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Integrating Science and Mathematics Education Research into Teaching: A Conference for Students, Teachers and University Faculty in Science, Mathematics, and Related Fields

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Final Report for Period: 01/2007 - 12/2007

Submitted on: 04/03/2008

Principal Investigator: McKay, Susan R.

Award ID: 0541862

Organization: University of Maine

Title:

Integrating Science and Mathematics Education Research into Teaching: A Conference for Students, Teachers and University Faculty in Science, Mathematics, and Related Fields

Project Participants

Senior Personnel

Name: McKay, Susan

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. McKay is a professor of physics and founding Director of the Center for Science and Mathematics Research at the University of Maine. She also provided leadership to establish the Master of Science in Teaching Program and serves as its graduate coordinator. Dr. McKay's research interests include: condensed matter theory, phase transitions and critical phenomena, systems with quenched disorder, spin glasses, random-field ferromagnets, complex fluids, non-linear systems, and chaos. She managed and supervised all aspects of planning, implementing, and evaluating the project from its inception and continues to direct all project follow-up activities.

Name: Amar, Francois

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Amar is an associate professor of chemistry at the University of Maine. He worked collaboratively to introduce Peer Led Team Learning into general chemistry and is co-director of the department's InterChemNet Project, which uses a web-based laboratory course management system with support for advanced instrumentation and integrated assessment. Dr. Amar has worked with secondary teachers to adapt InterChemNet for high school and middle school and serves as research advisor to graduate students in chemical education research. He served on the Conference Planning Committee and the Course Advisory Committee and was instrumental in recruiting chemistry education presenters and facilitating all aspects of planning and implementing the project. Dr. Amar was a course co-instructor for the Summer Academy Workshop entitled, 'UV-Spectroscopy: Compounds, Colors and Concentration'.

Name: Wittmann, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Wittmann is an assistant professor of physics and co-operating assistant professor of education at the University of Maine. He co-directs the Physics Education Research Laboratory, teaches courses in the MST Program, and advises graduate and undergraduate student theses in physics education research. Professor Wittmann and his collaborators have developed research-based curricula to teach concepts of quantum mechanics to students without physics backgrounds. He served on the Conference Planning Committee and the Course Advisory Committee and was instrumental in recruiting presenters in the physics education field and all aspects of planning and implementing the project. Dr. Wittmann was the course coordinator and course co-instructor for two Summer Academy physics workshops entitled, 'Using Computer Tools to Diagnose Student Reasoning' and 'Using Data Acquisition Tools to Enhance Learning in Secondary Physical Science'.

Name: Maurais, Owen

Worked for more than 160 Hours: Yes

Contribution to Project:

Mr Maurais worked 31 years in public education as a teacher, special education director, assistant superintendent and superintendent of schools. He is the executive director of the Penobscot River Educational Partnership, an action-centered collaborative effort of local schools, the University of Maine and state Child Development Services that works to enhance the learning of PreK-12 students by continually improving teaching and the educational experience. Mr. Maurais served as a link between this community and those planning, implementing, evaluating and following-up on the project.

Name: Pandiscio, Eric

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Pandiscio is an associate professor of mathematics education in the College of Education and Human Development at the University of Maine. He specializes in the teaching and learning of mathematics, especially mathematics teacher preparation and teaches and advises research students in the MST program. His research interests focus on how students learn geometry and he collaborates with University faculty and classroom educators within the Penobscot River Educational Partnership professional development network. Dr. Pandiscio served on the Conference Planning Committee and was instrumental in recruiting mathematics education presenters and facilitating all aspects of planning and implementing the project.

Name: Bruce, Mitchell

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Bruce is an associate professor of chemistry at the University of Maine. He worked collaboratively to introduce Peer Led Team Learning into general chemistry and is co-director of the department's InterChemNet Project, which uses a web-based laboratory course management system with support for advanced instrumentation and integrated assessment. Dr. Bruce has worked with secondary teachers to adapt InterChemNet for high school and middle school and serves as research advisor to graduate students in chemical education research. He served on the Conference Planning Committee and the Course Advisory Committee and was instrumental in recruiting chemistry education presenters and facilitating all aspects of planning and implementing the project. Dr. Bruce was a course co-instructor for the Summer Academy Workshop entitled, 'UV-Spectroscopy: Compounds, Colors and Concentration'.

Name: Donovan, John

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Donovan holds a joint appointment as an assistant professor in the Department of Mathematics and Statistics and the College of Education and Human Development at the University of Maine. He teaches and serves as research advisor to Center MST students. Dr. Donovan conducts collaborative research with Center faculty regarding the promotion of meaningful connections between physics and mathematics teaching and learning.

Name: Franzosa, Robert

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Franzosa is a professor of mathematics at the University of Maine. He earned the 2003 University of Maine Presidential Outstanding Teaching Award and was one of the principal investigators for the NSF CETP Maine Mathematics and Science Teaching Excellence Collaborative. His work includes research in the areas of dynamical systems and applied topology, applied mathematical consulting, and the development of general education mathematics courses that incorporate inquiry-based strategies. His education outreach efforts include directing or co-directing collaborative networks and summer academies that introduce teachers to new practices and curriculum materials for teaching mathematics. He served on the Conference Planning Committee and the Course Advisory Committee and was instrumental in recruiting mathematics education presenters and facilitating all aspects of planning and implementing the project. Dr. Franzosa was course coordinator for all three Summer Academy mathematics workshops and course co-instructor for two of these. The workshops were: 'Real-Time Data Collection Software Use in Algebra, Pre-Calculus and Calculus', 'Learning Mathematics With Excel' and 'Geometer's Sketchpad for Standards-Based Middle School Mathematics'.

Name: Gellen, Amie

Worked for more than 160 Hours: Yes

Contribution to Project:

Ms. Gellen was a practicing civil engineer before earning a Master's Degree in Mathematics Education. She has been involved in Maine Mathematics and Science Teaching Excellence Collaborative as a Lecturer in Mathematics, with expertise in teaching mathematics to elementary school teachers and in using classroom observation protocols. She is currently Center Assistant Director and part of the assessment team for the Center's Howard Hughes Medical Institute project, which provides biomedical research experiences at the Jackson Laboratory and related curriculum development work for MST students. Ms. Gellen served on the Conference Planning Committee and was instrumental in recruiting mathematics education presenters and planning and

implementing the project.

Name: Kaback, Stephen

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Kaback has been a middle school mathematics teacher, a high school physics teacher, and a physics lecturer at the University of Maine. He was the conference director of the 2002 Center conference and is a frequent visiting scholar at the Center. Mr. Kaback's expertise is in physics education research and he served on the Conference Planning Committee and was instrumental in recruiting physics education presenters and planning the project.

Name: Murphy, Michael

Worked for more than 160 Hours: Yes

Contribution to Project:

Mr. Murphy served as Conference Director and administered all aspects of planning, implementing, and evaluating the project. He has an undergraduate degree in mathematics and is a graduate of the MST program in mathematics education. He has a strong physical sciences background and has worked for almost a decade in software development and database creation and maintenance. He has taught both science and mathematics in teaching assistant positions and brings to this position a fluency with technology and knowledge of discipline-based research in both mathematics and physical science. Mr. Murphy is currently a technology educator at John Bapst Memorial High School in Bangor, Maine.

Name: Norton, Stephen

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Norton is a professor of Earth sciences and a member of the Climate Change Institute at the University of Maine. He served as the director of the University's recent K-12 Teaching Task Force and is a teacher and advisor in the MST program. Dr. Norton's research interests include paleolimnological analysis of lake and bog sediments for their contained information about acidic deposition (including metals) and its direct and indirect impacts on lakes and ombrogenic bogs, chemical manipulations of ecosystems or ecosystem components, and assessment of the impact of land surface pollution such as road salt. He served on the Conference Planning Committee and was instrumental in recruiting presenters in Earth science and facilitating all aspects of planning and implementing the project.

Name: Schauffler, Molly

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Schauffler is an assistant professor in the Department of Earth sciences, an experienced physical and life sciences teacher, and a member of the Climate Change Institute at the University of Maine. She held an NSF postdoctoral fellowship, which supported her development of a course for teachers on community-based research projects. She teaches this course and a course in research-based curriculum development for the MST program and works extensively with K-12 teachers to help them incorporate cross-disciplinary environmental monitoring projects into their science curricula. Dr. Schauffler served on the Conference Planning Committee and the Course Advisory Committee and was instrumental in recruiting Earth science and life science education presenters and facilitating all aspects of planning and implementing the project. She was also course coordinator and course co-instructor for the Summer Academy Workshop entitled, 'Data Data Everywhere... Classroom Resources for Using Online Data to Answer Questions about Environmental Change'

Name: Shockey, Tod

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Shockey is an assistant professor of mathematics and co-operating assistant professor of education and a Center faculty member at the University of Maine. His research specialty is ethnomathematics, particularly the interplay between mathematics and culture in Native American populations. Dr. Shockey teaches MST courses and advises theses in the program. He served on the Conference Planning Committee and was instrumental in recruiting presenters in the ethnomathematics field whose work involves research on the teaching and learning of science and mathematics among Native Americans.

