2014 NSF STEP GRANTEES MEETING

Post-Meeting Report

2014 NSF STEP GRANTEES MEETING:
Identifying Best Practices:
Helping Each Other (and Our Students) Succeed

MEETING REPORT

March 6-7, 2014
Washington, D.C.
Hosted by the American Society for Engineering Education

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EXECUTIVE SUMMARY

The 2014 National Science Foundation's STEP Grantees Meeting was held March 6-7, 2014 in Washington, D.C.

The goal of NSF's STEP program (for Science, Technology, Engineering, and Mathematics Talent Expansion) is to increase the number of American students receiving associate or baccalaureate degrees in established or emerging fields within STEM disciplines: science, technology, engineering, and mathematics. STEP is a program of the Division for Undergraduate Education in NSF's Directorate for Education and Human Resources.

The 2014 meeting was the third annual STEP Grantees Meeting funded by NSF; the first was held in 2012. The purpose of the meetings was to bring together scientists, administrators, student support specialists and evaluators involved in STEP-funded projects to identify best practices.

Programmatic and funding decisions made by NSF mean that the work of STEP is being incorporated into an NSF initiative called Improving Undergraduate STEM Education or IUSE. As a result, this may have been the final meeting of its kind, and a pre-conference meeting was devoted to discussing ways to sustain STEP's mission in the new funding landscape.

The meeting's proceedings were captured on STEP Central, the centralized web site (***www.stepcentral.net***) that supports all STEP participants.

MEETING FORMAT

About 340 people attended the STEP Grantees Meeting, a figure that includes representatives from NSF itself. The format included plenary sessions, breakout sessions, lunch table discussions, and poster sessions, with discussion and elaboration online via STEP Central. As a result, STEP Grantees were exposed to a variety of the best practices of a large cross-section of their peers.

At the core of the meeting was a series of three breakout sessions on more than 30 topics lasting 90 minutes each. There was some commonality of theme within the sessions; the second, for example, included sessions on STEP evaluations, managing projects, and disseminating and publishing results. One topic, Improving Student Success in Foundation Courses in Math, was repeated to meet demand. Breakout sessions followed several different formats; some incorporated poster sessions as well, and one took the form of a round-table discussion on Type 2 projects and NSF's two STEP Centers.

Both days of the conference opened with plenary sessions. On Thursday, Jo Handelsman, Frederick Phineas Rose Professor at Yale University and Howard Hughes Medical Institute Professor, discussed the future of STEM education in the 21st century. On Friday, Vincent Tinto, a Distinguished University Professor at Syracuse University and the former Chair of the Higher Education Program, spoke about what goes into student success in STEM fields, how colleges can use this knowledge to help students, and how their efforts can be supported and scaled up over time. Both speakers made themselves available at breakout sessions on the days they spoke.

Informal networking took place during breaks and meals. At breakfasts, participants were able to sit together in random groups. Lunch seating was by discussion group. Some groups were determined by job function; project coordinators, for example, could sit together. Others were by type of institution (community colleges, large universities, institutions in Texas, minority-serving institutions), or topic of interest, such as sustaining two-year/four-year collaborations.

Thursday afternoon featured two one-hour poster sessions. Half of the posters were staffed for each session, so as not to tie up all the exhibitors at once. Projects were clustered by topic. The best-represented topic was Two-Year/Four-Year Partnerships, with 16 posters; at the 2013 meeting, the best-represented topic had been Learning Communities and Cohort-Building.

An unusual feature of the 2014 Grantees Meeting, as with the 2013 meeting, was the role of STEP Central in creating a virtual meeting to mirror the physical conference. Before the conference began, STEP Central was already sharing information among grantees on upcoming topics. As it took place, participants started to share comments and suggestions about speakers and breakout sessions. Most important, STEP Central carried the work of the conference forward by allowing discussions to continue online well after the participants had left for home.

MEETING FORMAT

1. **An action agenda to ensure that the spirit of STEP survives.** As the funding landscape shifts and STEP is absorbed into IUSE, there was a strong consensus that STEP's achievements are too valuable to be forgotten and that they can be built on and advanced despite the changes at NSF. As proof, participants in a pre-conference workshop on sustaining STEP's mission drew up a 10-point action agenda to make sure this happens.

