Maine Physical Sciences Curriculum Partnership (MainePSP) Seventh Year Implementation Report

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Introduction

In our efforts to move to a sustainable community with a focus on statewide science, technology, engineering, and mathematics education at all grade levels, we have merged our different communities into the Maine STEM Partnership @ the RiSE Center. The mission of the Maine STEM Partnership is to build and sustain a diverse, statewide community that strengthens PK-16+ science, technology, engineering and mathematics education by promoting rich, research-supported classroom experiences that deepen learning and engage all students. This community seeks to build STEM literacy and career competency and to encourage students to become STEM educators and education researchers.

In the past year, we continued to develop and sustain a vibrant professional community of educators, with a core of 8 staff members bringing together over 900 teachers, pre-service teachers, University faculty, graduate and undergraduate students for a full suite of professional development opportunities throughout the summer and academic year. Teachers came from 160 schools and 101 districts and participants spent more than 20,000 person hours in MainePSP activities, including attending conferences, participating in ongoing learning communities, learning through intensive science content sessions, and developing teaching and learning resources for the larger community.

We continued the district buy-in model where districts were responsible for paying a membership fee for participation, a per student fee for materials rental, and a per teacher fee for participation in the professional development community. The remaining funding for supporting this model comes in part from the University through additional grants and base budgeting, which covers staff support and overhead such as office space, warehouse space, etc.

In addition, we looked to teacher leaders to design and lead professional development sessions for many of our communities. The Assessment for Learning community utilized the train-the-trainer model in which teacher leaders taught science resource partners to lead training sessions in the schools and districts. The Teaching and Learning community also relied on the expertise of teachers as well as University faculty and staff to lead sessions focused on pedagogy.

Throughout the duration of the MainePSP, the RiSE Center was able leverage funding to support

teachers with classroom instructional resources, increase teacher content knowledge, inform teaching practices, and build a diverse community. The Maine STEM Partnership plans to continue this work and grow and sustain this broader community to conduct STEM education research and engage in research-supported STEM education.

In order to continue to support this community, the Maine STEM Partnership aims to support educators through building teacher leadership capacity, deepening teacher knowledge for teaching, integrate research, assessment, and practice and promote evidence-guided and data-informed instructional strategies. Through this process we plan to build an effective state-wide model to positively influence policy as well as practice, and to disseminate knowledge of our model to others nation-wide.

Major Programs and Activities of the MainePSP in 2016-2017

New Programs and Activities in 2016-17

As a result of obtaining supplemental funding from the National Science Foundation, we were able to offer several new programs and activities over the past year, in addition to our many other ongoing programs and activities. The new programs and activities begun in 2016-17 are listed below, followed by a detailed write-up of each activity.

- Affinity Groups
- Curriculum Selection Task Force
- Ice Age Trail, Place-Based Professional Development
- Intensive Content Immersions
- K-12 Leading Teacher Community: Assessment for Learning
- K-16+ STEM Teaching and Learning Community
- Maine STEM Partnership Leadership Team
- Pre-Service Summer Academy and Pre-Service Design Week
- Talk Science Institute
- Teaching Pods
- 3-D Printing Programs
- Write Science Academy

Affinity Groups

Affinity Groups have provided teachers with a common professional space to meet and collaborate to extend their learning of classroom strategies, building familiarity with content and materials, and improving teaching and learning. Teachers participated in rich discussions while strengthening their pedagogical content knowledge. The topics covered by these groups were Linear Functions, Force and Motion, 3D Printing, Student Science Journals, and Waves.

Objectives

The specific objectives of the Affinity Groups expand on some of the goals of the MainePSP:

- Support teachers in learning science or mathematics content and/or strengthening high quality resources for their classrooms
- Support teachers in creating and/or strengthening high quality resources for their classrooms
- Strengthen proficiency with high-impact instructional strategies

Results in the Past Year

A total of 20 teachers from 14 districts participated in Affinity Group meetings at 1 location: Central Maine. We offered 6 meetings throughout the 2016-2017 academic year. The teachers that participated had the option of which session to attend at each meeting, according to their needs. An application went out for those teachers that were interested in facilitating a collaborative on a topic that was not yet offered by the RiSE Center.

Dissemination of Results

Experiences from these sessions have been shared with the leadership team and is being used to influence the design of the expanded version of the statewide high school collaboratives program in the 2017-2018 school year.

Next Steps

We plan to continue running our Affinity Groups in Central Maine for the 2017-2018 academic year. We also plan to provide the application to teachers interested in this community throughout the summer so the sessions are able to begin during the first meeting. Each Affinity Group will be required to set at least one measurable goal to accomplish during these meetings. The groups will also share their products with the greater community.

Curriculum Selection Task Force

A task force was convened to review currently available science resources for 6-9th grade science instruction. The RiSE Center currently supports science teachers with instructional materials which were selected at the start of the MainePSP. This task force was brought together to reevaluate our current resources and compare them with new resources that have been developed in recent years.

Objectives

The specific objectives of the Task Force include:

- Identify the strongest set of science resources for 6-9th grade science instruction in the following content areas:
    - Middle school physical science
    - Middle school Earth science

    - Middle school life science
    - High school Earth science
- Identify resources that were inquiry-based, research-supported, aligned with the Next Generation Science Standards, and were well suited to Maine students

Results

Throughout the year, RiSE staff members worked with 23 teachers and Master of Science in Teaching graduate students to evaluate science instructional resources. The task force selected three resources to pilot during the 2017-2018 school year and elected to hold off on making a decision regarding the middle school Earth science resources until the 3rd edition of our current resources are available to review.

Dissemination of Results

All steps of this process included extensive documentation of findings and data for each resource. Three task force members will be compiling a report detailing the process that was used and the decisions that were made that will be made available to the broader community and public.

Next Steps

Next steps include piloting the materials recommended by the task force and considering them for adoption by the Maine STEM Partnership at the end of the pilot year.

Ice Age Trail Place-Based Professional Development

In an effort to engage students in locally relevant science content and to support teachers in providing active inquiry-based learning in outdoor environments, the Ice Age program was designed to educate teachers about Maine's ice age history and support them in the development of lessons focused on this topic. To accomplish this the RiSE Center partnered with Dr. Hal Borns, founder of the Climate Change Institute at the University of Maine, to provide rich engaging content to teachers and then provided time for teachers to work collaboratively on developing instructional materials based on this information.

Objectives

The specific objectives of the Ice Age Program include:

- Increase teacher Earth science content knowledge in the context of Maine's glacial history
- Demonstrate ways to include guided inquiry field experiences in science education
- Support teachers in development of ice age lessons that are derived from local geological features

Results

The RiSE Center coordinated two Ice Age conferences during weekends in September and May.

During the fall conference 28 teachers attended and learned about the Maine Ice Age Trail located in downeast Maine and designed lessons that used this content knowledge. During the remainder of the school year 12 teachers participated in an affinity group to continue development of units related to the ice age in Maine that could be shared with the Maine STEM Partnership community. In May, 23 teachers attended the second conference focused on glacial and fluvial erosion in the Kennebec River Valley. Teachers then used this new knowledge to identify geological features near their schools and design lessons that would be relevant to their students.