Name: Thompson, John

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Thompson is an assistant professor of physics and co-operating assistant professor of education at the University of Maine. He facilitates the University High School Physics Teachers Collaborative and has organized the annual Maine High School Physics Teachers Meeting. Dr. Thompson co-directs the Physics Education Research Laboratory, teaches courses in the MST Program, and advises graduate and undergraduate student theses in physics education research. He also teaches Physics By Inquiry, a course for pre-service teachers. Dr. Thompson served on the Conference Planning Committee and was instrumental in recruiting presenters in the physics education field and all aspects of planning and implementing the project.

Name: Kraus, Pamela

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Kraus was a course instructor for the Summer Academy physics workshop entitled, Using Computer Tools to Diagnose Student Reasoning. This course made use of computer-based diagnostic instructional tools for middle and high school teachers and students. She is a research scientist at FACET Innovations (FI) where she is currently working on the Diagnoser Tools and related professional development research projects. She is a former middle and high school science teacher who works closely with classroom teachers as they implement these diagnostic tools in their schools and districts. FI is an educational research and development company dedicated to the improvement of learning and teaching in K-20 science.
<http://www.facetinnovations.com/daisy-public-website/daisy/fihome/12.html>

Name: Owen, Beth

Worked for more than 160 Hours: No

Contribution to Project:

Ms Owen was a course co-instructor for the Summer Academy Workshop entitled, 'Data Data Everywhere... Classroom Resources for Using Online Data to Answer Questions about Environmental Change' She coordinates all education activities for the Maine Sea Grant College Program, and she is the liaison to educational organizations around the state, region, and nation. The Maine Sea Grant is associated with the University of Maine and plays a leadership role in marine science and education and promotes sustainable development, management, and stewardship of marine and coastal resources.
<http://www.seagrants.umaine.edu/index.htm>

Name: Rawson, Paul

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Rawson was a course co-instructor for the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'. He is an associate professor in the School of Marine Sciences at the University of Maine. His research and teaching interests focus on the ecological genetics of marine invertebrates, with an emphasis on shellfish. Current research in his lab investigates the forces which shape the evolution of physiological traits in a variety of marine invertebrates using a combination of population genetic, phylogenetic, quantitative genetic, and molecular genetic methodologies and physiological assays.

Name: Greenberg, Neil

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Greenberg is a PhD candidate and an assistant scientist and facility manager with the University of Maine School of Marine Sciences Aquaculture Research Center. He was a course co-instructor for the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'.

Name: Pietrak, Mike

Worked for more than 160 Hours: No

Contribution to Project:

Mr Pietrak was a course co-instructor for the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'. He holds a Masters of Science from the University of Maine in marine biology and is Project Manager for the Maine Aquaculture Association where he works in support of the Maine aquaculture industry. Mr. Pietrak is currently involved in developing solutions to minimize the risk of aquaculture escapes, finding alternative and sustainable methods of reducing the nutrients in hatchery effluent and public education. <http://www.maineaquaculture.com/html/welcome.html>

Name: Geiger, Jon

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Geiger is Director of Educational Programs at The Jackson Laboratory in Bar Harbor, Maine where he oversees all residential and outreach educational programs. Dr. Geiger collaborates with the Center on a number of educational programs including the Master of Science Teaching Jackson Laboratory research semester internship and Teacher-In-Residence research internship programs. He served on the Conference Planning Committee and was instrumental in recruiting presenters and planning and implementing the project. Dr. Geiger also facilitated the Open Space forum at the conference <http://www.jax.org/>.

Name: Kass, Len

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Kass is an associate professor of biological sciences at the University of Maine and a member of the Center Advisory Board. His research specialties are neurophysiology of sensory and motor systems; biological rhythms; cellular neurobiology of vision; and gene expression in frog oocytes. He served on the Conference Planning Committee and was instrumental in recruiting presenters in the biological sciences and planning and implementing the project.

Name: Kirk, Robert

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Kirk was a co-instructor for the Summer Academy Workshop entitled, 'UV-Spectroscopy: Compounds, Colors and Concentration'. He is a teaching associate in chemistry at the University of Maine and has worked collaboratively on the department's InterChemNet Project, which uses a web-based laboratory course management system with support for advanced instrumentation and integrated assessment.

Post-doc

Graduate Student

Name: Steinman, Medea

Worked for more than 160 Hours: Yes

Contribution to Project:

Ms. Steinman is a student in the MST Program with a life sciences focus. Her research involves using online data to teach science to middle school students. She worked collaboratively with other MST students and Summer Academy course instructors to establish the environmental data web pages for the project website and is the lead person currently in charge of creating, developing and launching the entire website that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Ms. Steinman also assisted with the development and implementation of the Summer Academy Workshop entitled, 'Data Data Everywhere... Classroom Resources for Using Online Data to Answer Questions about Environmental Change'

Name: Knight, Kathleen

Worked for more than 160 Hours: No

Contribution to Project:

Ms. Knight was a student in the MST Program with a mathematics focus. Her research involved the study of pre-service teachers understanding of geometry. She worked collaboratively with other MST students and Summer Academy course instructors to establish the geometry web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Ms. Knight is currently teaching mathematics at Sumner Memorial High School in Sullivan, Maine. She assisted with the development and implementation of the mathematics workshop entitled, 'Geometer's Sketchpad for Standards-Based Middle School Mathematics'.

Name: Haynes, Briana

Worked for more than 160 Hours: Yes

Contribution to Project:

Ms. Haynes is a student in the MST Program with a mathematics focus. Her research involves observing how college professors teach the concept of functions. She worked collaboratively with other MST students and Summer Academy course instructors to establish the environmental data web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Ms. Haynes is currently teaching mathematics at Mountain Valley High School in Mexico, Maine. She assisted with the development and implementation of the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'.

Name: Martin, Danielle

Worked for more than 160 Hours: Yes

Contribution to Project:

Ms. Martin was a student in the MST Program with an earth sciences focus. Her research involves teaching students basic concepts about the watershed and water cycle. She worked collaboratively with other MST students and Summer Academy course instructors to establish the chemistry web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Ms. Martin is currently teaching mathematics at Penobscot Valley High School in Howland, Maine. She assisted with the development and implementation of the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'.

Name: McIntyre, Zachary

Worked for more than 160 Hours: No

Contribution to Project:

Mr. McIntyre a student in the MST Program with a mathematics focus. His research involves college algebra students' knowledge of variables. He worked collaboratively with other MST students and Summer Academy course instructors to establish the Excel workshop and math homepage web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. He assisted with the development and implementation of the mathematics workshops entitled, 'Real-Time Data Collection Software Use in Algebra, Pre-Calculus and Calculus' and 'Learning Mathematics With Excel'.

Name: Reed, Daniel

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Reed is a student in the MST Program with a physics education focus. His research involves contextual mathematics within technical physics. He worked collaboratively with other MST students and Summer Academy course instructors to establish the physics web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Mr. Reed assisted with the development and implementation of two Summer Academy physics workshops entitled, 'Using Computer Tools to Diagnose Student Reasoning' and 'Using Data Acquisition Tools to Enhance Learning in Secondary Physical Science'.

Name: Smith, Trevor

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Smith is a student in the MST Program with a physics education focus. His research involves superimposing physics education research-based teaching methods. He worked collaboratively with other MST students and Summer Academy course instructors to establish the academy homepage and aquaculture web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy and has provided on-going support for development of the website as a whole. Mr. Smith assisted with the development and implementation of two Summer Academy physics workshops entitled, 'Using Computer Tools to Diagnose Student Reasoning' and 'Using Data Acquisition Tools to Enhance Learning in Secondary Physical Science' and the Summer Academy Workshop entitled, 'Aquaculture: Domestication of Aquatic Organisms'.

Name: Zukowski, Adam

Worked for more than 160 Hours: No

Contribution to Project:

Mr. Zukowski is a student in the MST Program with a mathematics focus. His research involves attitude changes and learning at

Upward Bound in the field of mathematics and statistics. He worked collaboratively with other MST students and Summer Academy course instructors to establish the mathematics web pages for the project website currently in development that will provide teachers with ongoing access to the technological resources and tools that were presented during the Summer Academy. Mr. Zukowski is currently teaching mathematics at Gray-New Gloucester High School in Gray, Maine.

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Jackson Laboratory

The Jackson Laboratory partnered with the Center for Science and Mathematics Education Research (the Center) to support the conference, through subawards to the Center from the Balfour Foundation and the Howard Hughes Medical Institute. Also, Dr. Jon Geiger, Director of Educational Programs and Affiliated Scientist at the Jackson Laboratory, assisted with conference planning and served as the facilitator for the Open Space section of the conference program.

