Partnerships for alignment and broader impacts

Liesl Baum, Center for Research in SEAD Education, Virginia Polytechnic Institute and State University

The most critical collaboration for the Center is the partnership we are building with the Office for the Vice President for Research and Innovation. As the Center is in the early stages of its development and experiencing a transition from a previously established university-wide initiative, it is critical that we build this relationship with the OVPRI, also helping us build a relationships with the Provost's office. This partnership provides us with two things: university-level visibility and impact in regards to broader impacts, and a voice in the PK12 Pipeline initiative.

The OVPRI is the university-wide support for faculty to engage in national and international research priorities. Through collaboration with OVPRI, the Center will gain university-wide visibility and work to become a uniform mechanism for research and evaluation, allowing us to strategically align research proposals and evaluation plans for PK12 STEM- and SEAD-based research projects. One critical component of this is helping faculty with their plans for evaluation and, more specifically, broader impacts. As the Center develops, we continue to add faculty that have extensive knowledge of, and experience with, PK12 policy and procedures and have a long record of building and maintaining strong relationships with school districts throughout the region and across the state. As these relationships are often difficult for individual faculty to develop, the Center will serve as a liaison to provide access to, and agreements with, public schools to allow opportunities for faculty to explore various plans to establish high quality broader impacts.

Directly related to the plans to support broader impacts is our role, as a Center, with the Provost's PK12 Pipeline initiative (official name TBD). This new initiative seeks to strategically align university outreach opportunities with needs of individual school districts with the intent of strengthening student pathways through PK12 toward college and career. Several members of the Center's executive committee serve on the development team for this initiative and we have identified a number of ways the Center can directly contribute, from establishing relationships with school districts to providing longitudinal evaluation for the program. One of the critical elements of this initiative will be to conduct a series of needs assessments for school districts willing to participate in the program. The Center will provide expertise and support to gather that information, analyze the results, and help the university with its alignment.

As the university engages in long-range strategic planning through the Beyond Boundaries initiative, the Center was formed to respond to themes including student preparedness, campus of the future, and ensuring our graduates have the capacity to solve complex problems of a regional, national, and global scale that have yet to be envisioned. We believe this process begins very early, even prior to when children enter the school years. As such, through our commitment, expertise, and solid relationship with the university President, Provost, and OVPRI, we can position Virginia Tech to make contributions to programmatic change in STEM education, and become a leader in STEM workforce development from early childhood through professional practice.

DLRC Partnership Models

Wilella Burgess, Discovery Learning Research Center, Purdue University
Loran Parker, Discovery Learning Research Center, Purdue University

Building partnerships is the key to DLRC's success as a research center. Rather than describe a single partnership, we will describe our general approach to collaboration and partnership building. DLRC fosters development of approximately 40 grant proposals each year with diverse teams of researchers both internal and external to the university. While our role is often seen as contributing to the education or evaluation of a STEM research proposal, our actual function is more often focused on team-building and project development. We use a variety of tools, but find that the use of logic models is effective in guiding multidisciplinary teams to a place of convergence and clarity as they define goals and objectives, align activities and strategies, and imagine outcomes and measures. Our staff provide insight into funding mechanisms, potential team members, knowledge of the education research and funding landscapes at both the federal and foundation levels. We also provide knowledge and expertise regarding evidence-based practices in STEM education at all levels and contexts (preK through professional training in formal and non-formal settings). We provide research methodology expertise that entails deep knowledge of social science theoretical frameworks, associated methods and study design. This includes quantitative, qualitative and mixed methods that help researchers plan effective studies. This adds value to research-based projects by enhancing rigor and outreach-based projects and proposals by enabling evaluation and scholarship. Four examples illustrate common types of partnerships: 1) internal evaluation/project collaborator, 2) external evaluator (off-campus), 3) external evaluator (on-campus), 4) research collaborator. 1) Internal evaluation/project collaborator: "This is How we "Role" is an NIH SEPA project aimed at enhancing interest and aspirations for STEM research careers among underserved elementary students. DLRC provides formative program evaluation to promote iterative improvement. We also contribute to scholarship related to program development and impact. 2) External evaluator (off-campus): A regional community health network has federal funding to conduct inter-professional team-based training as a mechanism for improving patient care and outcomes. DLRC serves as external evaluator for this project, aiding the leadership team in developing logic models to inform project implementation and evaluation, collecting and analyzing data, and providing feedback to enable continuous improvement. 3) External evaluator (on-campus): DLRC supports a large on-campus federal grant by serving as external evaluator. This project is examining the impact of student-centered course reform on student outcomes. DLRC staff develop and implement evaluation strategies, data collection, analysis, and reporting that meet What Works Clearinghouse requirements and provide evidence of project efficacy for funders and the research community. 4) Research collaborator: Faculty researchers are developing an educational intervention that gives students authentic project-based experience with computer science with the goal of increasing student interest in pursuing careers in computer science related fields. DLRC staff partner with faculty researchers to develop theoretical frameworks that guide research and create study designs that can examine program efficacy.

The Work of the MVPs

Tiera Coston, Center for the Advancement of Teaching and Faculty Development, Xavier University of Louisiana

In the fall of 2014, the Center for the Advancement of Teaching (CAT) marked its 20th anniversary and undertook the task of expanding its mission to include faculty development for scholarship. One of CAT's values is "broad-based involvement of Xavier faculty and Center staff in our decision-making process," and it is well accepted that faculty-driven faculty development is most effective. Therefore, CAT solicited committee members from each academic division as well as a representative from the Center for Undergraduate Research. The members of the Mission, Values and Programming Review Committee became known as the MVPs. CAT staff then took the Academic Year 14-15 to work with the MVPs to explore a mission/values change that takes a holistic approach to developing the whole faculty member (as well as a potential name change for CAT). The MVP committee met throughout the fall of 2014 and drafted revised mission, values, and vision statements. Committee members sought feedback from their division colleagues throughout the process. CAT also solicited broad faculty participation by posting its meeting notes publicly and inviting faculty comment. At each committee meeting, faculty comments were taken into consideration and a final proposal was drafted and submitted to the Office of the Vice President for Academic Affairs for approval. Upon approval, all changes took place and faculty voted on a new name for CAT, which became CAT+ (Center for the Advancement of Teaching and Faculty Development). At each step of the process, faculty were made aware of potential changes which were intended to directly benefit them, and subsequently, students. This approach was effective because all components of faculty responsibility – teaching, scholarship and service – are ultimately for the benefit of students' learning. Faculty were informed that the modified role of the Center was to provide support in all areas of faculty responsibility and work/life balance. Although students have always been viewed as stakeholders in CAT+, the changes in the Center's role were not communicated specifically to students. CAT+ operates under the premise that the potential positive effect that the work of the Center eventually has on students' learning experiences should be seamless to students. Students should see only that are having a good experience with the faculty and that they are learning. It is not necessary for students to understand or even know of the support provided to faculty by CAT+. Consequently, the message of CAT+ is conveyed consistently from one audience to another. Whether the Center is being described in a grant proposal to a funding agency or being discussed in an informal conversation with a new faculty member, the role that CAT+ plays in the Xavier community is unchanging. As mentioned above, the student's learning experience is the ultimate focus of the work of the Center. Although messages about CAT+ are not specifically directed to students, it is not hidden from them either. There are situations where the work of the Center comes into direct contact with students (e.g., mid-course reviews). In those situations, students are told that CAT+ is there because their professor wants to improve both his/her teaching and the student's learning by getting their input about the course, and CAT+ is there to facilitate the process.

Building Partnerships

Dr. Dabney Dixon, Center for STEM Education Initiatives, Georgia State University

Currently, our most important partnership at Georgia State University (GSU) is between the College of Arts and Sciences (COAS) and Perimeter College (PC, a two-year, open access institution). The merger occurred in January 2016. The "new GSU" now serves over 50,000 students and offers more than 300 degree and certificate programs in over 100 fields of study, as well as associate degrees in over 30 areas of concentration. There are six campuses: Alpharetta, Atlanta, Clarkston, Decatur, Dunwoody, and Newton, as well as online. GSU has one of the most diverse student populations in the nation. The Atlanta campus alone has graduated more African-American students than any other non-profit university in the country. Joint projects include improving math preparedness; providing support and wrap-around services for first-generation, women, and other populations that have been traditionally underrepresented in STEM; a multiple semester initiative focused on the fall freshman class for the most academically at-risk students; and assisting beginning STEM students with the rigors of STEM coursework by providing Supplemental Instruction, Learning Assistants and Tutoring Centers. All of these support the goal of improving performance and increasing retention in STEM core courses and majors with the anticipation that this will lead to increased graduation rates.