2. **A road map for the future from NSF.** All three of the key speakers on Day 1 took time to explain how the Division of Undergrad-

uate Education will operate in future and how STEP fits in. And all three praised the work that has been accomplished by the projects funded under STEP, which now number about 250.

3. **Recognition of common themes.** Despite the wide variety of topics covered in the breakout sessions, it was clear – as it was at the previous year's grantees meeting – that certain challenges and opportunities recur in different STEP projects. The difficulty of changing institutional culture is one; the need to support underprepared students in a way that keeps them engaged and doesn't discourage them is another. One advance since last year's meeting: more colleges and universities are finding innovative ways to make sure students get the math they need for STEM courses.

4. **Sustainability is a real concern.** Perhaps because of the uncertainty surrounding the future of STEP itself, many breakout sessions grappled with the issue of sustainability. Two common issues: ensuring a project's survival when the initial grant runs out, and effecting a smooth transition when the person who spearheaded an initiative is ready to hand over the reins.

5. **A high level of engagement.** As in the past, most participants took an active role at some point in the meeting, whether as presenters or scribes in breakout sessions or as resident experts during poster sessions; the poster sessions drew almost 100 entries. There was a significant groundswell of opinion in favor of a similar grantees meeting next year, despite the absorption into IUSE.

6. **A call to listen to the students.** A meeting like this is a chance for those involved in higher education to speak from the heart about their work – and the students they help are central. In the words of Denise Hayman of Northern Illinois University, explaining why NIU uses journaling to support students through difficult math courses: "Give students VOICE!"

PRE-CONFERENCE WORKSHOP

STEPping into the Future: Sustaining STEP's Mission in the New Funding Landscape

Recognizing the coming suspension of STEP and its absorption into IUSE, a pre-conference workshop was held March 5 to discuss the implications of the change and recommend ways to sustain the work of STEP. The facilitators were STEP Central's director, Daniel Udovic, professor emeritus of biology and environmental studies at the University of Oregon, and its coordinator, Tania Siemens, who works with Oregon Sea Grant at Oregon State University. The session was designed to allow participants to discuss what they had learned from implementing their STEP projects and to use their collective knowledge to guide decisions in the future. The facilitators asked the participants to identify features of STEP that they had found essential to the success of their projects – features they would like to see sustained and supported in the future. One important goal was to give NSF some guidance as to what the STEP community itself thinks the new landscape will look like. The format was small-group discussions followed by report-outs.

One overarching theme that emerged was that STEP has allowed many programs to experiment in ways their own institutions would not otherwise have supported. Another was the remarkable diversity of programs STEP has supported: learning communities, supplementary instruction via peer mentors, scholarships, articulation agreements between two- and four-year colleges, the hiring of staff coordinators, and many more.

Two other points made as the small groups reported out: When NSF funds a program, the foundation's prestige gives that program a credibility and a cachet that their institutions value. And when a program receives STEP funding, it often has a transformational impact on the campus as a whole.

A consensus formed around a number of suggestions from the floor, including the following:

1. Send a white paper from the STEP community, signed by as many attendees as possible, that spells out what STEP has achieved that would not have been possible otherwise. The initial suggestion was to send this to NSF; as discussion continued, a broader audience was envisaged, including policy makers and legislators, members of the National Science Board, and the institutions that STEP grantees belong to.

Create and publish a book of best practices.

1. Ensure that the public, as well as policy makers in academe, industry, and government, are aware of the benefits that STEP has achieved by

    a. Communicating your projects achievments in writing and in person and having your students tell their own stories of success,

    b. Create videos with the theme of "How STEP impacted our institution." Post them on STEP Central and share them broadly, and

c. Seek out prominent media sources such as the Wall Street Journal, the Chronicle of Higher Education, and similar publications through which to share the STEP story.

Stress to as many audiences as possible the intangible benefits of STEP: How the resources that STEP provides become resources for the institutions that house the programs, and how there is often a multiplier effect: x numbers of dollars spent on STEP can bring in x+y dollars at the institutional level.

Stress the general benefits to STEM resources that come from STEP. One institution noted that STEP allowed it to hire someone for a position it would never have been able to afford otherwise; another said it had a STEM coordinator only because of STEP.

Stress the appeal to private and corporate donors. One grant from a foundation was made possible only because STEP showed that a living-learning community works.

Encourage NSF to be more vocal on the successes of STEP.

Before the conference opened on Thursday, another preliminary meeting was held for new STEP grantees.