<http://www.jax.org/>

Howard Hughes Medical Institute

The Howard Hughes Medical Institute supports a collaborative program between the University of Maine's Center for Science and Mathematics Education Research and the Jackson Laboratory, Biomedical Research Experiences for Teachers and Students. Part of this program includes the development of curriculum materials that are aligned with state and national science standards and include current research and the scientific concepts and skills related to them. Master of Science in Teaching students spend a semester at Jackson Laboratory, conducting research with one of the research groups there and taking a course on inquiry-based teaching and learning. The grant includes some funds to support conferences in order to disseminate the curriculum materials and generally improve science and mathematics education.

<http://www.hhmi.org/>

Bank of America Company

Bank of America Company is the trustee of the Lloyd G. Balfour Foundation, which is a co-supporter of the Master of Science in Teaching students participating in the program described under Howard Hughes Medical Institute, Biomedical Research Experiences for Teachers and Students, including workshops for teachers to improve science and mathematics teaching. Funds from the Balfour Foundation helped to support this conference.

Other Collaborators or Contacts

Maine Learning Technology Initiative (MLTI) Ms. Bette Manchester, Director of Special Programs and Distinguished Educator, and members of her staff at MLTI identified a need for content-specific professional development for science and mathematics teachers to help them use technology more effectively in their classrooms. They suggested that the Center for Science and Mathematics Education Research develop programs for science and mathematics teachers to support their use of technology in general, and the laptop computers available in Maine to all middle school students, as part of the science and mathematics curriculum. The Summer Academy funded through this project and some of the workshops and invited presentations were designed to provide this type of professional development.

<http://www.mainelearns.org/>

Future Teachers Academy (FTA) - This summer academy for talented secondary students considering teaching careers in mathematics and science is run by the University of Maine Office of Multicultural Programs and directed by O.J. Logue, Associate Dean for Academic Services in the College of Education and Human Development. Participants come primarily from the Riverdale-Kingsbridge Academy in the Bronx, NY and from Maine high schools, and the FTA includes a high proportion of students from groups underrepresented in STEM fields. The FTA

collaborated with the Center by having its participants take part in the afternoon workshops during the conference. These students learned about research-supported teaching practices and contributed to the diversity of perspectives brought to the conference.

<http://www.umaine.edu/multicultural/fta/asp>

Paul Rawson û Dr. Rawson, associate professor in the University of Maine School of Marine Sciences, holds an NSF Career Award (NSF-IBN 0133349, 'Career: Physiological Genetics of the Dwarf Surf Clam') in which he had included a workshop for science teachers. He collaborated with us to make his workshop part of our Summer Academy and hired two Master of Science in Teaching (MST) students to assist with its development and implementation. MST students have also worked with him to develop a website as follow-up to this workshop, and he is planning additional follow-up through the Summer Academy website and with the workshop participants for Summer, 2008.

<http://www.marine.maine.edu/~rawsonp/rawsonlab/home.htm>

Penobscot River Educational Partnership

<http://www.preppdn.org/>

This school/university collaboration serving the Penobscot River Valley is an action-centered collaborative effort of local schools, the University of Maine and state Child Development Services that works to enhance the learning of PreK-12 students by continually improving teaching and the educational experience. Their executive director, Mr. Owen Maurais, assisted with the publicity for the conference and encouraged teachers within the partnership to attend. He also assisted with program development, to ensure that it would be useful to teachers. They also invited Dr. Susan McKay to meet with their curriculum coordinators to discuss ways to make the conference match teacher needs and to help publicize the conference and summer academy.

Schoodic Education and Research Center û Two of the Summer Academy courses used the Schoodic Education and Research Center (SERC) facilities, and their staff arranged for a common after-dinner speaker from the Regional Air Quality Consortium, another group that was meeting at SERC at the same time. Participants from the two groups sharing the facilities also had a chance to interact informally at meals, which enriched the Summer Academy experience for our groups.

<http://www.nps.gov/archive/acad/rm/sercinfo.htm>

University of Maine Conferences and Institutes Division û Ms. Marlene Charon collaborated with the conference organizers to arrange for meals, facilities, directional signs, equipment for presentations, and all other logistics to make the conference run smoothly. She was assisted by Ms. Leisa Preble, secretary for the Center for Science and Mathematics Education Research, and Ms. Patricia Byard, administrative assistant, who handled registration and other arrangements for participants.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:

The conference and summer academy planning teams, which included both secondary and post-secondary STEM educators, learned about the breadth of research being done into student learning in their disciplines as they worked to select invited speakers and contributed talks. The team of Master of Science in Teaching (MST) students, teachers, and faculty who prepared and implemented the Summer Academy short courses learned about research-supported materials and developed skills and experience in conducting teacher professional development and in reviewing and selecting materials to teach particular concepts. The follow-up team of MST students developed research and web-site development skills in the process of building the web-site as follow-up to the Summer Academy.

Outreach Activities:

This project's conference and summer academy reached 98 in-service and pre-service teachers, providing them with the opportunity to have hands-on experiences with emerging research-based curricula that help students learn content in a more meaningful way. These events also support the development of networks of teachers and faculty working together to improve student learning in science and mathematics. Local coverage of the conference in the Bangor Daily News focused particularly on the presentation by Dr. Stephanie Blaisdell, a consultant in the area of diversity in STEM fields, who spoke about 'Smart girls, too few choices: Why young women still steer away from science and math

careers and what teachers can do about it' and conducted a workshop on gender equity in the science and math classroom, thus increasing readership's awareness of the need for a more diverse group of participants in STEM fields. The conference web-site provides tested materials to bring more relevant content into science and mathematics classrooms, including, for example, on-line data bases that can be used to answer authentic scientific questions posed by students. These materials support middle and secondary student experiences in the process of science.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

<http://www.umaine.edu/center/Academy2006.html>

Description:

This site was created as a follow-up to the short courses offered in the Summer Academy supported by this award. It provides materials from the short courses and related resources. There is also a way for practitioners to share their experiences in using these materials.

Other Specific Products

Product Type:

Set of professional development workshops

Product Description:

The short courses developed for the Summer Academy provide a set of content-rich professional development for science and mathematics teachers who would like to use technology more effectively in their classrooms and laboratories. Some of these courses have already been offered in other places by the academy presenters, and more are planned in the future. (See Activities section)

Sharing Information:

The website for the Summer Academy provides the short-course materials and descriptions, as well as input from peers, for teachers who are planning to implement these items in their classroom.

Contributions

Contributions within Discipline:

The conference and summer academy supported by this grant have brought together middle and secondary school teachers, post-secondary science and mathematics educators and researchers into student learning in science and mathematics, and others involved in improving science and mathematics education. The interdisciplinary emphasis of this conference and its breadth of grade levels represented have led to new collaborations extending beyond the conference, as described above. The short courses developed for the Summer Academy have been requested at other venues and met a need for specific ways for teachers to use technology in their classrooms to teach science and mathematics. The Open Space session was particularly effective in getting groups to talk about productive ways to continue and implement the ideas of the conference. In particular, the Center for Science and Mathematics Education Research has moved toward developing an infrastructure to bring STEM researchers, STEM education researchers, and teachers together to develop research-supported curriculum materials and coordinated professional development for teachers. In response to Open Space discussions, the Center has successfully pursued funding to continue the Maine High School Physics Teachers Collaborative and the Mathematics Cross Tier Teaching Teams.

Contributions to Other Disciplines:

The conference and summer academy initiated collaborations between Center for Science and Mathematics Education Research faculty and other science and engineering faculty. These collaborations will improve the pedagogical and scientific value of curricula, workshops, and other outreach projects initiated by faculty from either group. Examples of new collaborations include those with the School of Marine Sciences, the School of Integrative Biology and Ecology, and the Department of Electrical and Computer Engineering. Professor Paul Rawson of the School of Marine Sciences, assisted by the Center's Master of Science in Teaching (MST) students, developed a short course for the Summer Academy on Domestication of Aquatic Organisms. Subsequently, Professor Sara Lindsay, also of the School of Marine Sciences, agreed to advise an MST thesis project to assess student learning and develop data-guided modifications in a series of undergraduate

inquiry-based marine sciences courses that the School is developing. The School of Integrative Biology and Ecology, which had several faculty participate in the conference and its planning, has decided to begin offering guided inquiry laboratories and assessing learning outcomes in introductory biology. An MST student is going to do her thesis on the pilot implementation of these laboratories. Finally, the conference increased awareness of the research capability of the Center and the MST program, and two faculty in the Department of Electrical and Computer Engineering have built involvement of Center faculty (Professor Molly Schaffler) and an MST student as part of a project to involve middle school students in computational research and state-of-the-art data visualization.

Contributions to Human Resource Development:

The conference and summer academy provided content-focused, research-supported professional development for 88 in-service and pre-service science and mathematics teachers and 62 post-secondary faculty and graduate students. These events also provided the opportunity for those involved in STEM education research to hear about recent research findings and discuss their work with other researchers in the field. A team of nine Master of Science in Teaching (MST) students were involved in preparing summer academy materials and building the website as a place for teachers find these materials, provide information about their experiences in using them, and explore related links. In building this website, the MST students researched available materials, learned about building and testing a website, and located and reviewed related research on student learning. These skills are an important part of the education of these future STEM educators. Participants in the Future Teachers Academy, run by the UMaine Office of Multicultural Programs and directed by O.J. Logue, Associate Dean for Academic Services in the College of Education and Human Development, took part in the conference workshops. This group is a combination of secondary students from Maine and from the Bronx who show interest in becoming teachers. The conference offerings were considered to be such a valuable piece of this academy that we have decided to make this collaboration a regular part of the Center's biennial conferences.