Prior to this year, the two GSU STEM Center's most important partnership/collaboration was with the university administration. GSU began a new advising program at the Atlanta Campus with $2M of new funding from the Board of Regents. Through this initiative, GSU has become one of the first universities in the nation to implement a web-based marker advising system to track all GSU undergraduates. Our system uses ten years of Georgia State's own historical RPG data to identify over 700 markers noting when students have gone off course in their individual academic programs. We have hired more than 40 new academic advisors to ensure that we can intervene in a timely manner—and before damage is done to the students' chances for graduation. The STEM Office works with the advising team to identify points where early intervention can help students, particularly in course placement and course selection. The rapid growth of the sciences at GSU has meant that classes are often full. We have been working with the administration to study and make recommendations regarding this "unmet need." We support a variety of administrative changes that save time and effort for the faculty. The Office of Institutional Effectiveness has been able to supply our office with quantitative data about our students and the impacts of our STEM programs.

Linking STEM Education with Industry in Southern Arizona

Lisa Elfring, UA STEM Learning Center (UA-SLC), University of Arizona

Southern Arizona's economy is not as diversified or robust as our neighbors in the Phoenix area. Economic development in this region is dependent on recruiting and retaining high-technology employers, and they will not move to this area of the state in the absence of an educated technology workforce. With this in mind, the UA STEM Learning Center's Workforce Development team commissioned a report on the supply and demand of technology workers in southern Arizona. The report concluded that it will be difficult for recent UA and community-college graduates to fill technology job openings (most of which arise due to separation, or employees leaving) because most require 2-5 years of practical experience. Therefore, it is critical that we begin students' practical training earlier in their careers so that they are more marketable for technology jobs. It is also critical that we retain diverse populations in the STEM pipeline.

The UA STEM Learning Center has addressed these findings through several kinds of partnerships. First, to increase local students' contact and training in local industries, the UA-SLC has partnered with the Office of Career Services to facilitate a streamlined internship application process. This streamlined process enables more UA, community-college, and high-school STEM students to gain practical experiences, gaining valuable skills and building relationships with the region's employers. In just one year, this program increased the number of internships posted through the UA Career Services site by 40%, and the number of participating businesses by 35%.

Another way to build partnerships with industry is to strengthen our local STEM teaching workforce, allowing them to learn more about the STEM jobs in our regions and to learn the skills required in the technology workforce. The Teachers in Industry program is a business-education program that provides paid summer job experiences for classroom STEM teachers, paired with a master's degree focused on helping teachers bring STEM practices from industry back to their classrooms. This program helps to address the teacher-retention issue that many areas of our country are facing, and allows the teachers to experience first-hand the challenges and rewards that their students will feel when they enter the STEM workforce.

Finally, we have engaged Raytheon Missile Systems, one of the largest industries in our community, to cooperatively address the issue of persistence in STEM that will lead to a greater participation of underrepresented populations joining the STEM workforce. In particular, we offer a two-year professional STEM mentoring program for sophomore and junior undergraduate female students in majors that continue to lag in participation of diverse populations (electrical, computer, mechanical, and aerospace engineering, computer science, mathematics, and physics). The students are paired with early-career female engineers from Raytheon who are in turn, being mentored by Raytheon Fellows. Within the last six months, UA-SLC and Raytheon have partnered to submitted two proposals to promote persistence in STEM for (1) high-achieving, Hispanic and Native American high school girls to stay on track with math and science courses needed for baccalaureate STEM degrees, and (2) Navy ROTC undergraduate midshipmen to persist in a STEM major.

The WIDER Vision

Andrew Feig, Office of Teaching and Learning, Wayne State University

The focus of our group has been on the dissemination of evidence based teaching methods across campus. The project team grew organically as we prepared the first grant application. We invited a wide group of individuals to the meetings and those that kept returning over time became the core team. As a group, we then shaped the project such that each member of the team contributed an element that they cared most deeply about. This led to a shared ownership of the project as a whole as we prepared our initial grant submission. When it was funded, this gelled the team and the group has maintained its core ever since.

As the project progressed, we have had the opportunity to share the work repeatedly to a variety of audiences both internal to campus and external across the country. Each team member has been invited to participate in these events to ensure substantial visibility for the individuals involved. This allowed the team members to learn to articulate their perspective on our shared vision.

The third part of the process involved sharing this vision with our colleagues on campus. This process is still on-going, but the mechanism for us is now pretty well established. We do it through a series of workshops and events that occur regularly. These include PD events open to the entire university community on evidence-based teaching methods as well as departmental group meetings that focus on teaching and student success. These meetings allow us to spread our vision to new groups on campus, recruiting additional faculty who are ready to make changes and adopt student-centered approaches. Identifying these individual and reaching out to them with the support they need to adopt is critical to our success.

Not everything that can be counted counts: or how I learned to quit worrying and love the evaluation.

Noah Finkelstein, Center for STEM Learning (CSL)

"Not everything that can be counted counts, and not everything that counts can be counted" – Cameron 1963

"If you don't know where you are going, you'll end up someplace else." – Yogi Berra

Volumes could be (and have been) written about assessment in higher education. As much as anything the questions around assessment and evaluation are political. I don't suggest that they are not essential in the development of effective programming, operation, and outcomes from our centers. However what counts depends upon who is asking.

By-and-large, we do not act as an evaluation resource for other programs on campus. However there is need (and there is a new Center for Assessment, Design, Research and Evaluation (CADRE), and the longstanding efforts of Ethnography and Evaluation Research (E&ER) at University of Colorado.) We also do consulting and development for individual faculty (especially through the new TRESTLE effort, that is housed within our Center).

We also require that any CSL sponsored effort engages in some form of evaluation – At minimum summative, so there is documented evidence of outcomes, impacts, and accomplishments of programs. This is true of our sponsored seed-grants (Chancellor Awards for Excellence in STEM Education), and initiatives that we run (annual symposia). Often these sorts of evaluations are akin to the NSF-style of demonstrating outcomes and impacts.

We have engaged in some significant efforts in formative evaluation, both of individual efforts and for our center. Much of our informal and formal faculty development efforts are around promoting capacity for formative development And, through annual reviews of activities we do assess whether or not our CSL programming is achieving the goals we establish. As a result of such evaluations we have curtailed and modified programmatic offerings.

Of course, a grand challenge is in the evaluation of impact of the Center itself. While we have undergone a number of informal and formal (paid consultant) efforts to engage in identifying strategic roles, mission , outcomes of the center, lately we have been focusing our attention not on our own mission but rather how our efforts (and mission) align with the strategic priorities of the Chancellor and Provost (noting there are priorities that are stated and those enacted).

Where there is some variation, our campus strategic priorities are: reputation (of the institution), retention (of students), and revenue (new revenue streams).
Reputation: As national attention continues to focus on STEM education, CU-Boulder is seen as a national resource and innovator in this space.
Student Success / Retention / Investing in the Student Experience: The Center incubates, hosts, and advances new models of educational change and effective practices.
Models of Revenue: The Center seeds new funding streams, supports extramurally funded work from foundations and federal sources, and allows for agile and innovative approaches to revenue development.

Within each of these buckets we have provided examples, such as:

- The Center provides the collective home for many of the most-cited DBER scholars in the NRC 2015 Reaching Students report, as well as for our weekly DBER seminar series. [Reputation]
- The Center serves as resource, connector, and advocate for the nearly 100 programs in STEM education on the CU Boulder campus¬ advancing our collective mission for excellence and inclusion in STEM education and success for students across initiatives. [Retention]
- Chancellor's Awards to 35 faculty have resulted in 11 NSF grants totaling roughly $5M, and more than $1.5M in F&A (indirect) to this institution. [Revenue]

(A full exec. summary of the FY2015 outcomes for CSL can be found at:
https://dl.dropboxusercontent.com/u/5240402/CSL_Exec_Summary_8_2015.pdf)

But of course, not everything that counts can be counted... I firmly believe that the capacity building and cultural development that gets supported by the Center are among its most impactful and long-term outcomes. IF we are too reductionist in our accounting, we will miss out on the promise of these centers and the foundational purposes of higher education.

Related

Center Profile: Center for STEM Learning - University of Colorado Boulder

Developing a Shared Mission and Vision

Scott Franklin, CASTLE Center for Advancing STEM Teaching, Learning & Evaluation, Rochester Institute of Technology

The CASTLE Center began as a smaller research collaborative, with five faculty from departments of chemistry, biology and physics coming together to support discipline-based education research. The initial mission and vision was local: supporting individual research projects and identifying opportunities for collaboration. At the urging of the Dean of the College of Science, the group expanded in scope to form the CASTLE Center, which now includes programmatic and outreach initiatives. Maintaining consistency of vision and mission is a priority, and the group maintains several activities and practices that encourage this.

The Center maintains a weekly journal club AND separate research group meeting. This encourages regular contact between core and affiliated Center faculty, with multiple opportunities for communication and collaboration. As a result, concerns are freely voiced early, before they grow into more significant challenges.