Dissemination of Results

All lessons were shared with conference participants to continue to be developed. As lessons are completed they will be reviewed by the Maine STEM Partnership Curriculum Review Board and then shared with the broader community.

Next Steps

There will be a four-day summer workshop as well as an affinity group during the 2017-2018 school year to allow teachers time to continue unit development. As lessons are completed they will be reviewed by the Maine STEM Partnership Curriculum Review Board and once approved will be shared with the broader community.

Intensive Content Immersions

In the past year, we developed a new way to enrich teachers' STEM content understanding by tapping into the expertise of University research and instruction faculty. University faculty offered intensive content immersion weeks, designed specifically for K-12 teachers, focused on a variety of topics. Teachers were able to sign up to attend the content offerings that were most useful to them and with grant support, received a stipend to attend. This model is different from our original "Summer Academy" model, in that teachers can attend the content immersion weeks and benefit from them, regardless of the curriculum that they are using in their classrooms. This expands the reach of our programming.

Objectives

- Improve teachers' content knowledge for teaching STEM
- Support meaningful collaborations between University STEM faculty and K-12 STEM teachers
- Build a professional community that supports exemplary STEM teaching

Results in the Past Year

50 teachers participated in 3-day (24-hour) content immersions last Summer, with offerings in Chemistry, Earth Sciences, Physics (Energy), and Life Sciences. Some of the teachers participated in two content immersions. Participants found these to be extremely valuable

experiences. As one participant stated, "Through the content immersion class in chemistry I took last summer, I learned/relearned/refreshed content-area knowledge that let me better engage and explain. The methods demonstrated and materials used more actively engaged students and let them construct meaning from their experiences."

Dissemination of Results

Results were shared with the Maine STEM Partnership Leadership Team, through a community-wide share-out event held last September that included a panel discussion on the Content Immersion model, and through a panel discussion for new faculty/instructors interested in facilitating future Content Immersion workshops.

Next Steps

This summer, 149 teachers are signed up to participate in 11 content immersion offerings in earth sciences, chemistry, engineering, mathematics, physics, astronomy, and computer coding.

K-12 Leading Teacher Community: Assessment for Learning

The Assessment for Learning Community allowed teachers the opportunity to hone leadership skills in a variety of ways, while learning about Formative Assessment strategies. The sessions were a model that is an outgrowth of our previous Maine Elementary Partnership train the trainer model. Each evening meeting was facilitated by a teacher leader, where Science Resource Partners (SRPs) would receive the information they would then disseminate to their study groups at their schools.

Objectives

The specific objectives of the Assessment for Learning Community expand on some of the goals of the MainePSP:

- Deepen understanding of how to collect evidence of student growth and learning
- Strengthen proficiency with high-impact instructional strategies
- Support regional professional learning communities

Results in the Past Year

A total of 93 Science Resource Partner teachers and 410 study group members from 60 schools participated in meetings at 5 locations around the state: Northern Maine, Central Maine, Southern Maine, Downeast Maine, and MidCoast Maine. We offered 7 meetings throughout the 2016-17 school year, including a Release Day in Central Maine, to disseminate strategies one through five. During each meeting, one module was presented to teachers, which they took back to their schools to present to a study group of colleagues. Teachers reflected on the previous strategy at each meeting and discussed how the strategy was implemented into their classrooms.

Dissemination of Results

Experiences from this community have been shared with the leadership team and are being used to influence the design of the continuation of this program in the 2017-2018 school year.

Next Steps

We plan to continue running our 5 locations of meeting (north, central, downeast, midcoast and south) in the 2017-2018 academic year, and we are also looking to expand locations to include western Maine. We will disseminate modules for strategies 5 through 7 to SRPs and, in turn, to study group members, via SRPs. During the meetings, teachers will share and discuss samples of strategies used in the classroom.

K-16+ STEM Teaching and Learning Community

We adapted our long history of MainePSP Cohort meetings into Teaching and Learning Community our main vehicle for ongoing professional development and community building within the Kindergarten-16+ community. The evening and weekend meetings brought teachers, faculty and RiSE Center staff together to discuss common issues in science and mathematics education, content, and practices. These topics included how to teach students to engage in argument from evidence, waves, data literacy, orbits and Newton's Law of Gravitation, densities and how it relates Earth science topics, processes that shape the Earth, geometry, and common student misconceptions. These meetings allowed teachers to work together within grade bands and content areas on these various topics and teaching strategies. At each meeting, small group and whole group discussions followed to report out on the activities and how they could be utilized in a classroom.

Objectives

The specific objectives of the Teaching and Learning Meetings mirror those goals of the MainePSP:

Build and strengthen the science and mathematics education community.

Support new teachers in the MainePSP by working through activities in the curriculum.

Strengthen teacher content knowledge and pedagogical content knowledge by engaging them with data from their own classrooms.

Results in the Past Year

A total of 59 teachers from 23 districts participated in collaboratives at 2 locations in the state: Central Maine and Southern Maine. We offered 3 meetings in the fall semester, and 3 meetings in the spring semester, one being our Release Day held in Central Maine.

Dissemination of Results

Experiences from this community have been shared with the leadership team and are being used to influence the design of this program in the 2017-2018 school year.

Next Steps

We plan to continue running this community in the 2017-2018 academic year, however, in Central Maine only. We also plan to break the community into two types of meetings each week they are offered: one devoted to using the science resources provided by the RiSE Center, the other dedicated to specific teaching strategies and implementing the practices and crosscutting concepts of the NGSS.

Maine STEM Partnership Leadership Team

The Maine STEM Partnership Leadership team is comprised of teachers, administrators, faculty and staff from our partnership who have held leadership roles in our community. This group met monthly during the 2016-2017 school year to discuss the mission and vision of the Maine STEM Partnership and to guide the transition from the MainePSP and MaineESP into the Maine STEM Partnership @ the RiSE Center. This team played a key role in making decisions about Maine STEM Partnership professional development and resource programs for this year in addition to determining goals for these programs for next year.

Objectives

The specific objectives of the Leadership Team include:

- Guide the transition from the MainePSP and MaineESP into the Maine STEM Partnership
- Provide voice, feedback and oversight during our period of project transition that reflects the needs of all stakeholders in our community

Results

This group met seven times during the 2016-2017 academic year. A total of 25 members participated including 6 faculty, 8 staff, 7 teachers, 2 administrators, 1 small business owner, and 1 non-profit partner. Through monthly meetings, this group provided support and guidance for Maine STEM Partnership programs and goals. Their participation in this process ensured that all community stakeholders had a voice in the development of the Maine STEM Partnership.

Dissemination of Results

Meeting minutes are recorded during each monthly meeting. This information is used to design and improve RiSE Center initiatives.

Next Steps

This leadership team will continue to be a core component of the work we do at the RiSE Center. This team will continue to meet and provide direction to the development and growth of the Maine STEM Partnership as well as feedback to support program improvements.