Contributions to Resources for Research and Education:

These contributions have all been discussed above: the conference and summer academy, the academy follow-up website for the teaching community, the ongoing High School Physics Teachers' Collaborative and Mathematics Cross Tier Teaching Teams, the collaboration with the Future Teachers Academy, and the Future Mathematics and Science Teachers Club, as well as the development of a conference infrastructure to support collaborations among STEM and STEM education researchers and teachers at all levels.

Contributions Beyond Science and Engineering:

This initial collaboration between the Center for Science and Mathematics Education Research and the Maine Learning Technology Initiative for the Summer Academy short courses, which focused on using technology in research-supported ways to improve student learning in mathematics and science, has led to additional conversations and collaborations between Center faculty and the Maine State Department of Education (ME DOE) Professor Susan McKay, PI on this grant, attended a conference with a team including members of the ME DOE 'Designing and Implementing High Quality Professional Development for Teachers of Mathematics and Science'. This conference provided a common framework for future professional development in science and mathematics in the state. This collaboration is significant because it brings together the research and content expertise of the Center and the decision makers of the ME DOE to help improve science and mathematics teacher professional development. Two Center proposals, one to NSF for a conference and summer academy in 2008 and the other to the U.S. Department of Education for bringing more guided inquiry instruction into introductory physical science laboratories, are strongly supported by the science and mathematics specialist at the Maine State Department of Education. The latter proposal is tied to an increase in the secondary laboratory science requirement in Maine and includes a teacher-in-residence program. Clearly, this type of university and governmental link is very valuable to the State, providing an infrastructure for improvement of its science and mathematics education, and thus, improvement of its economy. This economic improvement is particularly crucial for a state like Maine that is transitioning from a resource-based economy to one that has a larger technology sector.

Categories for which nothing is reported:

Any Journal

Any Book

SURVEY SUMMARIES FOR
Integrating Science and Mathematics Education Research into Teaching –
A Conference for Students, Teachers and University Faculty in Science,
Mathematics, and Related Fields
June, 2006

- 1. Summary of anonymous surveys completed by participants at the conference and summer academy (pages 2-7).**

- 2. Summary report of anonymous follow-up surveys conducted using surveymonkey.com distributed approximately one year after the conference in August, 2007. All answers received in response to Questions #13, 14, and 15 are included at the end. (pages 8-20).**

Response to surveys distributed during Conference and Summer Academy in 2006

Conference evaluations forms for the Sunday evening keynote and Monday morning talks were collected immediately following the Monday morning sessions. Evaluations for the Monday afternoon workshops, Poster Session, and Tuesday morning talks were collected immediately following the Tuesday morning sessions. Evaluation of the Tuesday afternoon workshops, Open Session, Wednesday morning events and the overall conference evaluation were collected immediately following the conclusion of the conference on Wednesday. Summer Academy evaluations were collected at the end of each course.

The evaluation forms included a mixture of narrative response items and questions that used a Likert scale from 1 to 5. One rated poor and five rated excellent. As can be observed the ratings were shifted toward the upper end of the scale for morning sessions. Sixty-eight percent of responders gave morning sessions a favorable rating. Over 75% favorably rated the workshops. The vast majority of participants rated the talks and workshops between good and excellent. The keynote was very highly rated, with 93% of responders giving a favorable response with no one rating it lower than a "3" or satisfactory.

Roughly 40% of conference participants completed the overall evaluation. Nearly sixty percent returned evaluations on Monday and Tuesday mornings and about 50% returned forms on Wednesday morning. Nearly all Summer Academy participants responded.

Conference Survey: Participant Responses 2006 National Summer Conference

	Rating					5+	% favorable responses
	1	2	3	4	5		
Talks at the morning sessions	4	24	61	93	85	3	68%
Afternoon workshops	0	13	31	64	70	2	76%
Poster sessions	2	20	14	31	23	0	60%
Open Space	6	9	27	21	27	0	53%
Keynote	0	0	7	25	57	1	93%
	(Number of responders)						

Overall evaluation

In the evaluations forms an opportunity was provided for responders to give written comments concerning the conference.

Below is a list of responses to a series of three questions:

What did you find most valuable/interesting/useful about the conference?	Did the conference influence your knowledge of and ability to use research supported teaching strategies?	What kinds of useful new ideas are you taking away from this conference?
Focus on Math Science connection	Yes - Hands on Astronomy	distance lesson study
Focus on encouragement of girls	Yes - Helped clarify the foundations of educating in Math and science	hardware and activites
Identification of lack of conceptual learning in students coming out of high school	Yes - good to understand where strategies come from.	ideas for increasing student interstin science and technology
Opportunity to connect with other educators	Yes - Research that showed results and solid applications(e.g. Mike Murphy's talk) were helpful	Gender issues
Exposure to educational research and researchers	Yes - research supports current strategies in classroom	Native American topics
Opportunity to discuss ideas with other educators in evenings after morning sessions	Yes - awareness of research raised	Process vs. object
Witnessing enthusiasm in other educators about the subject		Science fiction in teaching
Exposure to experts in a wide variety of fields	Yes - encouraged new avenues of research	data collection ideas
Presentation of strategies to increase learning	Yes - encouraged more reading of current research	research ideas
Short presentations good with follow-up workshops		contacts
Keynote was interesting	Yes- gender equity research is helpful	student assessment
presentations helpful in finding new ways to understand student learning.	Yes -research into student cognition helpful	Flexibility vs. competence
Useful activities provided in workshops		Student management

Helpful to hear about Native American topics		Science By inquiry
Conceptual change model		meta-cognition
Reform lessons that can be used		Faculty - teacher connection
Research that has practical outcomes or application		Conceptual change ideas
		Group work in the classroom
		Student preparation for College ideas
		Math Science connection
		New resources

With regards to several questions based on a Likert scale as described above. The questions are listed below with their average scores.

Content	Score
Pre-Conference Logistics	3.98
The overall content of the conference	4.1
The overall structure/logistics of the conference	4.1
To what extent did the conference affect your knowledge of discipline based education research?	3.6
To what extent did the conference affect your understanding of student learning in your field?	3.4
To what extent did the conference affect your familiarity with hands-on learning activities in your field?	3
To what extent did this conference provide opportunities to meet and exchange ideas with colleagues?	4.2
To what extent did this conference provide opportunities for potential future collaborations?	3.7

*Free form comments were elicited from participants in the various activities.
Below are selected comments from 2006 Conference and Summer Academy*

Regarding Open Space

- “A really nice idea to build cross-cutting conversations!”
- “A fascinating idea, might have been useful to do each day, or alternatively to do ‘Crackerbarrels’ on specific general topics the first night (with panels?) and then Open Space Tuesday and Wednesday.”
- “Great idea – it would be nice to have even more participation & have something like this every day. For example: Math teachers get together to decide how to integrate what they learned in the sessions and practically use it in the classroom. Also, make it clear in the overview what the Open Space is about.”
- “A great idea! Entertaining and fun”
- “Great way to get discussions going.”
 - Facilitator was great!
 - First time I’ve done this; liked it!
- “Great idea”
- “I loved this concept! Where can I get materials for setting this up elsewhere?”
- “Nicely organized – good opportunity!”
- “Very good idea, and very good use of our “down time”. Our group worked very well together (12 folks).”
- “Loved this concept and the way it was framed for us by Jon Geiger – do more of this!”
- “Very good opportunity for like-minded educators to collaborate.”

Regarding Panel Discussion:

- “A useful way to reflect on important connections.”
- “Very good idea to debrief as a group!”
- “Thank you for this opportunity of share & reflection; a necessary time to process.”
- “Good use of time”

Regarding Poster Session:

- Allowed people to continue conversations and explore the posters.
- “Super! Great variety, very knowledgeable presenters all around.”
- “Excellent collection of ideas and work!”
- “Excellent way to discuss research conducted at area colleges.”
- “Nice job overall”
- “High level”
- “I had 3 great detailed discussions with different presenters.”
- “Other than the room’s warm temperature, this was a good evening of discussion. With the large # of posters, it could have been 2 sessions.
- “Excellent variety”
- “I liked the presentation.
- “Presenters were approachable & knowledgeable. Very interesting ideas & projects.”

Regarding Keynote Address:

An interesting topic, indeed!

Refreshing ideas! Thought provoking

Relevant.

Excellent way to open conference.

Riveting speaker

Entertaining and an excellent model for approaching science education.

Keynote was excellent

Brought to light something that we all need to focus on in schools, and in daily life.

Very informative

Excellent choice for a keynote speaker.