GENERAL SESSIONS

OPENING SESSIONS AND DAY 1 LUNCH SESSION

Three general sessions were held, one to open each day and one lunch session on Day 1.

OPENING SESSION 1: WELCOME/ OPENING ADDRESS

To open the meeting, Connie Della-Piana, NSF's lead program director for STEP in the area of research and assessment, welcomed participants. Jose Herrera, a lead program director for NSF for biological sciences and a workshop co-coordinator, noted that about 125 STEP grantees were in attendance.

In opening remarks, Susan Rundell Singer, NSF's Division Director for Undergraduate Education, addressed the transition from STEP to IUSE. One key message, she said, was that all of the goals that STEP grantees have been working on are central to the forward momentum at NSF. These include increasing the number of quality STEM graduates and implementing and institutionalizing evidence-based best practices.

Singer also outlined current government priorities, notably the push to increase the number of STEM graduates by one million by 2020 and a related initiative to increase the number of engineering graduates. She paid tribute to several innovative programs to achieve these goals, some in partnership with Intel and GE, and also singled out efforts to increase retention among STEM students. And she noted that STEP efforts take place both inside the curriculum and in co-curricular activities, drawing from current STEP programs to illustrate these.

Addressing how STEP fits into the new world of IUSE, Singer said IUSE is an umbrella that covers not just STEP but two other NSF programs with overlapping goals: TUES (Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics) and WIDER (Widening Implementation and Demonstration of Evidence-Based Reforms). With three programs operating independently, she said "people were getting trapped in boxes" at the intersections where they met. "IUSE is a program that lets you out of the box," she said.

IUSE, Singer added, supports improving the undergraduate STEM enterprise. It funds foundational and exploratory research; and it funds design and development work, and some scaling work. Proposals, she said, should build on evidence, as STEP has always done. In 2014, as an experiment, IUSE is sponsoring three ideas labs in specific disciplines: biology, engineering, and geosciences. These involve collaboration across different parts of NSF.

Responding to questions, Singer addressed a concern over whether the broad impact of STEP programs will be lost with the switch to IUSE. She said much of what STEP has achieved will continue. NSF is able to invest about $300 million every year, and a large part of its goal is to document and articulate why good programs work so they can be adapted elsewhere.

Speaking to a concern that IUSE focuses on undergraduates while STEP has shown the need for a continuum from kindergarten through college, Singer agreed that recognizing the spectrum across all fields of education is important. She said the directors of NSF's four divisions dealing with education work closely together to make sure programs are aligned.

Asked whether NSF can do a better job of sharing best practices across different programs, Singer said NSF's goal, by December, is to rethink how this happens and come up with different ways to do it, including more themed evaluation of core goals.

Singer's address is available on **YouTube**.

OPENING SPEAKER, DAY 1: JO HANDELSMAN, YALE UNIVERSITY

Jo Handelsman is Professor of Molecular, Cellular, and Developmental Biology and Frederick Phineas Rose Professor at Yale University and a Howard Hughes Medical Institute Professor. At the time she spoke she was awaiting Congressional confirmation of her appointment as associate director for science at the White House Office of Science and Technology Policy.

Describing STEP as "one of the most high-impact programs I've seen in the federal agencies," Handelsman stressed the country's need for STEM graduates, drawing on recent reports including "Engage to Excel," the 2012 report to the president that she co-chaired and that called for one million more STEM graduates in the next decade, and the President's Council of Advisors on Science and Technology's letter of December 2013 about using advanced education technologies to improve outcomes and lower costs in higher education.

Handelsman said research indicates that three of the fastest-growing fields in the workforce will require STEM graduates, and that, by 2018, 92 percent of STEM jobs will require at least some post-secondary education and training. Both government and industry are concerned, she said, about whether the nation's need will be met.

Handelsman said the authors of "Engage to Excel" were struck by the fact that fewer than 40 percent of students who enter college with the intention of majoring in a STEM field actually complete a STEM degree (and the figures for minority students are much lower). The students who drop out seem to represent a huge pool of untapped potential, but research indicates that many are turned off from pursuing STEM majors for a number of reasons. These include uninspiring introductory courses, a discouraging lack of proficiency in math and an unwelcoming attitude from faculty.