Pre-Service Summer Academy and Design Week for Pre-Service Academy

Our first Pre-Service Summer Academy ran in Summer 2016 and was led and facilitated by RiSE staff in collaboration with the leading teachers who participated in the first Pre-Service Academy Design Week during Spring 2016. Another Design Week was held in Spring 2017 and a second Pre-Service Summer Academy will be held in Summer 2017. The Academy is a week-long intensive institute for pre-service middle and high school STEM teachers. The Design Team for the Pre-Service Summer Academy met for two full day work sessions to create, prepare and practice workshops sessions for the Academy.

Objectives

The specific objectives for Pre-Service Summer Academy expand on some of the goals of the MainePSP:

- Prepare workshops to lead pre-service teachers in core curriculum: talk science and assessment for learning
- Prepare workshops to lead pre-service teachers in core topics: inquiry instruction & student engagement
- Prepare workshops to lead pre-service teachers in electives: workshops by teachers for teachers
- Prepare leading teachers to support and providing quality professional development to pre-service teachers
- Support pre-service teachers in developing confidence and comfort in tackling situations that new teachers will face

Results in the Past Year

Last summer, 23 pre-service teachers from the University of Maine and three other campuses attended the Pre-Service Summer Academy. Participants found the academy to be a valuable experience and we were encouraged by the feedback to continue to offer this opportunity. Pre-service teachers enjoyed the workshops designed by veteran teachers as well as the opportunity to have relaxed professional discussions with practicing STEM teachers. The veteran teachers who designed the week felt that it was valuable to them as well.

In Spring 2017, 9 middle and high school teachers participated on the Design Team for the upcoming Academy, and these teachers will be part of the leading teacher team at the Pre-Service Academy in July. For the Design Week, we began our work by brainstorming topics that we thought would be important to share with pre-service teachers as part of this institute. We reviewed and approved a rubric created by last year's design team to provide feedback on the workshops and discussions that will be presented by leading teachers. Using the rubric and workshop topics list, teachers worked in pairs to create 50 minute workshops on a variety of topics and 30-minute lunch discussions. Each of these workshops was presented to the entire design team for feedback and polishing. Using the rubric we created, we provided each pair of

leading teachers with a collection of feedback to inform the next iteration of their workshop design.

New activities at this year's summer academy will include a panel discussion with principals and administrators, job interview preparation, resume and cover letter writing. Activities continued from last year included a session on working with the academic data that your school provides and using data to make decisions. how to prepare for a substitute teachers, and a session on using inquiry-based teaching.

Dissemination of Results

Survey feedback from the Summer Academy (which was extremely positive) was shared with the Maine STEM Partnership Leadership Team and with our external evaluator (Inverness Research). In addition, feedback from Inverness Research and from the veteran teachers who led the Academy last year, was used to revise plans for the upcoming Academy. One specific change was to replace a "lesson demo" activity, with some of the new activities (such as the principal and administrator panel) that will be offered this year.

Next Steps

Our leading teachers will co-lead the Pre-Service Summer Academy in July, sharing the workshops and discussions they created and refined with the pre-service teachers.

Talk Science Institute

The Talk Science Institute consisted of two one-day workshops designed to support teachers in using Talk Science during classroom discussions. The first workshop was geared towards teachers who were new to using Talk Science in their classrooms and to provide an overview of how to get started. The second day was designed for teachers who are skilled at using Talk Science and wanted to learn more advanced means of holding Talk Science discussions in their classrooms. Teacher leaders who were experienced in using Talk Science lef both of these workshops.

Objectives

The specific objectives of the Talk Science Institute for teachers new to Talk Science include:

- Investigate why talk is important for learning
- Discuss characteristics of Productive Talk and how to establish a classroom culture of Productive Talk
- Share tools for practicing Talk Science in the classroom
- Introduce and prepare for next year's Talk Science Professional Development Plan

The specific objectives of the Talk Science Institute for teachers who are experienced with Talk Science include:

- Reflect on how we are currently using Talk Science
- Review data connecting Talk Science to student writing
- Connect Talk Science to WRITEscience
- Discuss ways to take Talk Science to the Next Level

Results

During these two days, 22 teachers attended the new to Talk Science workshop and 10 teachers attended the Talk Science workshop for experienced users. Teachers who were new to Talk Science were introduced to the value of using productive talk during discussions. They were also provided with suggestions for establishing a classroom culture through the development of class norms that supports using productive talk in the classroom. Experienced teachers reviewed researcher data showing how productive talk supports student writing and argumentation skills and worked to identify the types of questions that best support a Talk Science discussion.

Dissemination of Results

Experienced teachers will have the opportunity to lead Talk Science training sessions during the 2017-2018 school year to train teachers how to have productive discussions in their classrooms. The teachers who are new to Talk Science can attend these meetings as Science Resource Partners and bring back the information to share with other teachers in their school or district.

Next Steps

The RiSE Center will be implementing a train-the-trainer professional development program during the 2017-2018 school year to train teachers in the use of Talk Science. Teacher leaders will design each of the modules during a summer academy and then lead seven sessions during the academic year.

Teaching Pods

Teaching Pods were established to bring together a network of K-12 STEM teachers, joined by Master of Science in Teaching (MST) graduate students, RiSE Faculty, and Undergraduate STEM Education Professional (USEP) program students to create lesson plans and assessment around a particular topic with which students have conceptual difficulties.

Objectives

The goals of the teaching pods included:

- Curricular development in STEM disciplines that aims to meet the needs of the larger community of teachers through the RiSE Center and across the state.
- Collaboration with in-service and pre-service teachers.
- Pre-service teachers are given the chance to learn about curriculum development and work with with teaching professionals, while giving fresh perspectives to the

planning process.

Results

The 2016 Summer teaching pods included a group focused on Physics - Waves, Biology - Evolution, Mathematics - Linear equations, and Earth Science - Astronomy. Summer 2016 teaching pods included 28 K-12 STEM teachers, 10 USEP students, 15 MST graduate students, and 4 content expert consultants from UMaine.

Dissemination of Results

Work completed during the Teaching Pods was presented to the Maine STEM Partnership Curriculum Modification Review Board at the end of Summer 2016. Lessons and units that were ready for piloting were shared with the teaching community through a Summer Share-Out session held in September. Affinity Group meetings throughout the year continued to work on some aspects of the lessons and units.

Next Steps

During the Summer of 2017, the format of the teaching pods will be modified slightly to include one week of content immersion workshops in a variety of disciplines, followed by one week of Teachers-in-Residence (TiR) in which teachers, undergraduate and graduate students, and faculty will work on lesson and assessment development. The three 2017 TiR groups will be focused on: Geometry, Quadratic Functions, and Expressions and Equations. 2017 TiR groups will include 20 K-12 STEM teachers, 4 USEP students, 2 teacher facilitators, 2 MST facilitators, 4 MST student participants, and 3 content expert consultants from UMaine.

3-D Printing Workshop

The 3D Printing workshop was a four-day summer academy designed to train teachers in the use of 3D Printers and allowed teachers to collaborate on lessons that effectively used the 3D Printers in the instruction of material they currently taught. These lessons were used by teachers during the school year during the RiSE Center 3D printer loan program. Teachers were able to request to borrow one of the RiSE Center's 3D printers for a three-month period in order to teach 3D printer supported lessons in their classroom.