Unique, interesting, and was helpful in opening up the eyes to the public and maybe to administrators in that we teach subjects that can be related to real world situations.

Great Keynote! Thought-provoking & humorous – the perfect combination!

Excellent!

Absolutely wonderful!

The best!

A very intelligent and eye-opening look at misconceptions and misrepresentation of scientific information.

Very enjoyable! Reminds me that I need to get out and dispel myths about mathematics.

Excellent speaker – a nice intro for the conference!

Right on target

Excellent and eye-opening. What we as the educated population may take for granted because we feel it's "common sense" but others can be gullible because they don't have these educational experiences.

Regarding Summer Academy:

The most useful aspect of the workshop was the opportunity to have fun while trying something new. Remaining a student is the key to being a good teacher.

The 3D graphing was absolutely amazing! I am definitely going to use that in my upper level classes. I can't wait!

Best out of the whole week! I can immediately apply several of the Excel activities to my list of tools with which I tackle my curriculum (math)

Never used Excel before .. So the learning was all new. The kids will both enjoy and benefit from these approaches

Projects, particularly for more advanced students; renewed interest in using Excel as a teaching tool.

Energetic instructors! NOTE: What I would like to see is more workshops - even courses - that extend High School math ideas / teaching / math content.

Excel workshop was VERY useful for classroom ideas and own personal use.

This workshop will give me more tools to offer my students - nice visuals.

Absolutely fabulous--Learned so much that can be applied

Molly, Medea, Beth. You were wonderful!! Your patience, knowledge and persistence made it possible for great gains to be made in a short amount of time.

Learning to do the graphing program was extremely valuable. I plan to imbed my learning into my changes through seasons year long unit of study.

The Academy--was hands on, gave information; skills in research to take to students
Everything in Academy was wonderful, including contacts with others!
Greatly--I expect to develop a unit for my science class.
Academic research in very practical areas....How do we teach students most effectively

Workshops that were interactive and provided the opportunity to develop some basic skills needed to actually employ theoretical methodologies.

This is a great workshop and it seems we could have done so much more with just one more day. It exceeded my expectations!

I will DEFINITELY use this technology in my classroom.

I will definitely use this with my Calculus students and maybe my Advanced Math as well!

Will try to include such work in my curriculum. My understanding and experience (gained here) give me more confidence to try implementing.







It will improve my use of computers to help students learn concepts.

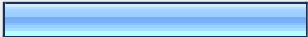


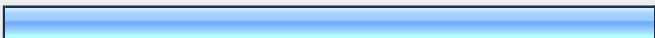
I was given several ideas/activities to use as a springboard to start using this program in my classes. I will be using it next fall, and I know my students will get a lot out of seeing how the data/graphs/functions powerfully work together.


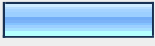

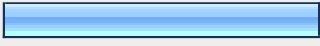
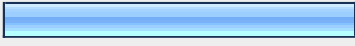
It will change the way I introduce Calculus and the way I teach model-building in Algebra.


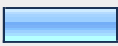
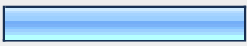
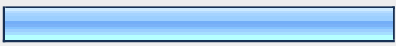
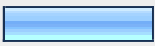
I am very excited to incorporate this into both Alg.I & pre-Algebra classes.



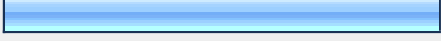

Conference and Summer Academy 2006




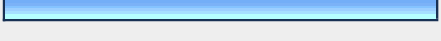
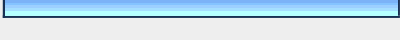
1. Current occupation (check all that apply): I am currently a:			Response Percent	Response Count
middle school teacher			16.7%	8
elementary school teacher			0.0%	0
secondary school teacher			39.6%	19
post-secondary school teacher			27.1%	13
student			6.3%	3
researcher			37.5%	18
other			6.3%	3
			answered question	48
			skipped question	1

2. Check all that apply			Response Percent	Response Count
I have attended other Center conferences			33.3%	13
I have been (or am) a student in the MST program			5.1%	2
I have been (or am) a student in another graduate program related to the pedagogy or content of my current or planned teaching			38.5%	15
I participated in both the conference and the summer academy			71.8%	28
			answered question	39
			skipped question	10

3. networking with colleagues			Response Percent	Response Count
1 not beneficial in this way			2.0%	1
2 somewhat beneficial in this way			16.3%	8
3 Neutral			8.2%	4
4 beneficial in this way			34.7%	17
5 very beneficial in this way			38.8%	19
			<i>answered question</i>	49
			<i>skipped question</i>	0

4. developing my own pedagogical strategies			Response Percent	Response Count
1 not beneficial in this way			2.0%	1
2 somewhat beneficial in this way			12.2%	6
3 Neutral			26.5%	13
4 beneficial in this way			42.9%	21
5 very beneficial in this way			16.3%	8
			<i>answered question</i>	49
			<i>skipped question</i>	0

5. supporting and or contributing to my teaching philosophy			Response Percent	Response Count
1 not beneficial in this way			0.0%	0
2 somewhat beneficial in this way			10.4%	5
3 Neutral			18.8%	9
4 beneficial in this way			47.9%	23
5 very beneficial in this way			22.9%	11
		answered question		48
		skipped question		1

6. hearing about research into teaching and learning in my field			Response Percent	Response Count
1 not beneficial in this way			2.2%	1
2 somewhat beneficial in this way			4.3%	2
3 Neutral			2.2%	1
4 beneficial in this way			47.8%	22
5 very beneficial in this way			43.5%	20
		answered question		46
		skipped question		3

7. introducing me to new resources available for my teaching			Response Percent	Response Count
1 not beneficial in this way			0.0%	0
2 somewhat beneficial in this way			4.1%	2
3 Neutral			14.3%	7
4 beneficial in this way			51.0%	25
5 very beneficial in this way			30.6%	15
			answered question	49
			skipped question	0

8. improving my knowledge of content of specific topics or in general			Response Percent	Response Count
1 not beneficial in this way			4.1%	2
2 somewhat beneficial in this way			10.2%	5
3 Neutral			20.4%	10
4 beneficial in this way			46.9%	23
5 very beneficial in this way			18.4%	9
			answered question	49
			skipped question	0

9. encouraging me to read or study more in areas related to my teaching			Response Percent	Response Count
1 not beneficial in this way			4.1%	2
2 somewhat beneficial in this way			2.0%	1
3 Neutral			28.6%	14
4 beneficial in this way			44.9%	22
5 very beneficial in this way			20.4%	10
			answered question	49
			skipped question	0

10. developing useful technical skills			Response Percent	Response Count
1 not beneficial in this way			6.1%	3
2 somewhat beneficial in this way			6.1%	3
3 Neutral			36.7%	18
4 beneficial in this way			40.8%	20
5 very beneficial in this way			10.2%	5
			answered question	49
			skipped question	0

11. helping me to make specific changes in one or more of the units I teach			Response Percent	Response Count
1 not beneficial in this way			6.1%	3
2 somewhat beneficial in this way			10.2%	5
3 Neutral			30.6%	15
4 beneficial in this way			40.8%	20
5 very beneficial in this way			12.2%	6
			<i>answered question</i>	49
			<i>skipped question</i>	0

12. assisting with developing or locating meaningful assessments			Response Percent	Response Count
1 not beneficial in this way			10.2%	5
2 somewhat beneficial in this way			6.1%	3
3 Neutral			40.8%	20
4 beneficial in this way			30.6%	15
5 very beneficial in this way			12.2%	6
			<i>answered question</i>	49
			<i>skipped question</i>	0

13. Please describe anything that you have done differently in your classroom during the past year and whether the conference/summer academy supported those changes		Response Count
		35
<i>answered question</i>		35
<i>skipped question</i>		14

14. What topics would you like to see included in future Center conferences and programs?		
		Response Count
		32
	<i>answered question</i>	32
	<i>skipped question</i>	17

15. What types of conference, academy, and other professional development activity formats and logistics are most productive and beneficial for you?		
		Response Count
		33
	<i>answered question</i>	33
	<i>skipped question</i>	16

Please describe anything that you have done differently in your classroom during the past year and whether the conference/summer academy supported those changes.

"I have had the students do many more guided learning activities in small groups and asked them more to explain and discuss their reasoning."

"The most significant thing I have used from the conference came from one of the workshops that I attended on a tool called ""Diagnoser"". This web based tool allows students to log in and answer questions related to the topic at hand, and receive immediate feedback. It also compiles statistics on student responses for the teacher to review. I have 7 other teachers using it now also."

"I am doing more small group activities with my students and having them explain and discuss their reasoning more. The conference/summer academy did support these changes."

"none"

"I was on sabbatical and did not teach during the past year. However, this semester I am starting to teach using some modifications of the materials I developed for use at the conference."

"I did develop in my research during the past year based on connections that I made at last year's conference."

"Student critiques of other student lab reports to make revision more meaningful to students"

"Any opportunity I have to learn about current research, practices, and educational ideas in math and science positively affect my classroom teaching. Call it a booster shot, if you will. The conference and summer academy allowed me the luxury of time to listen, think, discuss, and plan. The stipend also honored my time and commitment to continued improvement in my classroom approach."