"Engage to Excel" therefore focused on retention, figuring that if this could be boosted from 40 percent to just 50 percent it would produce three quarters of the one million new STEM graduates needed. To do this, it recommended improving the experience of the first two years by incorporating evidence-based best practices for active learning (and training teachers in these practices) and by switching from standard introductory lab courses to research courses. It also suggested developing metrics to measure the efficacy of active learning. The report recommended funding research courses and encouraging collaboration with research universities, small colleges, community colleges, and industry.

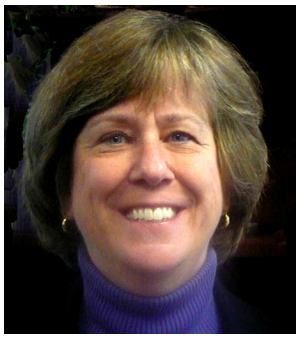
To illustrate the possibilities in replacing standard lab courses with discovery-based learning, Handelsman drew on her own experiences at Yale with a project involving the development of new antibiotics that has since expanded to other institutions at home and abroad.

Asked after her address about the federal budget, Handelsman said that in the initial budget for Fiscal Year 2015 there had been a slight increase in funds for STEM education at a time when other funding for science and technology had seen cuts.

Asked who exactly was reading STEM program reports, she assured participants that they did not go into a black hole and that staff members at the White House as well as people at NSF take an interest in them and use the information from them.

Workshop participants wishing to continue the conversation with Handelsman could do so in a breakout session immediately after her speech. In this session she repeated the attractiveness of concentrating on what she called "the low-hanging fruit" – the students who express interest in STEM on entering college but fail to graduate in the field. And she emphasized the diversity of active-learning methods available: case studies, problem-based learning, problems sets in groups, concept mapping, testing, clickers, group tests, writing with peers and peer review, small-group discussion and peer instruction, presenting an analytical challenge before a lecture, and computer simulations and games.

Expanding on the challenges she outlined in her address, she added one more: a disconnect between industry needs, student desires, and the curricula offered by colleges and universities. As the crucial area for improvement, she identified expanding the opportunity for students to engage in research in their first two years of college. She also said it was going to take time to change the way faculty approach their work.



LUNCH SESSION, DAY 1: JOAN FERRINI-MUNDY, NSF

At lunch, Joan Ferrini-Mundy, NSF's Assistant Director for Education and Human Resources, assured workshop participants that although NSF funds a broad range of research, STEM education is currently one of the government's top priorities. IUSE, she said, is "all about taking a very global view of the issues that face us in undergraduate STEM education," and she stressed the importance of increasing the numbers of women and underrepresented minorities in STEM fields.

Ferrini-Mundy said the scientific environment was changing, and the approaches of five years ago in undergraduate STEM education might not be the approaches that are needed today. She identified new trends such as the growth of "Big Data" through projects such as IceCube and EarthCube, both of which require a large number of scientists with analytical expertise; the increasing practice of science as a global activity, where what is happening at the graduate level has implications for undergraduate teaching as well; the challenge of diversity; innovation, which involves government partnerships with industry; and interdisciplinary research.

In connection with innovation, she mentioned NSF's I-Corps program, which is designed to develop a national innovation ecosystem that builds on fundamental research to guide the output of scientific discoveries that will help develop technologies, products and processes that benefit society. Efforts are underway to integrate undergraduate research with this initiative, she said.

Ferrini-Mundy ended by emphasizing the importance of institutionalizing and scaling up what STEP projects are doing. She noted that strategies promoted by NSF's ADVANCE program to increase the participation of women in academic science have broader applications as well, and that WIDER's remit means that it, too, has findings that may be applicable at the undergraduate level.

OPENING SESSION, DAY 2: ADDRESS: VINCENT TINTO, SYRACUSE UNIVERSITY

The tone for Day 2 was set with an address by Vincent Tinto, Distinguished University Professor at Syracuse University and former Chair of the Higher Education Program. Tinto has researched and written extensively about student success and the impact of learning communities on student growth and attainment. His presentation was illustrated with short video clips of interviews with low-income students from across the country.

"One of the clear lessons we've learned from institutions that have been effective is that they address it by a structured, intentional, and systematic course of action that coordinates the work of people throughout the campus," Tinto said. "They do not leave this work to chance."

As a beginning point, he said institutions need to focus on the first two years in STEM – the years over which they have the most control.