Objectives

The specific objectives of the 3D printer summer workshop include:

- Train teachers to design 3D objects using CAD Programs: Tinkercad and Onshape
- Train teachers to print 3D objects using MakerBot 3D Printers
- Support teachers in the development of instructional materials that support the use of 3D printers in the classroom

- Identify content in current RiSE instructional materials that could be supplemented using 3D printer lessons

The specific objectives of the 3D printer loan program include:

- Provide teachers with a 3D printer to use in their classroom
- Support teachers in supplementing RiSE instructional resources with an engineering design component

Results

During the summer program 19 teachers were trained to design and print 3D objects. These teachers worked in groups to design lessons that utilized 3D printing as a means to supplement current RiSE Center instructional resources. During the school year, 14 teachers were able to request and borrow a 3D printer to use in their classroom for a portion of the year.

Dissemination of Results

All 3D printer supports and lessons developed by the teachers were compiled and can be accessed by the broader community through the Maine STEM Partnership website.

Next Steps

This program will be continued through further training during summer 2017 during a second 3D printer workshop. Printers will continue to be available to teachers to borrow during the school year to use in the classroom.

WRITEscience Leadership Institute

This program involved six teachers who came together to explore the connections between science and writing. This group was interested in expanding on professional developments from the National Writing Project and the RiSE Center in order to create teaching demonstrations that they can share with other teachers regarding how to effectively teach the integration of science and writing. The emphasis of this program is on becoming a teacher-consultant for the Maine and National Writing Projects.

Objectives

- Consider the intersections of science, teaching and learning, and writing
- Practice integrating science and writing through several science writing projects
- Reflect on personal experience with science, teaching and learning, and writing, through writing a science learning autobiography and present your autobiography to the group
- Design a multi-genre piece on a science topic and present it to the group
- Develop teaching demonstrations and prepare teachers to present them as a teacher consultant with district and regional learning communities around the state

Results

During the week teachers practiced integrating science and writing through a series of projects.

Each participant created a multi-genre report and presented their project to the group. They spent time at a local nature preserve to practice science journaling techniques using plants and wildlife as subjects. In addition, teachers wrote and presented a science learning autobiography.

They used their experiences to develop teaching demonstrations that they could use to share science writing techniques with other teachers. They continued to develop these over the next couple of months. Once they were finished these teachers presented them to other teachers in the community.

Dissemination
Teachers from this workshop have completed district presentations at their home districts and presented at the RiSE Center Fall Summit. Some of these teachers were also asked to share their teaching demonstrations at other districts around the state. One teacher also presented at a Maine Education Association conference.

Next steps
These teaching demonstrations will also be presented at a National Education Association conference and a second Maine Education Association conference

Programs and Activities Continued from 2015-16

As a result of obtaining supplemental funding from the National Science Foundation, we were able to continue several programs and activities over the past year, in addition to our many other ongoing programs and activities. The programs and activities continued from 2015-16 are listed below, followed by a detailed write-up of each activity.

- Coaching Institute
- Faculty Course Modification Incentive Grant and Maine Learning Assistant (FIG-MLA) Program
- High School Collaboratives
- Leadership Academy
- MainePSP Materials Warehouse
- Maine STEM Partnership Fall Summit
- Master of Science in Teaching (MST) Bridge Program
- New Teacher Professional Development
- Teaching Partner Program
- Responsive Data Analysis
- Survey Alignment and Re-Design Process
- Undergraduate STEM Education Professional (USEP) Program
- University Classroom Observation Program (UCOP)

Coaching Institute

The Coaching Institute prepares leading teachers to provide high-quality instructional coaching

for pre-service teachers, student teachers and new teachers in their buildings. Our specific purpose was to create and host a professional learning community of classroom-based Coaching Teachers working collaboratively to strengthen pre-service teacher development and support induction of new teachers through one-on-one relationships and building their communication skills.

Objectives

The specific objectives of the Coaching Institute expand on some of the goals of the MainePSP: Develop skills to improve dialogue and engagement and practice skills to effectively and comfortably participate in crucial conversations.

Results in the Past Year

4 middle and high school teachers participated in this coaching institute. We kicked off our work in January by introducing the Focused-model of Crucial Conversations Training that the group would complete in this training. We then met as an ongoing professional learning community monthly January - April. The program was provided by Beth ByersSmall a VitalSmarts® trained facilitator for Crucial Conversations®.

Dissemination of Results

We have shared the structure and content of our coaching institute with the Maine Maine STEM Partnership Leadership Team.

Next Steps

We plan to integrate our work preparing veteran teachers as coaches into our Pre-Service Summer Academy this upcoming summer, utilizing the expertise of these veteran teachers to provide coaching and feedback to pre-service teachers.

Faculty Course Modification Incentive Grant and Maine Learning Assistant (FIG-MLA) Program

The core goal FIG-MLA program is for more undergraduates to experience learning STEM content in courses that make use of research-supported instructional practices. The courses that are modified as part of the FIG-MLA program will create enhanced learning opportunities for undergraduates because of the addition of student-centered, research-supported instructional practices. The targets of the FIG projects are courses where pre-service teachers receive their content preparation (either as part of a STEM major or as a content component of a STEM education major). All projects make use of undergraduate Maine Learning Assistants (MLAs) as part of the instructional modifications.

Objectives

Increase the number of undergraduate courses taught using student-centered, active learning

approaches; improve learning opportunities for pre-service students in their undergraduate STEM courses; create teaching-related professional development opportunities for STEM faculty instructors; create a community among STEM faculty that supports research-based instructional change.

Results

Our fifth cohort of FIG recipients carried out their course modification projects, in addition to the continuation of the first, second, third, and fourth cohorts. Cohort 5 included 13 new courses (nine new faculty), representing nine departments. As in previous years, these faculty were selected based on written proposals they submitted that included descriptions of their proposed course changes, the rationale for those changes, their plans for incorporating undergraduate learning assistants into their courses, and strategies they will use to assess the impact of the changes on the course and students' learning opportunities.

The number of students enrolled in FIG-MLA courses during the 2016-2017 academic year was over 4200. The faculty gathered data on their students' performance and attitudes and analysis of those data has begun.

Our sixth cohort of FIG recipients have been selected and will begin their course modifications in 2017-2018. Cohort 6 includes eight new courses (four new faculty), representing six departments. The student enrollment in FIG-MLA courses during the 2017-2018 academic year is estimated to be over 5000.

With these new courses, the set of departments represented by the FIG-MLA program now includes 14 departments. We are renewing the funding for all active FIG-MLA recipients and they will be analyzing their data and then teaching a revised version of their course in the coming academic year.

We met with FIG faculty once each semester during the 2016-2017 year. These meetings were an opportunity to discuss topics of relevance to all faculty, such as questions pertaining to MLA implementation.

Examples of project descriptions include:

> Enhancing students' opportunities to engage in authentic forms of inquiry-based, scientific writing so they can improve their knowledge and their scientific communication skills.
>
> Using clickers to facilitate peer discussion and to study how knowledge of peers' answers shapes peer-to-peer discussions. Also using MLAs to help with in-class small group

activities.