"I had three changes from the summer academy. The first one was focusing on language, especially the use of the word ""derivative"" in my Calculus classes. I spent a lot more time on vocabulary and defining it in multiple representations, for derivative as a slope at a point, an equation, a graph, and a process."

The second change came from a workshop where we talked about a more hands on way of teaching trigonometry as related to the unit circle. I used this unit with my students last year and many of them were surprised at how easy trigonometry was when presented in that way."

My last change came from the academy where I attended a workshop on rates of change in Calculus. This took a much more application look at rates and focused on units and understanding. I really enjoyed the work and so did my students. It gave them a much more connected idea of rates in Calculus and rates in everyday life."

"Applied for more real world applications, based on research."

"The conference did support the increase in cooperative learning that has taken place in my classroom. Also I was encouraged to look for a school that supported my instructional beliefs"

"Use probes to focus more on data analysis rather than just data collection"

"I have utilized practical chemistry doing real research on water quality and using a spectrophotometer as a result of my summer academy."

I also use ideas for discussing and correcting misconceptions in chemistry as presented by our keynote speaker, Joe Schwartz from Montreal, Canada. I purchased his recent book and appreciate the long-term interesting stories."

"More attention to specific strategies

Attention to lab and lab rubric

Will use peer review process this year (2007-8)"

"I have created more opportunities for students to play a role in the path of their learning, and in determining what constitutes learning success."

"Not a classroom teacher, participated as a professional writer discussing past work in curriculum development."

"more group work, new activities"

"I particularly benefited from discussions about equity."

"using more online data"

"I have used more real-time data in general. I revised my climate change unit to include more real-time data."

"I have used Microsoft Excel to help my students make graphs for my modeling physics curriculum."

"We have made a number of changes in the introductory physics classes. Some of the new changes are based on ideas from the conference."

"used Geo Sketchpad, Excell spreadsheets and the graph program"

"1. Use explorations in my AP class that are challenging learning experiences.

2. Felt empowered to ask for materials that benefit my student's learning.

3. Learned other teacher's attitudes and approaches to student learning issues in mathematics. This was enormously valuable since I work in a small school and am a relatively new teacher. I look forward to every conference, and haven't missed one. I've attended 3 of them in Orono - a long drive but worth the trip!"

"I took time in my classes to discuss research on why young men & women go into math and science fields. We discussed research that I heard about in your conference. It was a worthy discussion and changed what topics my students chose as research topics."

"It was great resource. However, there were many sessions convened at the same time, making attendance impossible. I was interested in topics outside of my scientific discipline."

"used more manipulatives, and greater use of the laptop"

"I was introduced to geo sketchpad; we are getting it for our department."

"We discuss more areas where there are likely to be misconceptions of material. We are bringing another fish tank online to increase students interaction with live organisms."

"I now do even more research ""discovery"" type teaching with my students. They are more plugged in and see the relevance of the material."

"Environmental History of Maine Timeline as an introduction to earth science; resulted from reinforcement of the value of place-based education discussed at the conference"

"Used online data activities a couple of times."

"I use a greater focus on inquiry based learning."

"I continue to work towards more inquiry-based learning and from a cognitive research perspective. I had some very significant interactions at the summer conferences I have attended."

"Focusing on the targets identified by pre-assessments.

Teaching of reading skills specific to mathematics

Computer-based applications/laptop initiative

analysis of test data to design/refine and to inform instruction"

"I have introduced a few of the inquiry techniques demonstrated as well as used some of the resources presented at the conference"

What topics would you like to see included in future Center conferences and programs?

"I like the variety of topics currently included in Center conferences. I particularly like to hear about research into how to broaden participation in STEM fields."

"Nothing in particular."

"More physics related, as that is what I teach."

"Ways to broaden participation and encourage students from underrepresented groups in mathematics and science. I like the combination of research presentations and ways to apply the research in teaching and learning."

"I felt that bringing the college professor is was wonderful, but the professors need to make their information user friendly. A lot of the material was very desirable to be able to use, but the method to bring it to the high school level was lacking."

*innovative uses of graphing calculators/graphing software/spreadsheets/data bases for middle school students

*low budget ideas for teaching middle level chemistry concepts

*presentation of scientific research in a variety of disciplines that would be of interest to teachers and students"

"I would like more information about woman in the STEM careers and more information about engineering. As a teacher, it's hard to push students in this direction when I don't know enough about it myself."

"More things practical to the K-12 curriculum rather than research on how students learn. The last conference was very disappointing, because there wasn't many talks that I went to in which I felt were beneficial. They seemed more tailored to post secondary education rather than the reality of K-12 science education."

"Continued work on best teaching practices in the middle and high school"

"An idea that I've had for a number of years, and which which was reinforced at this conference, is that middle and high school math teachers need some training and refreshing in specific connections between math and science concepts. I've talked to a number of teachers like myself for whom the passion is the mathematics but yet know that many students would like to see the scientific applications. Some of us have not studied science concepts for years and could use refreshers - especially in Physics."

"More presentations of ideas that are directly applicable in the classroom and specific strategies for implementing those ideas."

"ASU modeling"

"I would like to see topics including forestry, marine science, geology, environmental science, and biology for ideas relating to envirothon competition. More astronomy, meteorology, and oceanography for earth science."

"Action research and other research pertaining to HS science and scientific literacy"

"Strategies for ""going against the grain"" in promoting true inquiry-based learning. How do you deal with parents and administrations who just want you to teach to the tests?"

"A focus on insuring that middle school students are prepared for high school math. More communication between the two levels and data to track changes and improvements."

"computer science, laptop related things, how to use these tools that we have"

"deep ecology"

"more mathematics education. please consider adding math for grades K-5

I'm also interested in more ideas for keep girls interested in pursuing math & science"

"One of the nice aspects of this conference was that there were many disciplines represented. It may be useful if additional sessions were created that helped make explicit connections between the work in different areas."

"specific units for classroom teaching. Like the Japanese lesson plan style"

"1. Teaching techniques that link the real world with the world of Algebra.

2. Worksheets that can be used to improve learning.

3. Technological advances in teaching."

"Research strategies in STEM teaching and learning"

24,12/10/2007 3:11:00 AM,"Research on heterogeneous vs homogeneous high school classrooms. The number one topic among math teachers that I have talked to is, "" why are we moving to an elementary school model that delivers students with a 4th grade reading level to high school"". Where is the unbiased research that supports the idea that a differentiated classroom is the road to excellence in learning for all."

"More focus on the programs that I already use."

"Space, develop local geology field trips, local information on testing the water quality of nearby streams, rivers and ponds. develop local trips that could introduce students to different biospheres."

"Literacy with in the subject matter. Writing with in the subject matter."

"More hands on workshops where we learn useful skills we can apply in the classroom. The Conference portion doesn't really fit my needs at the middle school level."

"More on hands-on activities."

"Teaching to standards; Big-Ideas a la Grant Wiggins and Jay McTighe"

"Special education and the mathematics classroom.

What is research saying about ""reaching and teaching all children""?"

"None that I can think of at this time."

What types of conference, academy, and other professional development activity formats and logistics are most productive and beneficial for you?

"I like the mixture of invited and contributed talks and workshops. The poster session/social hour was also very effective. I also liked the Open Space session."
"Research conferences."

"The most productive seem to be when the teacher actually gets to participate in the activity as a student. It shows first hand what your students will experience, and gives you an idea on how you will present it in your classroom. Collaboration with other teachers is also at the top of my list."

"I like the mix of formats, including invited and contributed talks and workshops. I also think that the poster session/social hour works well. I enjoyed the new Open Space session at this conference."

"The most beneficial aspect of this conference for me was the involvement of researchers from many different areas of science education."

"The type that allows teachers to bring materials to share with colleagues. It does not have to be random. Pick one topic in each discipline each year. Give notice that there will be a share session so each teacher can give copies and explanations on their coverage of that topic."

"The summer academy was well-timed for me. I enjoyed hearing about some current research. I also enjoyed the two "classes" I took. A week to learn and network is more beneficial to me than one or two day conferences."

"What you do is wonderful."

"Hands on in which we participate in the activities (similar to the afternoon questions). The presenters need to better focus their presentations on the audience. Most were geared for post graduate work rather than a regular education teacher."

"I enjoy the summer conference immensely but the work with the CTTT is a breathe of fresh air throughout the year to keep me pumped up for the summer conference"

"The part of the conference which was most beneficial to me was the academy at the end. It was concrete and practical. While I appreciate the fact that research is being done in education, most of the presenters did not really make the connection between the research and classroom practices. I need more training in using technology in teaching math along with the time to practice with that technology."

"summer academy"

"I would like to see half-day multiple strands for high school and middle school teachers coupled with a research-based pedagogy lecture/discussion and a laboratory experience in each stem (science, technology,engineering,mathematics). The reason for the diversity is because teachers at these levels teach multiple courses."

"Small group discussion following a presentation of research."

