and resources to explore mathematical ideas and study student learning. Research assessment includes pre-test and post-test data that have been collected, coded and scored in preparation for analysis to identify changes from interventions making use of the VMC resources. The examined research question is with current data analysis in progress across multiple site interventions from several colleges and universities are there findings that are relevant to engineering education, in particular, growth in understanding of mathematics.

Research Study One: Teacher Education Models

The first examined research study is the work of Palius and Maher (2010). In their work they compared and contrasted two models for pre-service and in-service teacher education. In the pre-service teacher education the research developed content strands for the teachers to examine based on their grade level. Elementary-level teachers would study place value strands while secondary-level teachers would study combinatory strands. The teacher-students would first be given the tasks to develop and then examine VMC videos of K-12 students working on the same problem. In-service teacher education would be enhanced with professional development to implement the activities within their own classroom. The Palius and Maher research yielded rich teacher-belief changes throughout the lifetime of the teacher-education. For in-service teachers the research indicated that that there were changes in beliefs in how mathematics is learned and how teachers can influence student's learning. The research indicated that in-service teachers beliefs on how students learn was significantly shaped.

Research Study Two: Teachers Attending to Students' Reasoning

The second examined research study is the work of Maher, Landis and Palius (2010). Their research described an intervention model for the professional development of middle-school mathematics teachers. The year-long study indicated that teachers changed their views and beliefs on middle-school student learning. The intervention indicated that teachers a better prepared to promote and evaluate the mathematical reasoning of their own students. The intervention is developed around four objectives: (1) teachers doing mathematics, (2) teachers studying VMC videos of middle-school students doing mathematics, (3) teachers implementing the mathematics in their own personal classrooms and (4) teachers analyzing and discussing their student work. The first objective is initiated by a daylong workshop, or multiple shorter workshops, to immerse teachers in the process of becoming active participants in a learning community. The strands of problems given to teachers were used in research on student's reasoning (Maher, Powell, & Uptegrove, 2010) and designed to offer opportunities for viewers to make connections between strand problems to facilitate making generalizations. The second objective is initiated by teachers viewing VMC videos on the students working on the same strand problem. Before the actual viewing of the videos, teachers are expected to make predictions about student learning. The third objective is to have teachers implement the strands within their own classrooms followed by the fourth objective of having teachers share and analyze the students work with the professional development community. Prior to and after an intervention objective has been implemented, teachers are given pre-test and post-test belief assessments (see Maher, Landis and Palius, 2010) about student's learning and conditions for effective teaching. The scores are interpreted as 1 (strongly agree), 2 (agree), 3 (uncertain), 4 (disagree), and 5 (strongly disagree). The research found that changes in teacher beliefs about how

mathematics is learned and how teachers can influence student's learning may be prerequisites to making changes in instructional methods. Additionally, school administrators and parents need to understand the benefits to their own students (Mueller, Yankelewitz, & Maher, 2010) for them to help remove actual or perceived obstacles impeding teachers alternative mathematics learning approaches.

CONCLUSIONS

The results show that there are new teacher education models for promoting durable mathematical thinking within the K-12 environment. Students need to build a strong foundational understanding of mathematics throughout the K-12 grades in order to continue successful later study of mathematics required for mathematics-based reasoning in high school, college and beyond. New methods for (pre) engineering education can come with significant challenges as found in Maher (2005) including educating administrators and stakeholders. As such, the open VMC can be used as a powerful tool for educating teachers, administrators, parents and students themselves on the learning of mathematics as well as related science and engineering ideas.

REFERENCES

[1] Agnew, G., Mills, C. M., & Maher, C. A. (2010). VMC Analytic: Developing a collaborative video analysis tool for education faculty and practicing educators. In R. H. Sprague, Jr. (Ed.), Proceedings of the 43rd Annual Hawaii International Conference on System Sciences (HICCS-43): Abstracts and CD-ROM of Full Papers. IEEE Computer Society, Conference Publishing Services: Los Alamitos, CA.

[2] Maher, C. A. (2005). *Conditions for promoting reasoning on problem solving: Insights from a longitudinal study. Special Issue: Mathematical problem solving: What we know and where we are going* (Guest Editors: Cai, J, Mamona-Downs, J., & Weber, K.) The Journal of Mathematical Behavior, 24, 361-372.

[3] Maher, C. A., Landis, J. H. & Palius, M. F. (2010). Teachers attending to students' reasoning: Using videos as tools. Journal of Mathematics Education 3(2), 1-24.

[4] Maher, C. A., Palius, M. F. & Mueller, M. (2010). Challenging beliefs about children's mathematics learning through video study. In P. Brosnan, D. Erchick, and L. Flevares (Eds.), Proceedings of the 32nd annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (4), 885-992, Columbus, OH: The Ohio State University.

[5] Maher, C. A., Powell, A. B. & Uptegrove, E. (Eds.), (2010). *Combinatorics and reasoning: Representing, justifying and building isomorphisms.* New York: Springer Publishers.

[6] Massachusetts Institute of Technology. Mathematical Methods for Engineers II. Retrieved March 16, 2012, from http://ocw.mit.edu/courses/mathematics/18-086-mathematical-methods-for-engineers-ii-spring-2006/.

[7] Mueller, M., Yankelewitz, D., & Maher, C. (2010). Rules without reason: Overcoming students' obstacles in elarning. *The Montana Mathematics Enthusiast*, 17(1/2).

[8] Sigley, R., Maher, C. A., Hmelo-Silver, Cindy & Palius, Marjory. (2011). Are Their Arguments Convincing? In R. H. Sprague, Jr. (Ed.), Proceedings of the 44rd Annual Hawaii International Conference on System Sciences (HICCS-44): Abstracts and CD-ROM of Full Papers. IEEE Computer Society, Conference Publishing Services: Los Alamitos, CA.

[9] Stanford University. New Computational Mathematics Courses Offered for Freshman and Sophomores with Strong Interest in Engineering! Retrieved March 16, 2012, from http://engineeringmath.stanford.edu/.

[10] Palius, M. F. & Maher, C. A. (2011). Teacher education models for promoting mathematical thinking. In Ubuz, B. (Ed.), Proceedings of 35th Conference of the International Group for the Psychology of Mathematics Education 1, 321-328. Ankara, Turkey: PME.

Suzanna Schmeelk

Suzanna Schmeelk is a research associate at the Robert B. Davis Institute for Learning at Rutgers University where she completed an Ed.D. in mathematics education. Her research interests include representation research and evidence research of students' understanding of mathematical content.

Robert Sigley

Robert Sigley is a researcher at the Robert B. Davis Institute for Learning at Rutgers University as well as a Ph.D. student in mathematics education. His research interests include developing computer supported collaborative learning environments for mathematics education and the study of in-service teachers' beliefs and content knowledge and how it affects how they help their students' develop problem solving strategies.