Enhancing students' opportunities to learn during small group discussions in lab by having MLAs as facilitators for those discussions. Also enhancing student engagement with clicker questions in the classroom by having MLAs present to facilitate.

Incorporating clicker discussions, small group tutorials, and metacognitive and system design activities in an electronics laboratory.

In the past academic year, we carried out the data collection plan that we had developed in previous years. Data were collected from the following sources:

(1) Students in transformed courses
- Content survey (administered before and after instruction)
- Perception of the discipline survey (administered before and after instruction)
- Questionnaire about the impact of MLAs on course experience (middle of the semester and again near the end of instruction)

(2) Maine Learning Assistants
- Content survey (administered before and after instruction)
- Perception of the discipline survey (administered before and after instruction)
- Questionnaire about their experiences as MLAs (middle of the semester and again near the end of instruction)

(3) Global Measures
- Number of undergraduate MLAs, courses, faculty, and departments impacted
- Retention data
- Number of students earning a grade of D or F, or withdrawing (DFW) from courses
- Selectivity of MLA program

A total of 116 undergraduate Maine Learning Assistants worked during the 2016-2017 school year, with a total of 59 new to the MLA program who also enrolled in a seminar about teaching and learning (as a co-requisite to a student's first year as a MLA).

We continue to adapt the MLA seminar to accommodate a diverse assortment of STEM majors, including those who do not have backgrounds in the physical sciences. This course is based on the University of Colorado's pedagogy course for LAs (undergraduate peer facilitators). At this point, we have assembled a relatively extensive collection of suitable articles; while core articles are unchanged from semester to semester, certain articles are added to or removed from the course readings based on MLA interest. We continue to find that group presentations about articles on discipline-specific ideas ensure that MLAs think deeply about the learning and teaching of content related to their teaching assignments; moreover, the quality of the

presentations during the 2016-2017 academic year was highest we have seen since implementing the discipline-specific presentations. In addition, in-depth discussions about videos of teaching and instructor-student interactions in a variety of instructional setting continue to be a key part of the course. We continue to update and revise the course content and activities.

Dissemination of Results

A 2016-2017 FIG-MLA report was written for dissemination to UMaine administrators and to FIG faculty and is included in this report.

Next Steps

The FIG-MLA program recently received funding from the University to continue the program into the future. We plan to continue and expand the data collection and analyses to examine the impact of the FIG-MLA program on the various stakeholders. These data will guide modifications to various elements of the programs (including, for example, the MLA seminar).

High School Collaboratives

High School Collaboratives have allowed us a platform to expand the MainePSP into 10-12th grade and from physical science into life science and mathematics.

Objectives

The specific objectives of the High School Collaboratives expand on some of the goals of the MainePSP:

Deepen content knowledge and pedagogical content knowledge for high school teachers
Strengthen proficiency with high-impact instructional strategies
Support regional professional learning communities

Results in the Past Year

A total of 158 high school teachers from 68 high schools participated in collaboratives at 5 locations around the state: Northern Maine, Central Maine - Bangor, Central Maine – Winslow, Southern Maine and Downeast Maine. We offered 2 collaboratives in the fall and 2 in the spring for a total of 4 during the 2016-17 school year. We hosted groups for mathematics, physics, chemistry, Earth science, and biology. During the first half of the meetings a teacher selected by the content teachers shared a specific successful strategy. The second half of the meeting allowed each teacher to share an artifacts or strategy. These artifacts or strategies often led to the group requesting to hear more and selection of teachers to share out at the next meeting.

Dissemination of Results

Experiences from this these collaboratives have been shared with the leadership team.

Next Steps

We plan to continue running our five locations of collaboratives (central, downeast and south) in the 2017-2018 academic year, and we are also looking to expand to western. We will continue to recruit teachers from additional schools to attend.

Leadership Academy

Teachers in the Maine STEM Partnership Community were invited to attend a 3-day intensive Leadership Academy to support development of their leadership skills.

Objectives

The specific objectives of the Leadership Academy were:

- Support the role and work of teacher leaders within our community
- Support the work of individual teacher leaders in their home district and schools
- Provide teacher voice, feedback and oversight during our period of project transition

Results in the Past Year

A total of 28 teachers participated in the Leadership Academy this year. Teachers reflected on their current role as a leader and spent time identifying and developing their leadership skills. The group discussed facilitation skills, barriers to stepping into leadership roles, and ways to move past these barriers to become a more successful leader in a variety of situations. Teachers also participated in training on how to conduct "Crucial Conversations" in professional settings.

Dissemination of Results

This is a part of our ongoing work in developing a professional community of teachers who are able to lead in their schools and districts, as well as in our improvement community. Results of this work so far have been disseminated through a research project focused on development of teacher leadership, which is described in more detail in our research report.

Next Steps

Teachers who participate in the Leadership Academy will be integral in leading professional development programs for the RiSE Center during the coming year. These teachers will be able to step into facilitation and leading roles in each of our professional development communities

MainePSP Materials Warehouse

Since the MainePSP Curriculum Selection Task Forces selected materials in 2010-11 for middle school physical sciences and in 2011-12 for high school physical sciences, the RiSE Center has provided a materials warehouse (the MainePSP Warehouse) for our school and district partners. The MainePSP Warehouse is staffed by one or more Resource Coordinators, who work closely with partners to coordinate teachers' needs for materials. Coordination allows the entire community to share materials, to provide high-quality science materials to students in a way that is cost-effective for schools.

Objectives

The purpose of the MainePSP Warehouse is to provide high-quality instructional materials to teachers and students, including teacher and student books, and all materials needed to conduct extensive hands-on inquiry-based activities as recommended in the selected materials (SEPUP, PBIS, and EarthComm) as well as by MainePSP Teachers in Residence.

Results in the Past Year

A total of 146 teachers and 5,386 students in grades K-9 from 57 schools and 26 districts, obtained materials through the MainePSP Warehouse. For the first time, the MainePSP Warehouse was staffed by a single Resource Coordinator where in the past there have always been multiple Resource Coordinators. In addition, the MainePSP Warehouse expanded to provide materials to teachers in K-5, who participated in the RiSE Center's Elementary Sciences Partnership.

In order to improve the potential for sustaining the MainePSP Materials Warehouse beyond the lifetime of the MainePSP and MaineESP grant funding, school districts began to financially support the Warehouse by paying $12 per student for their books and materials.

Next Steps

For the coming year, school districts have been asked to include support for the MainePSP Warehouse in their budgets.

Maine STEM Partnership Fall Summit

We hosted our 6th annual summit in the fall at Point Look Out, bringing together our entire community for a focused celebration and conference on teaching and learning. The theme of our summit this year was Collecting Meaningful Evidence to Guide STEM Education Improvement.

Objectives

The specific objectives of the Summit expand on some of the goals of the MainePSP:

- Bring together members of our PreK-16+ communities, including the *MainePSP* and *MaineESP*, as well as new community members, for this first gathering of the *Maine STEM Partnership at the RiSE Center*.
- Learn about the breadth and depth of STEM education improvement work that our community is doing.
- Celebrate the successes and learn from our work as a community as we make plans and discuss priorities for the coming year.
- Provide opportunities for community members to share and learn formative assessment skills and strategies.
- Develop evidence-guided plans for improved preparation and support for science and

mathematics teachers.
- Learn about national and local research and evidence-based evaluations to improve teaching and learning outcomes in STEM disciplines.
- Share strategies across content areas and grade levels to guide further improvements in STEM education for all of our students PreK-16+.