The Center has engaged in multiple mission-defining practices, and developed a shared ownership of these processes. These include: 1) the initial proposal for the research collaborative, which solicited (and won) $45,000 from the COS Dean to support research, 2) the initial mission and vision proposal for the CASTLE Center, which solicited (and won) $100,000 from the RIT Vice-President of Research, and 3) a submission (which did not win) for $1,000,000 and designation as an RIT "Signature Research Area." Each of these was seen as an opportunity for the group to collectively define its goals, along with benchmarks of success.

As the Center continues to grow, the group's mission continues to evolve. Recently, the group agreed that, having accomplished its original "5-year plan," the time was ripe for a new strategic plan that builds on the past success. Research group meetings have been devoted to discussions and "group-writing" exercises to develop language that accurately reflects the collective vision.

Data-driven work in Yale's CTL

Jennifer Frederick, Yale University Center for Teaching and Learning, Yale University

Yale's Center for Teaching and Learning (CTL) relies on collaborative partnerships with many other units in campus, including the Graduate School of Arts and Sciences, the Yale College Dean's Office, and all professional schools. For our STEM education initiatives in particular, we have an important partnership with the Office of Institutional Research. In recent years the institution has paid more attention to recruiting students interested in pursuing STEM degrees. During the same period, we committed to addressing low student satisfaction with introductory science courses and lack of high quality STEM courses for non-majors.

The former Center for Scientific Teaching (CST) at Yale was first directed by Professor Jo Handelsman. Dr. Jennifer Frederick assumed leadership when Handelsman was appointed to work on the Obama administration as Associate Director for Science in the Office of Science and Technology Policy. Training institutes and ongoing support provided by the CST facilitated a number of interventions and curricular transformations in introductory STEM courses in biology, math, physics, chemistry, and statistics. During this period, Yale University launched a set of summer bridge programs. The Freshman Scholars at Yale (FSY) initiative provides a residential experience for at-risk students before their first semester. The Online Experiences for Yale Scholars (ONEXYS) program is a scalable online pre-calculus course that blends individual work, team-based problem solving in cohorts guided by a Yale student, and orientation to transitional and social aspects of life as a Yale College student. With all of these interventions taking place in different campus units, the need for coordinated outcomes analysis is high.

When the CST was dissolved and reorganized into the campus-wide Center for Teaching and Learning in 2014, the spirit of "scientific teaching" was preserved as a central pillar of the new CTL's mission. Assessment and evidence-based action were built into the organization as values of high priority. CTL is adding professional assessment staff and building upon efforts of the evaluation research team funded through STEM education awards from NSF and HHMI. Our focus is now trained upon analyzing the impact and student outcomes of our efforts to transform introductory STEM education. Departments recognize the importance of this approach and welcome assessment support from CTL. This work is aided by a critical partnership with the Office of Institutional Research, which has recently gained experienced leadership from a new administrative hire.

To operationalize this partnership, the Assistant Vice President for Strategic Analysis and Institutional Research meets regularly with the Executive Director of the Center for Teaching and Learning. We include appropriate staff members depending on the project of interest. In addition to formulating a coordinated approach to analyzing outcomes of ongoing interventions and experiments in gateway STEM courses, regular communication means that we can now build OIR support into new initiatives in the development stage. With this partnership, we will ensure that data collection mechanisms are identified early in project life cycles to be formative. Collaborating on data analysis for strategic initiatives contributes to a STEM education approach that is informed by local evidence.

Using Collaborations to Transform the Culture of Teaching and Learning

Regina Frey, Executive Director, The Teaching Center at Washington University in St. Louis

The Teaching Center has partners with multiple departments, schools, centers, and divisions across the campus to create a broad network of collaborations. This broad network allows The Teaching Center to work across the University at multiple vertical and horizontal scales. Our philosophy is to collaborate with faculty and staff across the entire campus to enhance teaching and improving student learning. These collaborations include evaluating initiatives in classrooms with CIRCLE to create assessment opportunities across disciplines, working with the library to develop digital pedagogy, and working with diverse university committees to address inclusive teaching from a pedagogical and technological perspective. The idea is to create a network of collaborations that allow The Teaching Center to best serve its constituents from an expansive and inclusive perspective. Below are examples of our collaborations with campus partners.

CIRCLE (Center for Integrative Research on Cognition, Learning, and Education)
The Teaching Center has a long standing and close collaboration with the researchers of CIRCLE on the evaluation of teaching projects including the AAU Initiative to transform the teaching and learning culture of Washington University using a multiple strategy approach to incorporating active-learning in STEM courses across the University. CIRCLE, founded in 2011, is co-directed by a Professor of Psychology and the Executive Director of The Teaching Center, the Florence E. Moog Professor of STEM Education and supported by funding from the Office of the Provost. The mission of the CIRCLE is to provide a bridge between Washington University faculty and researchers in the cognitive and learning sciences in order to facilitate collaborative projects to improve student learning.

STEM Educational Research Group
The STEM Education Research Group (ERG) brings together a diverse group of faculty and staff members interested in research on teaching and learning in STEM. The Executive Director of The Teaching Center (Associate Professor of STEM Education, Chemistry; and Co-Director of CIRCLE), and the Executive Director of the Institute for School Partnership and Assistant Dean in Arts & Sciences, and the Professor and Chair of Biology established the STEM ERG in 2008. The ERG founders developed the group in response to a specific need among faculty and staff involved in projects funded by the Howard Hughes Medical Institute (HHMI) to evaluate these projects in a systematic way. The ERG serves another, broader purpose by fostering collegial, collaborative interactions among scholars from different disciplines.
The group represents an array of fields, including Biology, Chemistry, Education, Physics, Psychology, and Engineering, as well as the Institute for School Partnership, The Teaching Center, and CIRCLE. The ERG uses a laboratory-group model, with individual members presenting current or completed work related to the scholarship of teaching and learning (SoTL) at weekly meetings.

The University Libraries
The Teaching Center collaborates with the University Libraries on several projects including the implementation of "clickers" in lecture courses (supported by AAU, the Libraries, Arts & Sciences, and Engineering), the video-recording and streaming of undergraduate courses in Chemistry and Biology, Blackboard training and consultations, and the development and support for teaching with technology. We are currently working with the library to develop a working group on digital pedagogy, and The Teaching Center Assistant Director for technology will be based in the library to strengthen our partnership and enhance faculty support.

The Center for Diversity and Inclusion, the Office of the Provost, the College of Arts & Sciences, Cornerstone, and The Center for Advanced Learning (Student Educational Services) and the Standing Committee on Facilitating Inclusive Classrooms
In 2014-2015, The Teaching Center began collaborating with these campus partners to develop Teaching Center programs on Inclusive Teaching and Learning and to coordinate these programs with related programs across the university. These programs, which were formally launched in 2015-2016, include workshops and online resources on Inclusive Teaching and Learning, the Inclusion and Diversity to Engage All Faculty Institute on Teaching (IDEA FIT), and a Faculty Fellowship on Inclusive Teaching and Learning. Programming on Inclusive Teaching and Learning is being delivered at all University levels, such as in New Faculty and Teaching Assistant Orientation as well as workshops for schools and departments, regular multidisciplinary workshops for faculty and graduate students, the STEM Faculty Institute on Teaching (STEM FIT), and the biennual iTeach symposium on teaching.

University Assessment and Cornerstone

The Teaching Center collaborates with the University Assessment Committee to assist in improving our ability to assess our teaching and learning across the university. In addition, The Teaching Center and Cornerstone have been collaborating on developing and implementing the general numeracy assessment exam.

K-20 Collaborations in Health Science and other STEM Areas

Janet Frost, WSU Health Science STEM Education Research Center

As a Health Science STEM Education Research Center, our most important collaborations at this time are with K-12 Project Lead The Way (PLTW) Biomed programs, our institution's health science colleges and programs, and the other local institutions of higher education (IHE) mathematics and mathematics educator faculty. All of these connections were made through personal and professional initiatives, based on past projects. The PLTW connections occurred because our Director was the coordinator for PLTW teacher training on our campus, and visited all schools where these teachers worked to accredit their programs. As a result, those schools feel a close connection with her and our campus. The connections with the health science colleges and programs occurred through making intentional efforts to learn about their work and offer support (e.g., faculty professional development, support for their "pipeline" programs). They are increasingly seeing us as a valuable resource. The connections with other IHE math educators occurred through many years of our Associate Director's (mathematics educator) collaborative work with them in a variety of professional development (PD) projects. This inter-institutional collaboration looks promising for developing a Center fees-for-service component in mathematics education that would be delivered by this collaborative group.