The research, he said, points to four major conditions that affect success. First: Expectations matter, and need to be clear and consistent. Students need to be clear on what steps they need to take to complete the journey on which they have embarked.

High expectations need to be underpinned by support. This can come as academic support, but it has more impact if it is more than that; the best of the summer bridge programs, he said, amount to a beginning membership in a scientific community. Other academic support, such as Supplemental Instruction, peer tutoring and adaptive learning, is also best when structured. Students learn better in groups than they do on their own.

Social support is the counterpart to academic support, and this means counselors and advisers; peer and faculty mentors; and cohort programs and first-year learning communities. Peer mentors need training, but a big advantage of them is that they offer an early warning system to identify students who are struggling.

Assessment and feedback are key. Adaptive learning helps with this, as do early warning programs – genuinely early – and classroom assessments such as one-minute papers and automated response systems. The last of these also produces feedback that helps with faculty development.

Engagement matters. This includes contacts with students, faculty and staff; active engagement in learning with others, and intensity, or time on task. Engagement strategies include cooperative learning and problem- or project-based learning, developmental engagement in research, and learning communities, especially interdisciplinary ones.

Implementation is everything. To make this happen, academics need to learn about what's going on elsewhere, then adjust for their own circumstances. And they must assess what they're doing so they can improve.

"It's one thing to begin a program. It's another to see it endure over time," Tinto pointed out. How do programs sustain themselves? His suggestions included:

1. Develop evidence of effectiveness.
2. Build support and align the initiative with institutional goals.
3. Establish a continuing source of revenue.
4. Plan for one's replacement.

Responding to questions, Tinto suggested that one way to help bring faculty along is to set up a faculty mentoring system similar to a peer mentoring system for students, using teachers who you know "get it" to bring along their colleagues. And he underlined the importance of group learning for students by pointing out that the onward march of science is in fact a process of collaborative discovery.

Tinto's speech is on **YouTube**.

As with Handelsman the previous morning, there was an opportunity for participants to continue the conversation with Tinto in a breakout session after his address.

In this session, Tinto was asked about the best methods for sustaining projects. He stressed the importance of understanding influence models and hierarchies, the need to develop a longitudinal and consistent plan of action, and the usefulness of developing a sales-and-marketing strategy. The project's success should be the institution's success, he said.

Asked what it would take to impel large state systems to motivate faculty to become better teachers, Tinto pointed out that more than 20 states are tying funding to outcomes, and the resulting accountability should help with this goal. Answering a related question, he pointed out that some research institutions allow faculty to do research on teaching and value publications on teaching and learning as highly as they do disciplinary research.

Discussing the smooth integration of transfer students into four-year programs, he said structured relationships between community colleges and four-year schools can help create a sense of community.

CLOSING REMARKS, DAY 2: CONNIE DELLA-PIANA, NSF

The 2014 STEP Grantees Meeting ended with closing remarks from NSF's Della-Piana, who had opened the workshop. She began by pointing out that, since 2002, NSF has awarded more than 250 STEP programs. Most of these have been Type 1 projects, dedicated to recruitment, retention, and graduation of STEM students; a small number are research projects focused on factors associated with STEM degree attainment. In addition, NSF has created two STEP Centers, one focused on the geosciences and the other, at Stanford, looking into entrepreneurship and innovation in engineering. NSF also supports a relatively recent series of projects under the "Graduate 10k+" umbrella through a partnership with Intel and GE.

Della-Piana said one hallmark of STEP was that it supported a wide range of institutions, from two-year colleges to research universities. She praised STEP grantees for the work they had done towards transforming higher education.

"I have to be upfront, and we all know this: Programs change and evolve, and so we are now at a new stage in the STEP program," Della-Piana said. IUSE, she said, is the next step in the evolution of the STEM community – with a program description that is now five paragraphs versus 15 pages. "I look at IUSE as an opportunity to integrate innovation, development and implementation with intentional and systematic innovation of what is working, with whom and under what circumstances," she said.

"The STEP community is well positioned to step into the future as champions and leaders in transforming undergraduate STEM education."

NSF reports in future will also require a project outcomes section that will be available to the public. This will say what was expected to happen in degree attainment and what was accomplished.

In closing, Della-Piana recognized Dan Udovic, director of STEP Central, for his pivotal role in linking the STEP community. Udovic recalled that he

started organizing STEP meetings when he was with NSF eight years ago, and offered thanks to the community for its support. The meeting ended on a traditional note with a haiku from NSF's Lee Zia.