Results in the Past Year

A total of 162 participants from 70 schools and 52 districts attended the fall Summit. This was broken down into 43 elementary teachers, 34 middle and high school teachers, 10 pre-service teachers, 8 faculty and 8 project team, and 24 partners, presenters and guests. In the two days, we hosted several strands focus on sharing best practices and research on the topic of active learning and student engagement. Through panels, invited talks, keynote presentations, workshops and working groups, participants deepened their knowledge and exposure to these themes and the work being done in this field.

Dissemination of Results

We made conference proceedings available to participants of the conference as well as others in our partnership who were unable to attend. Our summit planning committee also uses the findings and feedback from this summit to inform and improve the plans for the next summit.

Next Steps

We plan to continue running an annual Summit each fall focusing on a theme within evidence-based strategies for effective teaching.

Master of Science in Teaching (MST) Bridge Program

Over the past two years, the RiSE Center has developed the Master of Science in Teaching (MST) Bridge program. This program now supports and expands the work of the NSF Teaching Fellows program. Through the MST Bridge, leading teachers from the MainePSP (and now Maine STEM Partnership) Community co-teach and support MST courses, including STEM content and pedagogy courses, and the student teaching seminar that accompanies MST students' student teaching internship. Leading teachers have also formed a pool of mentors who partner with MST students (including those who have received an NSF Teaching Fellowship) to support them during their pre-service preparation and induction into teaching. As part of the program, MST students work with leading teachers in teaching pods (see section on Teaching Pods in this report) and during Teachers in Residence weeks over the summer months.

Objectives

- Bridge the gap between theory and practice of teaching by offering Master of Science in Teaching students mentorship and teaching experiences as part of their pre-service teacher preparation

- Induct pre-service teachers into a professional community of educators in order to support them through their early years of teaching and improve STEM teacher retention

Results in the Past Year

Twenty-eight teachers and 15 MST students collaborated through Teaching Pods during Summer 2016, developing instructional units in mathematics, life sciences, astronomy, and physics. During the academic year, 5 leading teachers supported or co-taught MST courses in the past year. In addition, 8 leading teachers participated in the Design Week for the Pre-Service Summer Academy, 4 teachers participated in Coaching Club meetings throughout the year in order to provide mentorship for MST students, and 5 veteran teachers participated as part of a pool of mentors to support MST students.

Next Steps

9 veteran teachers will lead the Pre-Service Academy for MST students and other pre-service teachers in July and 22 teachers will join 6 MST students in Teachers in Residence activities in Summer 2017.

New Teacher Professional Development

This targeted professional development focused on teachers who were new to our partnership and community. The goal was to prepare them for using our common instructional resources, and introduce them to teacher who would provide support during their upcoming school year.

Objectives

The specific objectives of New Teacher Professional development support the goals of the MainePSP:

- Prepare new-to-partnership teachers to effectively use our community's instructional resources
- Introduce new-to-partnership teachers to the value of inquiry pedagogy in science teaching
- Introduce new-to-partnership teachers to the concept of data-guided improvement community and show them how to be an active participant and get the most out of their participation

Results in the Past Year

A total of 6 teachers participated in new teacher professional development sessions in August. We brought in veteran teachers from our community to introduce the new teachers to our community resources and how they work.

Dissemination of Results

We have shared the results of this professional development with the Maine STEM Partnership

leadership team and design teams, and will use the lessons learned when offering this program this year to improve our offering for next year.

Next Steps

We have found this professional development to be an effective way to orient new teachers to our community and we will be offering this program again next year with a fee to districts.

Teaching Partner Program

The MainePSP offers a Teaching Partner Program for MainePSP teachers. The program matches teachers with a Teaching Partner (an undergraduate or graduate student) who spends regularly scheduled time in the teacher's classroom helping the teacher with instructional materials and small group work. The aim of this program is to provide a mutually positive and beneficial experience, wherein the teacher receives additional support from a University student who is familiar with the instructional materials and science content, and the University student experiences the science teaching and learning process in a K-12 classroom.

Objectives:

- Provide assistance to the teacher in the classroom.
- Provide pre-service teachers with classroom experiences in a science classroom.

Results

Twenty-five teachers had a Teaching Partner visit their classroom at least once this year. Self-reporting by teachers and Teaching Partners shows us that the experience is positive for both groups.

Next Steps

The Teaching Partner program has become a requirement for Master of Science in Teaching graduate students that have been selected to be National Science Foundation Teaching Fellows. We are also working with the faculty from the School of Earth and Climate Sciences to offer a Teaching Partner experience for undergraduate Earth science students who are considering teaching as a career.

Responsive Data Analysis

Throughout the life of the MainePSP, we've seen a strong demand from teachers to be able to see their students' content survey data. Unfortunately, the time and effort involved in making these reports rendered our response to this demand rare. In summer 2015, we decided to pursue the ability to efficiently produce reports of data. Using Excel, workbooks were created that would automatically produce figures and statistics about multiple-choice data. The figures could then be linked to a Powerpoint template and saved as a basic report. Last year, the primary user of the analysis tool was the tool's designer. This year, the primary user was new to the auto-analysis tool. While the auto-analysis tool was usable for meeting report demands, set-up and

familiarization by the new user highlights some aspects of the tool that need improvement.

Objectives

- Utilize digital tools to efficiently analyze and report any multiple-choice survey data
- Give teachers the option of receiving reports of their students' data in near-real-time
- Identify how the auto-analysis tool might be revised to improve broader usability

Results

On identifying areas of improvement: During set-up, the most salient shortcoming of the tool was its lack of usability for a variety of multiple-choice formats. Particularly, for multiple-response formats, for which participants are permitted to select several correct responses. This shortcoming was resolved by the addition of a design field which allowed for the specification of question value. While the addition of this field solved the issues in reporting capabilities, it raised new issues related to the tool's research capabilities. Set-up and use of the auto-analysis tool also highlighted the need for a polished version. As it stands, the tool is certainly usable, but the steepness of the learning curve could be mitigated by carefully organizing the parts of the tool that the user interacts with.

On reporting to teachers: We've been able to produce and distribute roughly 90 data reports to the roughly 26 teachers that have requested reports of their respective students' 2015-16 content data. The time between receiving the data and sending a report out was almost always within a week, often within several days. The teachers were then using the reports for a variety of educational purposes, such as measuring student learning outcomes (SLOs).

Dissemination of Results

Over the past year, roughly 26 teachers have requested reports of their data. We've been able to fill all of those requests, sending out roughly 90 reports throughout the school year. The reports are almost always produced and sent out within a week of receiving the data, often within just several days.

Last year, we piloted a new format of professional development session within our community: the data session. While these sessions facilitated productive discussions of data within our community, only a total of 10 teachers attended this session format. As such, this session format is discontinued at the moment. However, student data is still presented and discussed (to a lesser extent) in some of our other professional developments and conferences.