There are several advantages of working with these diverse groups. First, we are perceived as capable of offering valuable services, as well as helping them to find others with whom they can collaborate. We are seeing the results in a steadily increasing stream of requests to collaborate and/or provide services. Second, we have ready IHE and K-12 partners for new and innovative initiatives, including but not limited to NSF and NIH grants – although we have not yet obtained one of these grants, we have submitted NSF proposals that included partners from 3 IHE and several K-12 school districts, and others expressed interest in participating in the future. These kinds of collaboration will help the four new faculty hires planned in the next two years – they will be able to immediately develop a community of collaborators for their work. Third, these partnerships are already prompting new ideas for future innovations such that will ultimately benefit the Center, including the self-supporting status we need to develop. Fourth, our current collaborations help to generate new ones. For example, past PD projects have led to collaboration with a Rural Alliance, leading to developing an NSF proposal for delivering PD and support to rural teachers and students. This Rural Alliance collaboration has led to discussion of new ways to partner with the community colleges in our area on providing health science career education to rural students.

These examples and many other similar activities demonstrate that, despite being a relatively new Center, we are developing a strong sense of community across K-20. We believe this sense of community will provide an essential foundation for improving students' access to, retention in, and successful completion of health science and other STEM degrees.

K-12 Community Partnerships Influence Everything We Do

Jordan Gerton, Center for Science and Mathematics Education, University of Utah

The most critical collaboration for the CSME is probably our partnership with the local K-12 education community, which includes the entire spectrum of stakeholders from school districts, public/charter schools, administrators, and teachers, to UofU College of Education and other nearby higher education institutions that prepare teachers (e.g., Weber State University). These collaborations inform the development of CSME programs and set the stage for a successful pathway for students to the UofU from a broad range of backgrounds. These partnerships directly impact many of our programs and activities, like the Master of Science for Secondary School Teachers (MSSST), Teacher Research Fellows (TRF), Elementary STEM Endorsement (ESE), Navajo science teacher's workshop, the Salt Lake Valley Science and Engineering Fair (SLVSEF), and Refugees Exploring the Foundation for Undergraduate Education in Science (REFUGES). They also impact development and implementation of other programs through feedback, needs assessments, and identification of opportunities. Our K-12 partnerships also indirectly inform undergraduate education by providing insight into pre-service teacher education needs and gaps, by preparing students for undergraduate majors in STEM disciplines, and by providing insight into instructional best practices at the undergraduate level.

Our K-12 partnerships provide mutual benefits: the K-12 community benefits from better prepared teachers and the University benefits from better prepared incoming students. In addition, these partnerships allow us to identify and recruit certain populations within schools (e.g. refugees, first-generation college, etc.) into our programs, and to support them during their journey toward higher education. Initial collaborations were facilitated by CSME's connections to the College of Education. The CSME initially leveraged limited partnerships with schools and relationships with individual teachers and administrators to, for example, place graduate and undergraduate students into classrooms as professional development (e.g., to increase their science communication skills) and exposure to teaching as a potential career. These placements developed into robust partnerships over time, and built trust with the K-12 teacher and administrator communities, which then helped the CSME recruit teachers into its teacher development programs and students into its student support programs. As teachers completed their development programs with the CSME and adopted leadership roles within their schools and districts, interest in partnering with the CSME grew within the K-12 community. The depth of this interest was recently revealed when the CSME posted a job advertisement for a new staff position and received applications from a large number of very highly qualified candidates from the K-12 teacher and administrative communities.

CEILS and Institutional Assessment: A Critical Partnership

Jessica Gregg, Center for Education Innovation and Learning in the Sciences, UCLA

CEILS was founded a collaborative center for teaching and learning, as reflected in its mission statement: CEILS creates a collaborative community of instructors committed to advancing teaching excellence, assessment, diversity, and scholarship, resulting in the enhancement of student learning experiences in the Life and Physical Sciences at UCLA.

The center physically resides within the part of campus where the science buildings and faculty are located, and serves the life and physical sciences and their multiple departments through proactive efforts to engage its community members in collaborations around teaching innovation. For examples, to further its capacity for professional development, CEILS has established important relationships with campus units such as Partnership UCLA that engage alumni in undergraduate and graduate programs that support career development. Building a culture of assessment around teaching involves CEILS partnerships with two major assessment units on campus, including the Office of Instructional Development (OID) Center for Education Innovation and the Graduate School of Education's Higher Education Research Institute.

For the purposes of this essay, however, the partnership and collaboration that may be most "critical" as well as beneficial to all parties involved is a close collaboration between CEILS and OID. Through this collaboration, CEILS has been able to leverage a data-driven and evidence-based approach to nearly all aspects of programming. This relationship also allows for collaboration for proposal writing and successful attainment of extramural grants as a source of funding that is shared across departments and programs. CEILS has the ability to approach such proposals with expertise in discipline specific knowledge as well as knowledge on the scholarship of teaching and learning. OID and the assessment office has access to institutional-wide data as well as the skills to construct measurement instruments for specific programs and interventions, gather feedback, and interpret findings. These two skillsets in collaboration have proven exceptionally valuable to bring to light some of the issues that need to be addressed and better supported for the faculty and students in the sciences. To be clear, while some of the proposals are intended to provide funding to CEILS, CEILS also serves as a collaborator on proposals across the university - which additionally fosters good will, strengthens the reputation of CEILS as a collaborative center, and positions CEILS to be more likely to be included as a collaborated in projects spearheaded by other departments.

Developing strong local connections

Charles Henderson, Center for Research on Instructional Change in Postsecondary Education (CRICPE)

CRICPE has focused on being inclusive and building partnerships throughout the University. One of our major grant-funded projects is Broncos FIRST. The goal of this project is to improve the persistence and completion of low-income students at WMU. We are working to improve student success using an emergent collaborative change model to coordinate current institutional efforts and the promote changes in the university culture. Through this process we have built relationships, partnerships, and collaborations with individuals and organizations across campus. Specific examples include other student success initiatives, both within academic affairs and student affairs. We have also engaged passionate individuals in meaningful project work. These activities have directly advanced the goals of the project, but they have also gained CRICPE a place at the table in nearly all conversations, institutional initiatives, grant proposals, etc. related to improving undergraduate education. This creates additional opportunities for CRICPE that align well with our mission.

The Center and E-Learning

Howard Jackson, Center for the Enhancement of Teaching and Learning, University of Cincinnati-Main Campus

The effectiveness of the Center has been multiplied many-fold by three critical partnerships, firstly the collaboration with interested and knowledgeable faculty who have shared their expertise broadly in presentations, workshops, and institutes for other faculty under the auspices of the Center and with guidance from the Center. A second partnership is with our e-Learning group, which is part of the university's information technology infrastructure. The Center's approach to e-Learning programming fuses "pedagogy with best practices in instructional design and technology training." A key is the formation of a collaborative training team which includes not only knowledgeable faculty sharing their expertise, but instructional designers and instructional technologists from the e-learning group whose technical skills are integrated with disciplinary pedagogy into both workshops and individual faculty consultations. A third partnership is with a university-wide collaboration called Great Gateways. Here the object is to enhance student learning and success in first year courses, including specifically foundational STEM courses. The Center has been effective in collaboration and in integrating in a coherent manner course redesign (by the Center) with the offerings of other parts of the university, e.g. faculty early term feedback and learning communities, all led by the Office of the Provost.

The collaboration with the e-Learning group, which reports to the Vice President of Information Technology and Chief Information Officer, is both natural and powerful. If one underlying theme for the Center is active learning teaching strategies, these strategies most often have a foundation piece that is technological. One can think of many examples here, for instance the use of classroom response systems including the use of such advanced systems like Learning Catalytics. A second example is Echo360's Active Learning Platform (ALP) whose lecture tools for use in the classroom require both technological and, absolutely centrally, an understanding of how they support student learning in effective ways. A third example would be the use of Perusall, a sophisticated and student collaboration using text annotation. In each of these cases, the combination of advanced technology and deep pedagogical understanding can result in enhanced student learning. In each of these cases, course redesign based on pedagogy is imagined along with the use of the appropriate electronic tools. This is made possible by programming under auspices of the Center where the e-Learning group introduces a portfolio of technological tools and capabilities and members of the Center highlight the effective pedagogical use of the tools. This partnership is a clearly powerful one that will extend into the future. We have selected e-Learning as a key partner, but having many partners brings credibility to the Center and multiplies the Center's effectiveness in influencing student learning and student success.

Teachers in Industry

Bruce Johnson, University of Arizona STEM Learning Center

Teachers in Industry is a partnership between the University of Arizona Colleges of Education and Science, Tucson Values Teachers, Southern Arizona Leadership Council and more than 40 industry partners along with Arizona school districts, schools and teachers. We are one of the nation's leading STEM education programs, according to Change the Equation STEMworks Database and Arizona STEM Network. We offer teachers a combination of paid summer work experiences in Arizona businesses and industries and intensive coursework leading to either professional development credits or a master's degree focused on STEM education. The purposes of Teachers in Industry are to 1) increase teacher retention rates and 2) equip teachers with experiences needed to prepare their students for the 21st century workforce.