BREAKOUT SESSIONS

OVERVIEW

The conference organizers scheduled more than 30 breakout sessions over the two days of the gathering. The sessions took on a variety of formats, from presentations to panel discussions and poster sessions. In many cases, conversations continued on STEP Central after the breakouts were over, adding an ongoing dynamic to the discussions.

In the interests of presenting best practices in an easily digestible format, the notes from all of the breakout sessions have been grouped by theme and are presented below in alphabetical order by topic. However, to give a flavor of the sessions, here are two vignettes.

For a session entitled "Improving Student Success in Foundational Courses in Math," Jeffrey Watt of Indiana University-Purdue University Indianapolis outlined some tools IUPUI is using to prepare students, notably a pre-semester calculus boot camp and a math assistance center focused on peer mentoring. Dhushy Sathianathan of California State University - Long Beach presented a study of engineering grads at 19 different Penn State campuses suggesting the importance of engineering students being placed in Calculus I or higher for their first math course. And Denise Hayman of Northern Illinois University had a simple message: "Give students VOICE!" she said, explaining why NIU uses journaling to support students through difficult math courses.

The presenters of a session on Assessing Transfer Students at Four-Year Institutions took an interactive approach to their subject. John Siber of the University of Texas at Dallas, Dave Galley of Collin College, and Kory Goldammer of Richland College asked participants what they considered the crucial stages in the STEM pipeline from middle school through to the workplace, inviting them to brainstorm their answers in small groups. The discussion was wide ranging and participants left with a 26-page road map: the actual articulation agreement between Collin College and UT Dallas.

BEST PRACTICES

Notes from almost all sessions at the STEP Grantees Meeting are available at www.STEPCentral.net. Here is a distillation of them, grouped by subject matter.

Admissions/Transfers

Sessions:
I-5 ***"Activities and Measures for Critical Elements of a Truly Functioning 2Y/4Y Pipeline to STEM Baccalaureate Degrees"***

III-11 ***"Assessing Transfer Students at 4-Year Institutions"***

Strengths: Good partners – not just two-year and four-year institutions but the workplace as well – are essential to building a strong pipeline, and that pipeline is stronger if it runs from K-12 all the way through college to graduation. A strong program can include the following: K-12 – engineering modules, visits and career talks from college faculty, and project-based classes; community colleges – research experiences, strong advising across two- and four-year institutions, and articulation agreements; four-year colleges – interventions targeting transfer students, summer research programs, peer-led team learning; and the workforce (the most challenging because it's tough to track students after graduation).

Challenges: Inherent, unspoken biases against transfer students at some research universities; the difficulty of developing partnerships of mutual respect between two- and four-year institutions; the fact that many transfers are nontraditional students; ensuring appropriate advising; the inability of some transfer students to connect with the four-year institution; the fact that the importance of training for the workforce is sometimes more important to the two-year institution than the four-year; ask yourself what the students' "endgame" really is.

Insights: Students can lead the way; sometimes they can figure out the transition for themselves even if faculty members at a two-year institution are out of sync with those at their four-year partner. It may be possible to establish a loop in which successful high school graduates influence the next generation of high schoolers (a community college career day is one tool). College faculty need to court high school teachers; they're key. One way to do this: Pay high school teachers to teach dual-credit courses; it adds to their prestige and forms strong connections. Early advising is critical. And the direction of any collaboration needs to be data-driven to make it meaningful.

Suggestions: Disaggregate summative data on transfer student success to better target specific interventions at the two-year and four-year levels. Increase the quality of advising.

Changing Institutional Culture

Sessions:
II-10 ***"Fostering Changes in Institutional Culture and Practice"***

III-9 ***"Would You Say That If You Knew …? Addressing Inclusive Language on Campus"***

Strengths: Integrating undergraduate research experiences into lab-based courses leads to sustainability and can live on well after the project winds up. Identifying which elements of teaching or learning development are most compelling for faculty will make it much easier to create buy-in. In addition, the world is moving on – inclusive language such as "underrepresented majority," once a novelty, is being heard much more frequently. Institutions are also learning they can educate students on the implicit bias and micro-aggressions they may experience later in their careers.