Next Steps

At this point, the auto-analysis tools are ready for reporting and PD purposes. However, knowledge and directions on using these tools is not well-disseminated. As such, the major next steps would be to: a) revise the auto-analysis tool to be conducive to varied data formats and b) polish the layout of the tool and finalize instructions on how to utilize it. Meeting this objective would facilitate the use of this tool for projects by various parties within and without the RiSE Center.

Related Talks

Rogers, A. Z. Toward Sustainable Data Analysis: An Accessible and Comprehensive Analysis

Tool. Presentation, Maine RiSE Center Research Group, University of Maine, Orono, ME.

Survey Alignment and Re-Design Process: Aligning MainePSP Surveys to NGSS and Curricular Materials

Each year, the MainePSP distributes content surveys to investigate student thinking in each curriculum. Typically, these surveys undergo a process of revisions during summer in preparation for the coming school year. During the summer of 2015, we extensively revised most of these surveys to better meet the instructional and research needs of our community. This meant shifting away from national comparability, and moving toward trying to characterize more complex and subtle aspects of student thinking, relevant to the NGSS and our curricula. Following these more extensive revisions, in the summer of 2016, many of the survey revisions involved revising existing questions, adding new questions, or adding related open responses questions. The exceptions were the EarthComm surveys, which—upon recognizing the lack of coherence amongst existing questions—underwent extensive revisions for the 2016-17 school year.

Objectives

- Revise the content surveys to better elicit or characterize knowledge pieces held by students before and after instruction

Results

SEPUP Earth Science Surveys and PBIS/SEPUP Physical Science Surveys: These surveys saw extensive revisions during the summer of 2015. Among the changes, these surveys were made to be entirely multiple choice, with more coherent sets of questions. The data from these more coherent sets of questions allowed us to make informed hypotheses about the productive and unproductive knowledge pieces held by students. Based on these hypotheses, we revised the questions to better characterize student ideas within particular content standards, and added related open-response questions to elicit more complex, subtle student thinking.

EarthComm Earth Science Survey: This survey had remained largely unchanged for the 2015-16 school year. In reviewing the data collected from the 2015-16 school year, we realized that the questions were less coherent, and therefore less conducive than the other surveys for hypothesizing what knowledge pieces students had or developed within particular standards. As such, many questions were revised, removed, or added for the 2016-17 version of the survey. As with the SEPUP ES and PBIS/SEPUP PS surveys, these revisions included a mix of multiple-choice questions and related written questions.

Dissemination of Results

For the 2015-16 year, the surveys had roughly the following number of online student responses pre- and post-instruction:

Curriculum	Survey	Pre-Instruction	Post-Instruction
SEPUP ES			
	Unit B	261	197
	Unit C	169	215
	Unit D	257	266
	Unit E	135	120
	Unit F	107	107
PBIS/SEPUP PS			
	Energy	366	235
	Chemistry	429	251
	VIM	262	153
EarthComm			
	Mod 1	237	169
	Mod 2	143	66
	Mod 3	142	42
	Mod 4	43	38
	Mod 5	30	16

Teachers also had the option of administering the surveys on paper and bubblesheets as necessary. We did receive some data on paper, though we greatly encouraged administering the surveys online and therefore the table above reflects the majority of data collected.

Next Steps

Over the year, some revisions have been suggested by teachers and realized during professional development and research. This summer, we'll briefly revisit the surveys to evaluate whether any questions need to be edited, replaced, or removed to better address student learning for the 2017-18 school year.

Related Workshop and Poster

Millay, L. & Rogers, A. Z. Assessing Student Learning of Science Content: Designing and Interpreting Tasks. Workshop, RiSE Summer Conference 2017.

Rogers, A. Z. & Millay, L. Using Data to Revise Content Surveys in the Maine STEM Partnership. Poster, RiSE Summer Conference 2017.

Undergraduate STEM Education Professional (USEP) Program

The Undergraduate STEM Education Professional (USEP) program is a collaboration between STEM and STEM education faculty, Master of Science in Teaching (MST) graduate students, middle and high school STEM teachers, and selected undergraduate students from STEM majors. Students spend part of the summer focusing on and implementing an education research project; two days are spent at the RiSE Conference, two of the weeks are spent in a group with teachers and MST students focusing on a specific discipline (life science, physics, mathematics, or earth science); and the last week is spent attending a Pre-Service STEM Teaching Summer

Institute at the RiSE Center.

The purpose of the USEP program is to encourage strong STEM students to consider teaching careers as well as expose them to educational research. Interested students go through a formal application, interview and selection process and are chosen on the basis of their performance in STEM courses and a demonstrated interested in teaching. The USEP students work with a faculty advisor (and sometimes one or more MST students) to develop and implement an education research project in their discipline. Following the education research component of the USEP program, students work with schoolteachers to enhance the instructional resources that support new teachers as they learn to implement curriculum in the classroom. The intent is to provide teachers with supporting materials, pedagogical insight, and discussions focused on best practices and teaching strategies that will help them improve their teaching. In the process, the students and the teachers help each other strengthen their content and pedagogical content knowledge. The USEP program is one of the campus-based initiatives through which college students may enter the MainePSP community and they will continue that connection by being a part of the Maine Learning Assistant and/or the Teaching Partner programs. These experiences may ultimately lead them to pursue the Master of Science in Teaching and/or the Ph.D. in STEM Education programs at the University of Maine, professional positions as teachers in MainePSP schools, or as members of Maine's larger educator community.

Following the 2016 USEP program, we received feedback and suggestions for improving upon the program, and many of these changes are being implemented in the 2017 USEP program. Some of the changes include: lengthening the summer program (10 weeks compared to 6 weeks); including elementary, middle, and high school classroom observations in the first few weeks of USEP; completing the education research projects before moving onto the work with teachers; adding a Teaching 101 day with USEP students prior to work with teachers; and adding content immersion workshops for various disciplines for teachers, MST students, and USEP students prior to curricular development work.

Objectives

Provide professional development opportunities to undergraduate students in education research and in pre-college instructional design.
Encourage their interest in teaching and support their pedagogical development and learning.
Support research faculty by providing assistance of capable undergraduate students.
Encourage partnerships between K-12 teachers and college students.

2016 USEP Summer Program

Ten undergraduate STEM majors were selected from 32 applicants for USEP positions and worked with 10 MST graduate students, and 6 STEM or STEM education faculty on nine different education research projects.

The 2016 USEP Summer Program schedule:

Education Research: June 13 - July 22
RiSE Conference: June 26-28
Curricular/assessment development with teachers: July 5-15
Pre-Service STEM Teachers Summer Institute: July 18-21
Research presentations: July 22

In culmination, the USEP students delivered presentations about their work to the research community at the end of the summer. At the beginning of the school year, the summer work in the teaching projects were presented at a meeting with the whole RiSE/PSP community.

Following the 2016 USEP Summer Program, materials from the teacher curriculum development sessions were presented to the Curriculum Modification Review Board, and two of the lessons (Algebra and Physics) are in consideration for piloting next year.