"no comment"

"A facilitated conversation between teachers for their experiences/ideas around improving learning and remediation for low-performing students."

"shared community, so that I'm not all alone in this!"

"summertime conferences/academies that last 3 or 4 days."

"The summer academy with a specific focus on climate change was very productive and beneficial. I had already been teaching about climate change but the academy afforded me the opportunity to listen to and learn from scientists in the field. This was an invaluable experience. The specific focus on the topic meant that all the scientists we heard from were in some way involved in research regarding that topic. I appreciated hearing about the actual field work that was being done."

"quick talks on research are not as useful for me as hands-on workshops and extended courses like the summer academy"

"I really liked that your conference was a mixture of both classroom teachers and educational researchers. It forced the teachers to stretch and think about theory in ways that could benefit their students. It also challenged the researchers to make their ideas relevant in classroom situations. I thought the whole thing was well done."

"Talks and workshops."

"The summer conference is just my "cup of tea.""

"The format for the 2006 conference and academy was fine."

"Presentations of new research is of interest to me. It is nice to hear what's new outside of the classroom and in other classrooms.

Also any concrete sharing of high school math methods, lessons and projects very often end up as part of my curriculum."

"Things like the "hidden" social cues. Interesting and useful when I think about how I deal with my students."

"Activities that incorporate trips or resources that we can access as field trips or use in the classroom to supplement teaching."

"What you did works well."

"those that provide "ready-to-use" materials or time to develop same"

"The Academy (online data) was more useful and enjoyable for me than the Conference. Perhaps this survey should have asked about the two parts separately. I think my responses would be more favorable as regards the Academy portion."

"I think the most useful is just hearing other teachers' activities."

"1 1/2 to 2-hour interactive workshops -- get immersed in a topic or concept or issue or question"

"More that use examples that I can use immediately. The theory is nice but I often lack the time to move beyond that."

FINDINGS

Participants indicated in their evaluations that the Conference and Summer Academy held through this project met a need for the science and mathematics education community to share research findings and experiences in implementing research-supported practices in their classrooms. These events led to new collaborations and a set of workshops which are continuing to be used for teacher professional development. (See Activities section for details) The events proved successful in building both horizontal and vertical collaborations.

We found that stipended follow-up opportunities, such as the High School Physics Teachers Collaborative and the Mathematics Cross-Tier Teaching Teams, were more attractive to in-service teachers than graduate course credit for classroom implementation projects. This result might not hold in states where a graduate degree is required for continuing certification. Maine does not have this requirement, and most of the teacher participants in the Summer Academy were from Maine.

Having a planning team that included secondary and post-secondary science educators led to a program that provided useful information for both groups. In answers to free-response questions on the event evaluations, over 90% of the teachers who responded specified some element from the conference and summer academy that they planned to use in their teaching. Follow-up questionnaires will be used to see if these implementations occurred.

The Conference and Summer Academy proved effective in recruiting students into the Master of Science in Teaching program, with three participants subsequently enrolling in the program.

This conference was the first one held by the Center for Science and Mathematics Education Research that incorporated an “Open Space” section, in which participants formulated their own topic discussion groups related to the question “How can we collaborate to improve science and mathematics education?”. This program element proved to be very successful with a couple of ideas generated that have been implemented, as discussed in the Activities section. Participants did request that the question be distributed ahead of time, as well as information about general features of “Open Space”. These requests have been implemented in the Center’s 2007 conference.

Over a year after the end of the conference, collaborations are still developing that can be traced to the conference. For example, the Center for Science and Mathematics Education Research recently submitted a proposal to the NSF Math Science Partnership Program involving 13 school districts, most of whom were represented at the conference. Among the supporting partners on this proposal were the Maine Mathematics and Science Alliance, Acadia Partners for Science and Learning (and the Schoodic Education and Research Center), the Maine Learning Technology Initiative, and the Jackson Laboratory, each of which was involved in this conference. When surveyed a year after the conference and summer academy, respondents indicated that the events had been

beneficial or very beneficial in: networking with colleagues (74%), developing pedagogical strategies (59%), supporting and/or contributing to their teaching philosophy (71%), hearing about research into teaching and learning in their field (91%), introducing them to new resources available for teaching (82%), improving knowledge of content of specific topics or in general (65%), encouraging them to read or study more in areas related to their teaching (65%), developing useful technical skills (51%), helping them to make specific changes in one or more units that they teach (53%), and assisting with developing or locating meaningful assessments (43%). The answers to free response questions also indicated that educators had found many of the aspects of the conference and summer academy useful. All of these follow-up survey results are in the document attached.

This grant funded the conference “Integrating Science and Mathematics Education Research into Teaching”, which was hosted by the Center for Science and Mathematics Education Research (the Center) at the University of Maine on June 25th – 28th, 2006. The grant also supported the Summer Academy, a collection of eight courses for science and mathematics educators, which took place from June 28th – 30th. The Conference and Summer Academy were planned with input from teachers, researchers, and graduate students, some of whom are pre-service teachers. Summer Academy participants were given the opportunity to continue their work through the Fall 2006 semester for graduate credit, and a website <http://www.umaine.edu/center/Academy2006.html>, has been created for the use of Summer Academy participants and other science and mathematics educators, to share resources and experiences as they implement the materials and ideas from the Conference and Summer Academy in their classrooms.

In organizing and executing the Conference and Summer Academy, the Center succeeded in addressing these defining initial project goals:

- continue the process of building an established venue where there is an interdisciplinary exchange of ideas regarding research practices, curriculum innovation, and classroom instruction among all participants involved in science and mathematics (SM) education;
- provide current and future teachers with hands-on experiences with emerging research-based curricula that, through innovative uses of technology, help students learn content in a more meaningful way;
- instill in classroom teachers and post-secondary faculty a sensibility that assumptions about student learning need a strong basis of evidence;
- share strategies for improving the preparation of SM teachers in middle and high school and at the university level;
- sustain, solidify, and augment existing networks of SM educators among University of Maine faculty and high school and middle school administrators and teachers; and
- get technology-rich curricula with proven track records of improving the learning of content by students into the classroom.

Specific project activities have addressed the Center’s five stated goals in sponsoring this conference and summer academy:

1. Provide a venue for educators and scientists to disseminate information about how they are conducting research into student learning in their fields and how this research is changing curriculum and instruction from grades 6 through 16;

The Center for Science and Mathematics Education Research (Center) hosted a five-day national conference with a follow-up Summer Academy as proposed, entitled, “Integrating Science and Mathematics Education Research into Teaching”. Conference participants included pre-service undergraduates, middle and secondary mathematics and

science teachers, and University faculty and graduate students and postdoctoral research associates involved in discipline-based education research, with applications to science and mathematics teaching and learning at all levels. Twenty-nine invited speakers presented current research activities and findings in their fields of expertise. The Summer Academy included courses on the integration of technology into the classroom with a focus on applications in mathematics, physics, environmental data, aquaculture, and chemistry education. Presentations and academy abstracts can be found in the Conference Program: (<http://www.umaine.edu/center/CONFERENCE2006.htm>).

CONFERENCE PARTICIPANTS	
<u>Attendees</u>	170
Grades 6-12 teachers	80
Pre-service educators	18
Graduate students	10
University faculty/researchers	52
Members of non-profits, the Maine Department of Education, consultants working on mathematics and science education, etc.	10
Invited speakers	29
Contributed speakers	11
RESEARCH PRESENTED	
Invited and Contributed Talks	40
Two-hour Afternoon Workshops	16
Posters presented during poster session	35

SUMMER ACADEMY COURSE TITLE	# OF PARTICIPANTS
Learning Mathematics with Excel	21
UV-Spectroscopy: Compounds, Color and Concentration	10
Data Data Everywhere! Making Sense of Environmental Inquiry in a Sea of Online Data	13
Using Computer Tools to Diagnose Student Reasoning	24
Geometer's Sketchpad for Standards-Based Middle School Mathematics	11
Using Data Acquisition Tools to Enhance	16

Learning in Secondary Physical Science	
Real-Time Data Collection Software Use in Algebra, Pre-calculus, and Calculus	25
Domestication of Aquatic Organisms	8
TOTAL:	128

2. Give current and future teachers/instructors/faculty opportunities for hands-on exploration of emerging research-based curricula in SM;

The conference included sixteen two-hour hands-on workshops led by mathematics and science education researchers and faculty involved in research-based curriculum development and teacher preparation. Workshop topics included chemistry, mathematics, physics, astronomy, engineering, life science, and Earth science, along with sessions addressing broadening the participation in science and mathematics and the role of gender, ethnicity, and culture in science and mathematics education.

At the Summer Academy, teachers received training in technologies that can be used in mathematics and science classrooms. (See Summary Table, above). Summer Academy courses in mathematics, physics, environmental data, aquaculture, and chemistry were activity-oriented and provided participants with concrete examples of current research-based curricula aimed at using technology to improve student learning in middle and secondary mathematics and science classes. Two of the Academy courses were held at the Schoodic Education and Research Center, to take advantage of the field work opportunities that are available in this coastal location. Conference workshop abstracts can be found in the Conference Program: (<http://www.umaine.edu/center/CONFERENCE2006.htm>). Course descriptions and outcomes of the Summer Academy courses are assembled in an academy website. This website was reviewed by a team of secondary science and mathematics teachers and modified in response to their input.