Challenges: Institutions where the provost doesn't value STEM; faculty who are content with the status quo; disincentives related to money, tenure, and promotion; the overall environment in which people who are underrepresented have to operate; assumptions based on perspective or bias ("You're no good at science."); a lack of inclusivity, coupled with an unwillingness to speak up about it; failure to get to know students on an individual basis.

Insights: Programs that have enlisted the dean or provost as a champion have often had success because this relationship grounds them in the institution's own priorities. There are often existing assets to tap into, such as learning communities, tutoring centers, partnerships and synergies; direct students to what already exists. Present issues in a way that suggests to faculty you need their help to solve a problem. Inserting distance into the discussion of difficult issues by way of book clubs and the like can make topics seem less threatening; and, when all else fails, realize that chipping away at a problem over three to 10 years will indeed make a difference.

Suggestions: Ask alumni to come back and address faculty about their experiences. Having them talk about the impact that bias or micro-aggressions had on them at an institution is illuminating and does not put current students at risk. Develop data on the effectiveness of different kinds of programs to make a case for inclusivity that will appeal to various constituencies.

Data Collection and Dissemination

Sessions:
I-2 "Working With Learning Analytics Data: Basics That Can Inform Your STEP Project"

II-1 "Strategies for Dissemination and Publication of Results"

III-4 "Study Design, Data Collection and Dissemination of Results"

Strengths: STEP Central has a **list of publishing options** under the Dissemination working group, loaded in connection with Session II-1. Also available on STEP Central, this time under the Collecting, Organizing, and Making use of Data working group, is a **step-by-step guide** to designing, collecting, and disseminating data from from the Wisconsin Center for Education Research.

Challenges: There is no single place to look for published material on this topic, and it's not clear who might be interested in publishing it.

Insights: John R. Riesel of the University of Wisconsin – Milwaukee described how he had written a journal article comparing a new bridge program with previous programs as a way to meet the requirement for research at a research-based institution – something that is not always easy for STEP grant recipients. STEP grantees can work with communications departments to disseminate the results of their work to the community, including politicians and workforce development officials; local media may be receptive to developing stories out of these. Areas for improvement: Slimming down data into an executive summary that a busy provost can digest.

Suggestions: Engineers, scientists, and mathematicians can benefit from connecting with other disciplines on their own campuses to see how they disseminate their own data. NSF can summarize highlights of STEP projects and feature them on its website. IUSE should consider a journal.

Faculty Engagement/Development

Sessions:
I-7 "Faculty Learning Communities: A Tool for Engaging Faculty in Your STEP Project"

III-7 "Developing a STEM Faculty Member Training Program"

Strengths: Engaging faculty in mentoring programs puts the emphasis on prevention and intervention rather than on remediation. And these can give students confidence and self-sufficiency while also serving as early-warning systems.

Challenges: Low incomes, family obligations, poor prep; a successful program requires many components: an understanding of where students are coming from, a list of go-to resources, an understanding of course sequencing, and access to resources that will help admissions and advising; a faculty mentoring program should augment faculty academic advising; transfer students need to understand the culture of the four-year school; faculty may face an initial hurdle gaining access to their mentees' academic records.

Insights: A program works well if it has clearly defined goals; these should be to help students in science and math courses. With this in mind you can engage students, increase retention rates, and help students better understand university-level work. The mentor selection process is key – you want full-time or adjuncts who have demonstrated experience working with the mentee population and who can back up their credentials during an interview. Help students make good choices by giving them options instead of telling them what to do. Pair students with faculty who are from their own majors.

Suggestions: Advise faculty that they have limits; in some cases, mentors will need to direct students to the right professionals on campus. They can make this easier by facilitating appointments instead of telling students to make the appointments themselves.

Learning Cohorts/Communities

Sessions:
II-11 "Learning Communities and Cohort Building"

III-10 "Learning Communities 101 or 401"

Strengths: Students in learning communities are showing significant increases in retention, grades, and graduation rates over students in control groups (source: New Mexico Institute of Mining and Technology). Learning communities allow institutions to treat their students as a group and give them a sense of community, and they anchor the students' academic support system. A math lab within a learning community can reduce students' fear of math.

Challenges: Poor math skills; the difficulty of coordinating linked courses among students with disparate backgrounds, particularly transfer students; recruitment; training peer mentors; large numbers of dropouts in the second year; overcoming institutional resistance to what the college or university may perceive as "academic silos;" distance, in some cases; engagement and buy-in, by both students and faculty; transfers from community colleges where it's hard to pull together students with enough characteristics in common to form a cohort. With online bridge programs, lack of engagement can be an issue.