2017 USEP Summer Program

Four undergraduate STEM majors were selected from 34 applications for USEP positions and are currently working with 3 MST graduate students and 4 STEM or STEM education faculty on 4 different education research projects.

In culmination, the USEP students will deliver presentations about their work to the research community at the end of their 7 weeks of research. At the beginning of the school year, the summer work in the teaching projects were presented at a meeting with the whole RiSE/PSP community.

The 2017 USEP Summer Program schedule:

Education Research: May 22 - July 6
High school classroom observations: May 22-27
Middle school classroom observations: May 29 - June 2
Elementary school classroom observations: June 5-9
RiSE Conference: June 25-27
Research presentations: July 6
Teaching 101 workshop: July 7
Content immersion workshops with teachers: July 10-14
Curricular/assessment development with teachers: July 17-21
Pre-Service STEM Teachers Summer Institute: July 24-28

Next Steps

Later the Summer, the USEP students will work with additional MST students and teachers on four different projects related to evidence-guided teaching and improving instruction in middle and high school.

Following the 2017 USEP Summer Program, lesson materials and assessments created by the teachers and students will be submitted to the Curriculum Modification Review Board for possible dissemination to the larger RiSE community.

University Classroom Observation Program (UCOP)

Because of the national call-to-action to reform undergraduate STEM instruction, there is increasing interest in collecting information on the range and frequency of teaching practices at department-wide and institution-wide scales. To help facilitate this process, we helped to develop a classroom observation protocol known as the Classroom Observation Protocol for Undergraduate STEM or COPUS (Smith et al., 2013). This protocol allows observers, after a short 1.5-hour training period, to reliably characterize how faculty and students are spending their time in the classroom.

At the University of Maine, local middle and high school teachers have been using the COPUS observation protocol to collect snapshots of the types of instructional techniques used in STEM classes. This year, 48 middle and high school teachers submitted applications to participate in the UCOP program and 26 were selected. The selected teachers completed 221 observations, representing 92 unique UMaine STEM courses with total enrollment of over 6800 University of Maine students, taught by 91 instructors from 23 departments. New research was launched to compare instructional strategies in at middle, high school, and university levels. In 2013, Drs. Michelle Smith, MacKenzie Stetzer, Susan McKay, and Jeff St. John, who were awarded an NSF WIDER grant (DUE 1347577) to explore how to use the observation data to develop meaningful campus-wide professional development opportunities at the University of Maine, have been implementing additional new professional development programs under the WIDER program. During the 2017 UCOP, a new component was added - a half day for faculty and teachers to discuss teaching and learning in an open dialogue, including a whole group question and answer session. Teachers developed a list with a variety of topics to discuss with faculty and the faculty were able to select a table/topic to discuss with teachers. The topics included: use of technology, teaching strategies, classroom norms and culture, educators' common ground, assessment, students' transition to college, student engagement, and broadening participation in STEM disciplines. We also included an hour question and answer time for faculty and teachers, alternating between teacher and faculty questions for one another with the whole group listening and commenting. A total of 19 faculty and 26 teachers participated in the ½ day event.

Project Dates

The project began in 2011, but has been modified over the five-year period. The project is currently ongoing. Observations take place during the spring semester. Observation results were shared and discussed with the observed UMaine instructors in one-on-one meetings with the

program coordinator.

Data collected

1. COPUS observation data of faculty - 221 observations of 91 STEM instructors.
2. UMaine faculty filled out a survey about the types of teaching strategies used as well as a request for any specific feedback they would like from teachers (such as "were the students engaged?" and "what suggestions do you have for better engaging the students?").
3. UMaine faculty filled out a survey about their teaching practices. This survey is called the Teaching Practices Inventory (Wieman and Gilbert, *2014* CBE-Life Sciences Education).
4. UCOP teachers completed post-observation surveys for each class observed. One survey was completed as an observation pair and another was completed by each teacher individually. Both surveys were developed by MST student, Justin Lewin.
5. Middle and high school teachers filled out feedback surveys about their observation experience.

Findings

As described in a recent publication: Lewin JD, Vinson EL, Stetzer MR, Smith MK. A campus-wide investigation of clicker implementation: The status of peer discussion in STEM classes. CBE-Life Sciences Education. 2016, 15:1-12.
http://www.lifescied.org/content/15/1/ar6.full

We have found:
1) Investigation of various modes of clicker use in the classroom revealed differences in the range of behaviors, the amount of time instructors lecture, and how challenging the clicker questions were to answer.
2) Because instructors can vary their instructional style from one clicker question to the next, we also explored differences in how individual instructors incorporated peer discussion during clicker questions.
3) These findings provide new insights into the range of clicker implementation at a campus-wide level and how such findings can be used to inform targeted professional development for faculty.

For data collected during Spring 2017, we are interested in continuing to explore the following question: How do teaching practices vary from middle school, high school, and undergraduate courses (both introductory and advanced)? Are there differences in how active-learning tools are used?
We are also interested in looking at longitudinal data from UCOP 2014-2017 to see if instructors who have been observed each year show any changes in the teaching strategies used in the class.

Next Steps

We will be continuing to analyze the data to answer the research questions above, and MST student, Kenneth Akiha, is defending his Master's thesis based on these research questions in July 2017. Ken also plans to submit a manuscript in the fall based on his research.

This fall we will be looking at four years of observation data from UCOP 2014-2017 to explore a longitudinal study examining whether instructors who were observed each year of the program show any changes in their in-class teaching strategies.

We would also like to continue providing space for an open dialogue between teachers and faculty about teaching and learning.

List of publications or presentations directly related to this project

Lewin JD, Vinson EL, Stetzer MR, Smith MK. A campus-wide investigation of clicker implementation: The status of peer discussion in STEM classes. CBE-Life Sciences Education. 2016, 15:1-12. http://www.lifescied.org/content/15/1/ar6.full

Smith MK, Vinson EL, Smith JA, Lewin JD, Stetzer M. A Campus-Wide Study of STEM Courses: New Perspectives on Teaching Practices and Perceptions. CBE-Life Sci Educ. 2014, *13:624-635.*

Michelle Smith Interviewed as part of a video on the Festival of Learning in Teaching in Adelaide, Australia: http://www.adelaide.edu.au/festival-lt/

Michelle Smith Guest on RRR FM Australian science radio show Einstein A Go Go: http://rrrfm.libsyn.com/einstein-a-go-go-16-november-2014

UCOP teacher blog post:
http://www.hurricaneisland.net/science-for-everyone/2015/4/24/improving-stem-teaching-through-course-evaluation

Invited talk by MacKenzie Stetzer:
"Two projects focused on undergraduate STEM education: The University Course Observation Program and an investigation of the role of metacognition in student reasoning in physics," Center for Teaching and Learning Seminar, Technischen Universität Hamburg–Harburg, Hamburg, Germany, July 2, 2014.

Invited talks by Michelle Smith:
NSF, March 2015, "Strategies that Promote Institutional Transformations in STEM Education"

Dartmouth, March 2015, "Using Student Learning and Observation Data to Guide Changes in STEM Classrooms" Festival of Learning and Teaching, Adelaide, Australia, November 2014