Teachers in Industry is a three-year professional development and retention program for science, technology, engineering and mathematics (STEM) teachers in Arizona. Teachers in Industry offers teachers a combination of paid summer work experiences in Arizona businesses and industries and intensive coursework leading to either a MA (Master's of Arts in Teaching and Teacher Education) with a focus on STEM education or PD (professional development) credits.

Teachers in Industry addresses two critical issues in Arizona:

1. The crisis of STEM teacher retention in Arizona
2. Preparing K-12 students for the STEM workforce

Currently in Arizona nearly half of the teachers leave the profession in their first five years. Teacher recruitment costs are shockingly high, making teacher retention highly important. Teachers in Industry increases teacher retention rates by equipping teachers with knowledge, skills and industry experience they can use to generate STEM-excited students in the short term and boost their local economies in the long term. Seven years into the program, we're seeing meaningful, measurable results. Our key findings are that teachers who have participated in the program have much higher retention rates in teaching than the state average.

In Arizona the ratio of STEM job openings to job seekers is almost 2:1, indicating an increasing need for new talent in the state's STEM workforce. Our participants are more qualified to engage students in STEM content and 21st-century skills, and their students report a better understanding of STEM careers, a higher rate of planning to go into STEM careers and a greater understanding and experience with 21st-century skills. Teachers in Industry provides our MA participants with graduate level content courses in their STEM field, as well as a program-wide emphasis on equity and social justice in STEM classrooms. A significant proportion of our participating teachers are employed in low-income and/or high minority schools, where the need is greatest for high-quality teachers.

Teachers in Industry employs a number of strategies to help teachers make the transition to long-term careers in the classroom. Paid summer work experiences in STEM businesses and industries immerse teachers in the kind of business environment their students will likely encounter within a few years and inspires them to bring their real-world experience back into the classroom to more effectively prepare students to enter the workforce. Our coursework gets teachers to reflect on their practices and goals and then to consider strategies and plans that will engage all of their students in learning skills as well as content. Teachers in Industry aims to facilitate the creation of a classroom environment where collaboration and problem solving are integrated into everyday practice. We also emphasize the building of a community of teachers working together to translate real-world experiences into student learning.

Our approach is to create financial, professional development and social network conditions to enable teachers to make the transition to long-term careers in classroom teaching. Teachers in Industry uses a number of strategies to accomplish this. The paid summer STEM work experiences in businesses and industries immerse teachers in the kind of business environment their students will likely encounter within a few years. Teachers take their real-world industry experience back into the classroom to more effectively prepare students to enter the workforce. Our coursework is designed to create an environment where teachers reflect on their teaching practices and goals, then consider strategies and plans for teaching that will engage all students in learning skills as well as content in an environment where collaboration and problem solving are

integrated into everyday practice. Teachers in Industry emphasizes the building of a community of teachers working together to translate real-world experiences into student learning in the classroom.

Evaluation and Assessment

John Keller, Center for Engineering, Science, and Mathematics Education (CESAME), California Polytechnic State University

The Cal Poly Center for Engineering, Science, and Mathematics Education (CESAME) is actively pursuing efforts to enhance our evaluation and assessment efforts. Described below are two examples.

One of the programs that CESAME runs on behalf of the 22-campus California State University (CSU) system is the STEM Teacher and Researcher Program (STAR). Over the past decade, the STAR Program has provided over 550 paid summer research experiences at national research facilities (NASA, NOAA, NSF, DOE, DOD, USGS) and other university laboratories to over 420 aspiring STEM teachers. In addition to conducted pre- and post-summer evaluations of STAR participants, we have also begun to develop a longitudinal tracking system to investigate the following impacts of the STAR Program: teacher recruitment and retention, classroom practices, K-12 STEM student interest, teacher-leadership, and professional networking among STAR Fellows. We have administered longitudinal surveys during both 2011 and 2015 and are currently creating a database that will allow STAR Fellows to update contact information, career trajectory details, and additional survey items.

STAR is just one of several teacher recruitment and preparation efforts coordinated by CESAME. We also offer several several early field experience opportunities to pre-service teachers and work with partner school districts to provide teacher professional development to cooperating teachers who work with our teacher candidates. Over the past year, we have been developing a database system to document all of the interventions that our undergraduate and credential candidates participate in. We plan to link this database to teacher credentialing and teacher employment data collected by our School of Education to track the impact of these interventions on induction into the teaching career.

Both of the above projects are in their preliminary stages, and we look forward to learning more about other methods, platforms, and approaches that other Centers are taking in addressing the crucial component of evaluation and assessment. Successful tracking of the impact of our Centers is critical to sustaining and expanding Center efforts both locally and across the country.

Measuring Impact of Professional Development

Kathleen Koenig, Center for the Enhancement of Teaching and Learning, University of Cincinnati-Main Campus

The Center conducts evaluation to ensure that the professional development provided for faculty does in fact lead to faculty success. Success is defined as meeting personal professional goals as well as goals identified in the university Academic Master Plan (AMP). The 7-year AMP, launched in 2012, includes 9 transformative goals to propel the university into the 21st Century, with a heavy focus on teaching and learning. As a result, assessments implemented by the Center are carefully aligned with institutional priorities.

In recent years we began implementing a standard assessment tool to measure the impact of Center activities. This paper and pencil tool is administered immediately following all programming and collects demographic data about faculty participants as well as measures attainment of pre-identified program outcomes. The tool also assesses the confidence level obtained for specific skills or the understanding of material presented in addition to the self-reported likelihood that the faculty will apply this newly learned information to their teaching.

All collected survey data is entered into a master database and summarized for annual reports to provide formative feedback to program facilitators as well as provide internal summative information to the center regarding possible trends or shortcomings. For example, annual reports include the number and type of program offerings along with demographics of participants (i.e. college, department, academic rank etc.) to better understand how Center activities are addressing faculty needs. Where needs are not being met, programs are revised or new ones are created to continue to address evolving faculty needs, particularly those related to the use of technology in the classroom.

What has worked particularly well for us is that many of our workshops are led by faculty. This typically means that workshops are timely and responsive to the needs and interests across the faculty. In addition, all facilitators must supply beforehand a detailed list of workshop outcomes. This practice not only promotes more productive workshops, but also drives the assessment administered to participants after the session, allowing for better measurement of impact.

Some Center activities are evaluated through more formal studies. As an example, the Center implemented a New Junior Faculty program this past year. The 22 participants engaged in year-long programming which involved a mentoring component, an introduction to the scholarship of teaching and learning (SoTL), and peer observation of teaching. The evaluation of the program will involve a multi-year study to track the 22 participants through tenure. Data collection will occur annually and will include scientifically validated questionnaires which measure differences in experience of teaching, research, service, RPT process, and overall job satisfaction including perceived levels of stress. Other measures will include peer observation of teaching to determine use of evidence-based active learning strategies, SoTL activity, and eventually rates of earning tenure. A comparison group will be identified from new faculty who entered UC in the same time period to determine program effectiveness. Study outcomes will inform not only future New Junior Faculty programming, but the study itself also provides a research model for others to emulate.

Partnerships are the foundation for innovation

Laird Kramer, STEM Transformation Institute, Florida International University

Partnership and collaboration are core identities of Florida International University's (FIU's) STEM Transformation Institute. Partnerships facilitate knowledge transfer and develop community, often by validating challenges and promising techniques across various boundaries. We envision expansion of evidence-based instructional practice, research on those changes, and institutional change as extremely challenging arenas, thus bringing diverse and out of the box solutions to bear on these challenges optimizes the ultimate chance for establishing instructional culture change. At FIU, we embrace diversity as it brings a plethora of ideas to the table.

The most critical partnership for the STEM Institute is the vertical partnership across the student-faculty-administrative domains, perhaps better framed as an ecosystem. In one direction, faculty design, carry out and measure classroom interventions and students serve as agents of change in those interventions, either as learners in the classroom providing feedback on the work or as learning assistants facilitating the dialogues and reporting back to the instructional team. Feedback from the students, in turn, improves the curriculum and pedagogy. In the other direction, classroom change impacts institutional measures, research productivity, financial efficient and institutional prominence, all critical to the institution's administration and thus fostering a partnership with the administration. Resource allocation, policy development and political cover are critical to implementing and sustaining transformation.