3. Increase the number of pre- and in-service teachers who are informed about research into student learning within their SM discipline and who use research-supported practices in their classrooms;

The conference participants included 88 pre-service and in-service teachers. Seventy-one in-service teachers received stipends for attending both the Conference and the Summer Academy. Of the 104 Summer Academy evaluations returned by middle and secondary teachers (some teachers participated in two Summer Academy courses), over 90% indicated, in the free response questions, some specific aspect of the course that they planned to use in their classroom.

4. Facilitate the growth of university-school networks that connect faculty within both science and mathematics departments and colleges of education with current and future middle and high school SM teachers (*i.e.*, a *vertical* partnership); and

Based upon conversations that occurred during the Open Space portion of the conference and, more informally, at other times, Center faculty realized the importance of ongoing programs to connect with teachers in their disciplines. This realization led Center director Dr. Susan McKay and Center Assistant Director Amie Gellen to apply for an educational outreach grant, which was funded by the University's NSF EPSCoR Maine Forest Bioproducts Research Initiative to support the continuation of Mathematics Cross-Tier-Teaching Team meetings and the UMaine High School Physics Teachers Collaborative. Both groups bring together pre-and in-service teachers and University faculty approximately once a month for dinner meetings to discuss teaching issues and related research into student learning. The meeting topics are frequently picked by the participants.

The Conference and Summer Academy were attended by three teachers who subsequently enrolled in the Center's Master of Science in Teaching (MST) program in the Fall of 2006. One of the teachers who enrolled in Fall 2006 is Margaret Southworth, a mathematics teacher at the Troy Howard Middle School in Belfast, Maine and winner of a 2006 Presidential Award for Excellence in Mathematics and Science Teaching. As part of her program of study, she is currently on leave from teaching for the spring of 2007 and is participating in a teacher sabbatical research internship at the Jackson Laboratory. Under the guidance of a scientist-mentor, participants in the internship work full-time on a research project at the Jackson Laboratory, earning three graduate credits from the University of Maine. They also attend a three-credit course (SMT 507 Research-related Curriculum Development in Science and Mathematics) taught by UMaine Center faculty at the Jackson Laboratory, which guides teachers in the development of curricula that integrate research into their teaching. Ms. Southworth attended the Summer Academy mathematics course entitled, "Geometer's Sketchpad for Standards-Based Middle School Mathematics". She developed a series of Geometer's Sketchpad lessons for her classroom as an outgrowth of her work at the Summer Academy and presented these at a meeting of the Center's Mathematics Cross-Tier-Teaching Team. She will also be presenting this work at a regional or national conference later this year.

The Summer Academy workshops were so well received by teachers that a northern Maine partnership involving the University of Maine at Presque Isle, the Central Aroostook Council on Education, the Caribou and Presque Isle regional technical centers and area high schools has requested that Center faculty deliver some of these workshops in the summer of 2008 as part of a professional development plan funded by the Maine Department of Education's STEM initiative.

From Open Space discussions at this conference, the idea emerged of using the Summer Academy as a coordinated vehicle for teachers, STEM and STEM education research faculty, and graduate students (some of whom are pre-service teachers) to participate in and disseminate curriculum adaptations that involve K-16 students in more authentic research experiences aligned with national standards. For most projects, the Summer Academy will provide an initial two-day work period, which will be followed by regular meetings and communication during the academic year, as the project develops. This

idea is incorporated into the Center's conference proposal for 2008 to the National Science Foundation (pending).

5. Increase the number of faculty collaborating across disciplines to do research into student learning of specific content in their respective disciplines (*i.e.*, a *horizontal* partnership).

Numerous types of cross-disciplinary collaborations were begun as an outgrowth of conversations and presentations at the conference. For example, based upon conversations begun at the Conference, Michelle Zandieh, Ph.D. (Associate Professor of Mathematics and Statistics, Arizona State University); John E. Donovan II, Ph.D. (Assistant Professor of Mathematics Education, Department of Mathematics and Statistics and the College of Education and Human Development, University of Maine; Michael C. Wittmann, Ph.D. (Assistant Professor of Physics and Cooperating Assistant Professor of Education, University of Maine), and Edward F. (Joe) Redish, Ph.D. (Professor of Physics, University of Maryland, College Park); and others from their research groups have begun a semester-long series of on-line video seminars to discuss issues of learning theory as it applies to mathematics and physics education research. The conference led to extensive discussions about the interplay between mathematics and physics learning for students. These conversations led to presentations that are an outgrowth of mathematics use in physics learning at the conference on Research in Undergraduate Mathematics Education.

Participation in the Center's conference and summer academy by marine science faculty has led to the placement of a Master of Science in Teaching (MST) student as a research advisee working on curriculum development and assessment in the School of Marine Sciences with Assistant Professor Sara Lindsay and the first marine sciences graduate to enter the MST program beginning in Fall 2008.

Participation of faculty from the Department of Biological Sciences has led that group to seek funding for a faculty position in biology education research and to begin development of inquiry-based laboratories for a selected sections of introductory biology. A Master of Science in Teaching student is going to assist with the assessment of student learning from these laboratories.

A new collaboration to reform introductory laboratories in Chemistry, Earth Sciences, and Physics also developed following the conference, and a proposal submitted to the U.S. Department of Education (FIPSE program) to support this work is pending.

Continuation of collaborations following the conference and summer academy:

Conversations begun during the conference and summer academy have led to ongoing projects that are continuing even a year and a half after the event. Several examples include:

- Professor Paul Rawson, who conducted a Summer Academy short course for teachers on integrating topics in aquaculture into middle and high school curricula, has continued to work with two of the participants. Jane Grover, who teaches grades K-8 in a one-room school in Isleford, ME, and Kevin Malady, who teaches honors and AP biology at Lawrence High School, returned during

- the summer of 2007 to work on constructing specific lesson plans based upon the concepts explored during the 2006 workshop. Jane will be working with clown fish in her classroom to demonstrate the effects of nutrition on fish coloration while Kevin is working with his students to investigate the effects of genetics and the environment on zebrafish development. A meeting is planned in late spring, early summer of 2008 for these teachers to recap their experiences, fine-tune lesson plans, and develop strategies to “export” these lessons to other teachers.
- Professor Molly Schauffler, who conducted a Summer Academy short course for teachers focused on using on-line data to answer authentic research questions, has continued collaborating with some of the schools represented in her course. With funding from the University of Maine Forest Bioproducts Research Initiative Education and Outreach Awards, 10 teachers worked with Molly on classroom implementations related to the Summer Academy short course, focusing on evidence of climate change. As part of this study, 6 middle and high school teachers and their students are using automatic temperature data loggers to conduct a long-term temperature monitoring study, involving ~120 students, from Camden to Katahdin. Molly has made ten presentations that are outgrowths of this summer course. This conference also spurred further development of the Maine Environmental Monitoring and Assessment Program Directory (<http://library.umaine.edu/memap/>).
 - Peggy LaBrosse, a summer academy participant and teacher, has conducted a study, Analysis of the Effect of Specific Vocabulary Instruction on High School Chemistry Students’ Knowledge and Understanding, which has been accepted for presentation at the 2008 Annual Conference of the New England Educational Research Organization (NEERO). Meghan Southworth, a Master of Science in Teaching student and middle school mathematics teacher (currently working with the Maine Mathematics and Science Alliance) presented an interactive geometer’s sketchpad session for the Cross Tier Teaching Teams in Mathematics, a group organized by the Center for Science and Mathematics Education Research. This work was an outgrowth of the summer academy course that she attended.
 - Professor Francois Amar, who co-led a Summer Academy session for chemistry teachers, has strengthened his connections with the Orono Middle School through classroom presentations to six classes. He has also brought high school students to campus from a local chemistry class. The conference and summer academy provided materials, which have been tested and expanded in these interactions.
 - Professor Susan McKay has collaborated on two major proposals to NSF from connections that were strengthened at the conference, one to the Math Science Partnership Program, a major collaboration among schools and non-profits in Maine and the University of Maine, and the other with Acadia Partners for Science and Learning. The mathematics and science specialists at the State Department of Education have become much more familiar with the Center for Science and Mathematics Education Research, and collaborations there are occurring based upon the conversations that happened originally at this conference. For example, Susan and Anita Bernhardt, State Science and

Technology Specialist, have submitted a proposal to conduct an evaluation of student learning and changes in attitudes and aspirations related to STEM for ten classes that will be piloting a ninth-grade astrobiology curriculum during 2008-2009.

Thus, this conference and summer academy have led to sustained collaborations, with partners bringing distinct areas of expertise to work toward common goals. These events connected STEM educators within Maine more strongly with each other and also with researchers and teachers from across the country.