Specific actions that illustrate components of this partnership are numerous. Establishment of the Learning Assistant Program began through a grant-funded initiative, but institutional funding was added soon after the first evidence of the impact of LA's on classroom practice and retention was provided to administrators. Funding has continued to increase over the years as the LA program evolved into a signature campus program. The LA program erupted out of partnership, by being adopted from University of Colorado Boulder through the PhysTEC grant. The LA program would not be successful without our student agent partners, both the LAs that make it possible and the students who continue to advocate for LAs in all of their courses. A second example of the partnership is establishing active learning classrooms on campus. Originally conceived by FIU's previous Provost to 'prevent faculty from lecturing', the classrooms were positioned to incentivize active learning. Access to the rooms is limited to faculty utilizing active learning techniques and their popularity (and impact on student success and faculty practice) are evidence of its effectiveness. Other examples include establishment of the STEM Transformation Institute as well as commitments of a number of disciplinary-based education researcher (DBER) faculty lines to the institute. Outcomes of the partnership have also positioned FIU as a national leader in STEM education, leading to hosting a White House College Opportunity Summit Workshop that featured John Holdren, the President's Science Advisor and FIU President Rosenberg's participation on two National Academies STEM committees

Creating and sharing a new mission

Donna Llewellyn, Institute for STEM and Diversity Initiatives, Boise State University

As soon as the Executive Director came on board, she gathered the existing staff to start working on the mission of the Institute. Since we were transitioning from a grant-funded center with a very clear mission and scope, it was critical that we get ahead of our stakeholders and define our mission to be what we wanted it to be. Since one of our staff members was not officially joining the Institute for 5 months, we hired her on part-time to be able to participate in our mission sessions. We met for an hour twice a week to hammer out first what our priorities would be and then how to state these in a way that would be both aspirational and scope defining.

After approximately 5 weeks, we held a meeting of all of our stakeholders on campus to introduce our mission statement and to gather feedback. We answered concerns of those who found parts either too limiting or too broad (there were both types of responses). Then we tweaked the statement to still accomplish what we wanted and to answer the most pressing concerns.

Once the mission was complete, we put it on our website and carried it in hard copy format to every meeting we attended. We started every meeting by handing out our mission and discussing how it guides our work. Because Diversity is part of our Institute title and that can be a lightning rod type of word, we also created a side document articulating our office perspective and interpretation on that part of our mission.

The main way that we adapt this mission is to elaborate on the part of it that is most relevant for a particular audience.

Transforming a Land-Grant STEM Center

Susan Magliaro, The Center for Research in SEAD Education, Virginia Polytechnic Institute and State University

Over the past two years, Virginia Tech has engaged in a revisioning process to transform the long-standing VT-STEM university outreach initiative into a STEM/SEAD center that reflects the tripartite land-grant mission. Basically, we are transforming a center that was entirely devoted to outreach, to one that still addresses the outreach mission but includes advocacy and a significant emphasis on the research and evaluation related to the university's broader impacts on STEM/SEAD education. This process engaged stakeholders from the university as well as the various publics who are invested in ensuring high quality STEM education for all learners.

The process itself included a series of meetings that included our campus stakeholders and advisory board, as well as two community-wide STEM summits. The participants in this larger group included university faculty, staff, administrators, and students, our P-12 partners, the business community, and state and local government agencies. After initial meetings, a smaller planning group composed of the administrator, faculty, and key community partners met to review the feedback from the larger group of stakeholders, and begin to narrow down a very broad series of goals into ones that would meet central needs. The documents that were developed at each step were shared back with the constituents for confirmation and feedback. From these documents and feedback, we wrote a proposal to establish our new center, the Center for Research on SEAD Education (CRSE). The new center was approved through the university governance system. We are now at the stage of working with the Office for the Vice President of Research and Innovation (OVPRI) to work out the role that CRSE plays in collaboration with the OVPRI office and all of the colleges and institutes around campus. Out of these discussions we hope to a have a clear statement to share with our stakeholders.

One of the major shifts made during this transformation was the institutional relocation of VT-STEM from the Office for Outreach and International Affairs to the Institute for Creativity, Arts, and Technology. Our new home has offered us a more inclusive approach to the types of learning and opportunities found in STEM education, but with the additional enhancement of arts and design (i.e., SEAD = Science, Engineering, Arts, and Design). Given what we are learning about innovation and the needs of our youth, we need to ensure that STEM content is embedded in the types of creative thinking and problem solving found in the arts and design.

Clearly, we have a broad reach and a wide-range of stakeholders. At the foundation, we begin with the central message that the purpose of the center is to ultimately advance high quality STEM/SEAD learning for all – both in formal and informal contexts. The fact that our mission has an eye on the workforce pipeline and economic development, we open the doors to creating the types of partnerships that are sustainable and meaningful – all aligned with Virginia Tech's land-grant mission. Our message is then tailored to meet the needs of our partners through collaboration, negotiation, and the spirit of mutual benefit and respect.

Evaluation and Assessment

Gili Marbach-Ad, CMNS Teaching and Learning Center, University of Maryland-College Park

We use Colbeck's model for evaluating professional development programs to improve teaching and learning. This includes the following five levels of evaluation.

1. Participation
We maintain detailed records of all TLC program activities to understand who participates in these activities, their motivation for participating, and the types of activities in which they participate. We probe how participants learn about our activities, who participate in our initiatives, and why they decide to participate. For example, between 2007 and 2013, 77% of the faculty members in the departments we serve attended at least one TLC professional development activity. We disaggregate attendance along different dimensions to explore differences by affiliation, rank, and other variables. These results help us to balance our activities to accommodate all groups in our college.

2. Satisfaction
An example for this level of evaluation is an end-of-semester evaluation for the mandatory Graduate Teaching Assistant teaching prep course sponsored by the TLC. We queried about which topics were rated by GTAs as most useful. Based on this survey, we changed some of the topics in the next iteration of the course and improved the presentation of other topics that were perceived as not useful.

3. Learning
In this level of evaluation, we measure knowledge related to specific professional development activities. For example, after a workshop on blended learning, we may ask if participants improved their understanding of what constitutes blended learning and different ways in which blended learning can be implemented. We also use periodic surveys that ask faculty members, graduate students and undergraduates to rate the importance of various teaching practices (e.g., group work, inquiry-based learning, and scientific writing) and educational goals (e.g., the ability to work effectively in groups, understanding the dynamic nature of science, and problem-solving capacity).

4. Application
In this level, we assess the degree to which faculty members and graduate students use evidence-based teaching practices in classrooms. We have three means of measuring this:

- Faculty self-reports of the teaching practices they used (via periodical surveys)
- Student reports of teaching practices they experienced (via an exit survey of graduating seniors)
- Classroom observations

These mechanisms provide complementary evaluative information that assists us in understanding the impact of specific interventions and allows us to document broader patterns of institutional change.

5. Impact
In this level we are trying to measure if we have reached our ultimate goal – improving the learning experience of undergraduates and better preparing them for their future careers. We measure this in multiple ways, including undergraduates' end-of-semester course evaluations, attitudes and satisfaction surveys, and course grades.

You Gotta' Have Friends

Mathew Ouellett, Office of Teaching and Learning, Wayne State University

For the Wayne State University (WSU) Office for Teaching and Learning (OTL), collaborations with STEM faculty members and the Graduate School have been essential to advancing our campus wide goals related to the transformation of undergraduate education and to establishing the OTL as a meaningful and productive center for faculty and educational development in Academic Affairs.

Formally, our work together began with collaborations on two National Science Foundation (NSF) WIDER grants. The work related to these initiatives has been critical to the success at WSU in making progress towards transforming STEM education and career preparation at both undergraduate and graduate levels. They have also provided a particularly robust platform for a newly reconstituted OTL to expand and

The first OTL / WIDER collaboration took root in in 2013-15 with an NSF-funded WIDER planning grant, "Evaluation of WSU Use of Evidence-based Methods in STEM Instruction". Our research team included: Andrew Feig (chemistry) (P.I.), Peter Hoffman (physics), Robert Bruner (Math), Karen Myhr (Biology), Alsi Koca (Math Education), and Mathew L. Ouellett (OTL). Our goal was to study current teaching practices in use in our STEM curricula, to assess awareness of evidence-based teaching methods, and to gauge readiness to adopt such practices more fully in the future. As a part of this grant, we surveyed instructors in our STEM departments to establish a baseline of teaching related behaviors against which we can measure progress. Together, we hosted nationally recognized external speakers and co-presented a highly successful OTL-sponsored workshop series on evidence-based teaching practices. We facilitated departmental planning meetings with interested faculty from Biological Sciences, Chemistry, Math, and Physics. These departments were priorities as locations of key foundational STEM courses (often "gate keeper" courses with high DFW rates).

The second OTL / WIDER collaboration took root in in 2015-20 when the same research team applied for and received an NSF-funded IUSE grant, "WSU SSTEP: Student Success Through Evidence-based Pedagogies," 2015-2020. We will use this grant to engage faculty teams and departments in curricular and campus transformation via teaching development grants. Grants will be up to $100,000 per project to transform courses, labs, and course sequences in undergraduate STEM courses. Recipients will participate in a faculty learning community, and ongoing workshops and individual consultations via the OTL. This grant will allow the OTL to add a science education person to our instructional design team to further support the grant and the dissemination and implementation of evidence –based teaching strategies campus wide. The first round of funded projects launches in fall 2016 with projects in the departments of Biological Sciences, Chemistry, Computer Science, Mathematics, and Physics and College of Engineering.

Informally, these collaborations came at the most opportune time possible for the OTL as we launched a new staff, mission, vision, and complement of faculty development programs and services. As background, the OTL had previously reported to a specific dean (the dean of the WSU Libraries) and as such had primarily, but not exclusively, served a BlackBoard training function in the Technology Resource Center. In 2013, the then provost realigned the OTL in two important ways: the head of the unit now reports directly to the provost and has a split function and title (associate provost and director of the OTL). From the OTL's perspective, the opportunity to collaborate with our STEM colleagues on these grants afforded us a meaningful entrée to our STEM faculty and students, partnership on an important initiative to improve undergraduate education, and a persuasive way to signal the campus about the alignment of the OTL with a broad range of interdisciplinary teaching and learning issues of concern to WSU faculty.

Creating, Communicating, and Customizing the Mission of CRLT-Engin

Tershia Pinder-Grover, Center for Research on Learning and Teaching in Engineering (CRLT-Engin), University of Michigan

Back in 2013, CRLT-Engin began a process to formalize our mission statement. At the time, we began by gathering the mission statement of our University, College of Engineering, and the main teaching center,the Center for Research on Learning and Teaching (CRLT). The center director also pulled ideas from internal CRLT-Engin documents describing the center's purpose as a starting point. Then, the director, assistant director, and instructional consultant met several times to brainstorm, craft, and revise the statement. Over a period of two months, the CRLT-Engin staff revised the mission statement through several conversations among the staff and additional feedback from a broad set of stakeholders. For example, the statement was shared with our advisory board (approximately 7 faculty members), the director of CRLT, and the associate dean for undergraduate education. After each of these conversations, the CRLT-Engin staff reviewed and revised the mission statement accordingly. At the end of this process, we created the following mission statement:

The mission of CRLT-Engin is to serve U-M CoE and promote excellence in learning and teaching by:

- Conducting and cultivating rigorous engineering education research that leverages our colleges' innovative educational experiences and that has a broad impact locally, nationally, and internationally,
- Facilitating the adoption of research-based teaching practices and seeking continual improvement of teaching and student learning through a comprehensive range of professional development programs, and
- Providing leadership and service at the local, national, and international levels.

To communicate our mission statement to various stakeholders, we have included it as a part of our annual report, highlights brochures, and our website. We send out copies of our annual report via email to all faculty in the College of Engineering. We provide printed paper copies to our advisory board, department chairs, and key administrators. In addition, we've structured our website to align with the mission statement (i.e., sections focused specifically on engineering education research and teaching/learning).

Finally, in terms of adapting our message to different audiences, we emphasize different parts of the mission depending upon the context and needs of the audience members. For example, when the director presented CRLT-Engin to the College of Engineering's Development department, the presentation focused mostly on the teaching and learning aspects of CRLT-Engin's mission. Since Development wanted us to present information that would engage potential donors, we focused on providing stories or narratives about how faculty change their teaching practices to better support student learning based upon their interactions with our center. In contrast, when the director presented at the Program Director's meeting or department meeting, the director shows the value of CRLT-Engin to engineering faculty using numbers (ie., number of services, workshops, etcs.), graphs (e.g., use of services over time), and other forms of numerical data (e.g., teaching grants awarded to engineering faculty).

Center for STEM Education, UNC Charlotte

Dr. David Pugalee, Center for STEM Education, UNC Charlotte

Who is the Center for STEM Education? The Center matches the STEM and education resources of UNC Charlotte to the needs of the surrounding schools to improve K-12 mathematics, science, and engineering education in North Carolina. The mission of the Center for Science, Technology, Engineering, and Mathematics Education is to promote a regional vision for STEM education and outreach, to increase capacity in leadership, and to facilitate collaborative partnerships for addressing STEM priorities for PreK-20.

The mission and vision for the Center was revised in 2011. Through input from an advisory board ideas about the Center and the focus was collected over several months including a working face to face meeting. These ideas were reviewed by Center leadership (Director; Associate Director; PreCollege Coordinator) in multiple meetings resulting in draft statements. These statements were shared and discussed with all Center staff and the Center Advisory Board who provided comments. The feedback was incorporated into the vision and mission statements. This process was particularly critical in adding "to increase capacity in leadership" to the mission.

The mission appears on the Center website and is regularly communicated to stakeholders directly through reports and presentations. The mission and vision are comprehensive so that various components can be emphasized depending on context without requiring a deviation from the focus.

The Hawaii STEM Network for Innovation

John Rand, University of Hawaii Office of STEM Education

Hawaii's economic challenge is the continued dependence on tourism and government spending. Tourism alone generates an estimated 20% of all economic activity in Hawaii. As a result, Hawaii's economy is susceptible to greater economic shock from national and global economic downturns.

To aid in economic diversification, the University of Hawaii has developed the Hawaii Innovation Initiative. Working in partnership with the private sector and government the Hawaii Innovation Initiative is designed to serve as the focal point for building a thriving innovation, research, education and training enterprise in Hawai'i. The STEM Center of Excellence will play a critical role in the development of the timely education and training aspects of the Hawaii Innovation Initiative.

Partnerships are key to the success of the STEM Center of Excellence in creating a strategy to blend education, research and workforce development into a community of practice – a STEM Network. This network will develop broader impact templates that will be inserted in STEM research proposal submitted by the University of Hawaii in response to solicitations from agencies such as the National Science Foundation, National Institutes for Health, Office of Naval Research, and the National Security Agency. The templates will strengthen the competitiveness of STEM proposals by aligning UH research with Hawaii's corresponding STEM industry sector and academic pathway. This will (a) engage UH Researchers directly with K-12 projects and 2-yr college educational opportunities and (b) enhance Hawaii's knowledge base and engagement between UH researchers and business and industry professionals increasing the opportunity for commercialization of research activities that drive the innovation economy through the Hawaii Innovation Initiative.

An essential part of this network strategy relies on a well-trained STEM workforce in Hawai'i. The University of Hawai'i OSE has embarked on an ambitious journey to design, develop, introduce and navigate comprehensive, articulated and purposeful academic pathways to promote STEM students' success in Hawai'i. The STEM pathways will incorporate specifically designed student learning outcomes at all critical junctures of the students' progress. The pathways are designed for stop-out/move-in, so that students facing external, unanticipated challenges can leave the program with an academic credential—and an established set of skills attractive to industry—and rejoining the path later, once they're ready. In the early part of the journey, students can easily cross from one pathway to another to find the optimal fit. However, as students matures academically, the pathway narrows to an endpoint in the workforce or in graduate education leading to employment.

The 4 Pathways will be aligned with the UH ASNS Degree program that has four area Concentrations:

1. Biological Science (BS)
2. Engineering (ENG)
3. Information and Communications Technology (ICT)
4. Physical Science (PS)

These Concentrations provide students with a clear academic goal as they proceed through a pathway to their intended Baccalaureate STEM major.

These pathways are more than a recommended progression of required and elective coursework and academic curriculum. The pathway employ selected best practices in education aimed at critical junctures in the pathway; namely, at the transition from high school to college and the transfer from 2-year colleges to 4-year colleges. These critical junctures are point along the path where students can stop-out/move-in along the path.

The performance of the STEM Center of Excellence will be tracked and measured through the Hawaii P-20 Initiative and the Institutional Research and Analysis Office. This will be accomplished by enhancing student data tracking capabilities in the State of Hawaii, longitudinal education to workforce data system and the addition of data visualization and reporting dashboards. The enhanced visualization capabilities will improve reporting on Hawaii's STEM student recruitment, retention, persistence, graduates, and STEM Center activity participants within the prioritized STEM industry sectors. This new information is vital in growing Hawaii's STEM industries as it isolates the impact of emigration of Hawaii STEM graduates

(brain drain) that will be identified through the participation in the Western Interstate Commission for Higher Education (WICHE) study of Hawaii Resident Migration Patterns.

Communicating Mission and Vision

Matthew Saderholm, Berea STEM Education Center (SEC), Berea College

Berea College is breaking ground on a brand-new 125,000 square foot Natural Sciences and Health Building that will open for the 2018-19 academic year. This building will house our Division 1 programs (Biology, Chemistry, Mathematics, Nursing, & Physics as well as a Geology/Archeology program that has been dormant for almost 15 years). Planning for this space started as a divisional self-study using the Berea's "Great Commitments" to ask what our division's vision and mission were. This communal process produced a final report reaffirming our strong commitment to liberal arts education. We also strongly supported finding ways to increase opportunities for students, both current and potential, to succeed in STEM and related health fields like Nursing. To this end, we advocated for spaces in our new building that could serve us and the regional K12 student population and community (outreach) like a state-of-the-art digital planetarium. We also pushed to include spaces that would support new/current students who were considering STEM/Nursing majors but less likely to succeed without support (i.e., "inreach"), like a STEM Education Center. We want to provide support for all our students, not just the ones who would succeed regardless.

While all faculty from the five academic programs were involved, the Program Chairs, Division Chair, and Faculty Building Project Shepherd were instrumental in strongly advocating that we reserve space for outreach and inreach in our new building. However, we quickly realized that just planning rooms was not sufficient for success. Staffing our SEC with a strong director and designing and implementing effective programing were also essential. To this end, the current Division Chair and Building Project Shepherd appointed an unofficial SEC steering committee to lead the planning on the SEC and seek out funding to support the model for which we are advocating. As we move forward toward a functional SEC, we are working diligently to build excitement with current and prospective students, faculty, administration, and potential funders. We plan to focus our message to students on showing them they belong in our building through activities coordinated with aligned Centers (i.e., the Black Cultural Center) that provide support and practical strategies for success. We plan to focus our message to faculty on how the SEC will build student skills and core knowledge to enhance success in classes. We plan to focus our message to our administration on how the SEC will lead to higher retention rates in STEM & Nursing classes as well as the institution as a whole. And finally, we are focusing our message to potential funding agencies on the track record Berea College has with at-risk students and how the SEC is an essential component to expanding that success to STEM & Nursing. When the doors open on the Martha A. Cargill Natural Sciences and Health Building, we believe that our STEM Education Center will be ready to serve everyone who seeks it out for assistance.

Proposal success, participant response, and student outcomes inform our center programs and expansion

Shanna Shaked, UCLA Center for Education Innovation and Learning in the Sciences

The UCLA Center for Education Innovation and Learning in the Sciences (CEILS) evaluates its services in a variety of ways, ranging from tracking faculty interest and participation to formal assessment of education initiatives of which CEILS takes part. These tend to involve aspects of faculty development and instructional innovation.

The institution (UCLA) provides support for core staff and center operations; however, to maintain the entrepreneurial aspects of its mission, CEILS consistently competes for extramural grant funding. Successful awards provide leverage for CEILS to expand resources, including staff. Recognizing the value in our center, our Deans are positioned to request and commit institutional funds to sustain center programming. In this way, administrative leaders in the institution play critical roles as center advocates beyond the disciplines they immediately serve. Such efforts are also important to the credibility of the center for research and teaching faculty in the sciences.

Assessment of CEILS activities and professional development efforts include tracking event attendance and administering surveys. These data help Center leaders determine how to adapt or expand particular activities, modified accordingly to feedback for optimal effectiveness and maximum engagement of faculty. As evidence supporting the efficacy of this assessment methodology, CEILS has observed increasing numbers of faculty attending the annual "Faculty Workshop on Best Practices in STEM Teaching", with over 90 attendees at the most recent workshop in fall 2015, doubling the number of attendees in 2014. Furthermore, participation in weekly journal clubs has steadily increased between 2015 and 2016.

In terms of communication, we have recently started using an email marketing service for CEILS bi-weekly newsletters. This service enables us to track which items are clicked on most and therefore appear to be most appealing to subscribers. This feedback will inform the types of workshops and events CEILS offers to the community.

The last form of assessment CEILS regularly engages in is related to grant proposal reporting functions. Designed to be employed as both formative assessment for faculty as well as program assessment for education projects, we employ a variety of instruments and evaluation techniques. These include concept inventories, student and faculty surveys, and institutional data. Results from these assessments inform the development of future education projects as well as shape the professional development efforts of CEILS in support of the community it serves.

Developing a Shared Vision

Gwen Shusterman, Portland State University STEM Institute

The PSU STEM Institute grew from a faculty response to the call from the Provost to discuss our place in contributing to a regional "Cradle to Career" initiative with a focus on STEM. The initial group of faculty, who self-identified as having an interest, gathered to dream big and imagine what STEM would look like on our campus and in the region writ large. We were also tasked to discuss the barriers to achieving that dream. The team was given a short time line of about 10 weeks to complete a set of recommendations, and they were assured that there was no commitment beyond the 10 weeks. The resulting recommendation was to establish a campus wide, interdisciplinary STEM Institute. With a three-member leadership team selected by the college deans representing engineering, education and science, the faculty group continued to meet several times a term and work towards the establishment this institute. All interested faculty and staff were welcome and the group grew by word of mouth and with encouragement by the deans; the group is now known as the STEM Education Collaborative. During the first year, we met with an external facilitator for a full day retreat and revisited the goals and vision presented in the original white paper and penned this mission:

We aspire to enable PSU to be a leader in developing and implementing innovative, student-centered STEM education, in partnership with the broader educational community, responsive to the interests and needs of all learners.

The group also established four key goals for the STEM Institute (see below).

A fully developed communication strategy is still evolving. While keeping a focus on students front and center, how the efforts of the Institute are described depends on the audience. For a campus faculty discussion we might utilize a circle or cycle of education. We teach STEM → our STEM students are educated as TEACHERS → our TEACHERS prepare the students that come to us → we teach STEM. In this view, we would introduce faculty to innovative teaching strategies and how the Institute can support their development and assessment. The discussion might also highlight the student support programs under the umbrella of the Institute, such as LSAMP, NIH BUILD EXITO and McNair Scholars. For an audience of community and industrial partners we might use a tree growth metaphor or model. The roots are all the different paths and supports that students engage in on their way to the university. When they reach the university we provide the rich soil in which they grow and they travel any number of branches to their successful careers or professional programs. Our Institute feeds the soil helping roots to grow strong, coordinates programs and resources, illuminates pathways, improves the strength of the branches through excellent teaching, research and internship opportunities, etc. Feeding the soil includes a close collaboration with the regional state funded STEM Hub, the Portland Metro STEM Partnership (PMSP) with a focus on the pre-college STEM ecosystem, spearheading professional development of teachers around the NGSS and Common Core and facilitating partnerships between in-school and out of school program providers. Strengthening the branches includes the development of close ties to regional employers to facilitate the development of highly qualified STEM graduates. We are still in the nascent stages of this work, our STEM Institute gaining final Faculty Senate approval in March of 2016.

Goals:

1. To invest in the capacity of PSU faculty to design and teach undergraduate STEM courses and curricula that better engage students, increase their numbers, and enhance and deepen their learning;
2. To promote a measurable increase in enrollments and in the diversity of students enrolled in STEM courses and majors and an increase in the number of STEM degrees conferred annually;
3. To prepare students to be citizens who can address global and local challenges (e.g., energy, environment, health, food) in the context of economic and community development;
4. To work within the metro area to enhance P-12 students' level of preparation and readiness for college-level work in STEM fields and promote interest in STEM careers

VSTEM Collaborative Mission and Vision Process

Regina Toolin, Vermont STEM Collaborative - VSTEM, University of Vermont and State Agricultural College

Development of the VSTEM Collaborative mission and vision statements began in the Spring 2013. Participants included faculty from UVM and other VT colleges (Norwich, Johnson and Lyndon), UVM graduate students, K-12 teachers, VT Agency of Education staff, and STEM business and non-profit professionals. The goal was to conduct a series of focus group discussions that centered on STEM education needs in Vermont and begin the visioning work for the VSTEM Collaborative. These discussions spanned a period of one year and resulted in a mission and vision statement that was adopted by the VSTEM working committees in March 2014.

VSTEM MISSION
To coordinate, energize, and advance STEM learning and career opportunities across Vermont that foster sustained curiosity and learning.

VSTEM VISION
Vermonters will be STEM competent and prepared to work in STEM careers, able to integrate STEM principles across a variety of disciplines/professions and make informed decisions about STEM issues and questions in their lives.

LONG-TERM GOALS

1. Increase STEM literacy, achievement and career opportunities for Vermont's students.
2. Broaden participation of Vermont's in-service and preservice teachers and their students in STEM disciplines and careers.
3. Increase capacity and foster collegial relationships amongst faculty, administrators, VT AOE and state government representatives and agencies, teachers, students and businesses.
4. Promote diversity within the STEM fields through work force development, business partnerships and cross-disciplinary collaborations.

Over 70 professionals have been actively engaged in focus group and steering committee meetings, generating a number of valuable recommendations and initiatives. Within these recommendations, a number of specific initiatives were identified related to the development of the VSTEM Commons Portal and preparation for Next Generation Science Standards implementation over the next 3-5 years.