Insights: Learning communities can be set up around a theme (one institution picked watersheds; geosciences also works). Faculty can set up their own "learning community" with middle schools, high schools, and two-year and four-year colleges, although setting this up may be a challenge. Learning communities may allow all students to participate in residential programs. The scope of who may be included in a learning community is vast: at-risk students, math/calculus or chemistry students, students who need gateway classes (in engineering or computer science, for example). And some learning communities

can be exploratory, such as one that joins Algebra II with a first-year experience in transition strategies.

Areas for improvement: Increasing faculty involvement with student life; securing funding and long-term sustainability; strategizing over the most effective ways to create cohorts (bringing together all the Calculus I students, for example).

Math Programs

Sessions:
I-6 "Interdisciplinary Mathematics in STEM Education: Undergraduate Retention and Research"

I-11 and III-12 "Improving Student Success in Foundational Courses in Math"

INTERDISCIPLINARY MATH

Strengths: The University of South Florida's Mathematics Umbrella Model in STEM Education (MUM) gives calculus students the option of completing a final project or taking a comprehensive final exam; it has increased motivation and STEM retention. Another advantage of interdisciplinary math is that it can draw together coordinators and advisors from several departments.

Challenges: Setting up a good system to propose, manage, review, evaluate, and share projects; instructor overload.

Areas for improvement: Figuring out how to recognize the workloads of instructors and advisors (the panel saw the lack of a reasonable model in this area as a significant barrier to exporting the approach to other campuses).

FOUNDATIONAL MATH COURSES

Strengths: Various forms of structured summer programs. Examples: 1) Calculus bootcamp at Indiana University-Purdue University Indianapolis, a one-credit pre-calculus review course two weeks before semester starts. 2) Summer Math College at Northern Illinois University, a six-week intensive session, Monday through Thursday, or a less intensive eight-week session, Saturdays only. IUPUI also has a math assistance center; Northern Illinois has peer-led study sessions.
Challenges: It can be expensive for students who can't make it in a higher-level course (such as Calculus I) if they drop out to take a lower-level course (such as pre-calculus). IUPUI has addressed this by guaranteeing that students won't lose money by taking a step that in fact makes sense for them. There may be problems at the high school level: schools that don't tell students they need to take math in every semester in their senior year (so they arrive rusty). Some students blow off math tests without understanding how important they are.

Insights: You can address students who demonstrate clear attendance issues by revoking their registration for a class. IUPUI has such an administrative withdrawal policy in all disciplines, but where it has really made a difference is in pre-calculus. IUPUI got tremendous bang for the buck with an electronic flagging system that all teachers can access. Advisers must emphasize the importance of being placed in Calculus I or higher as the first math course an engineering student takes. Focus on what the students themselves are telling you about math and STEM (NIU uses journaling, with prompts such as: "My best experience with math was when …", "One math activity I really enjoy is when …," "I want to become better at math so I …"). "Give students VOICE" – Denise Hayman, explaining why Northern Illinois U. uses student journaling to support them through difficult math courses.

Areas for improvement: IUPUI is experimenting with a remedial course that actually runs concurrently with the class. It's currently aimed at business majors; the outcome is not yet certain.

Mentoring

Sessions:
II-9 "Peer Mentoring Programs"

III-5 "Strategies That Enhance the Success of Peer-Assisted Learning/PLTL"

Strengths: One model of peer leadership relies on a well-defined structure, with all peer leaders enrolled in a two-credit course and attending a class supported by peer-led team learning, or PLTL. This can include a research project such as observing the effect of algebra skills on success in calculus. Faculty can be enlisted to recruit peer leaders. Peer advising is also important. At-risk students can be identified in advance and should include those repeating the course and those on academic probation. Students should visit their advisor at least three times per semester. Advisors need grades for their students. They should receive 30 hours of training or more and should work in accordance with federal privacy rules.

Challenges: The session identified two main challenges. The first was obtaining faculty buy-in. Possible solutions: provide evidence of success at other institutions; run a pilot program first; file letters of commendation for promotion and tenure files; run an orientation session using PLTL for faculty; offer "bribes" (free lunches etc.); create a faculty learning community; minimize the workload of participating faculty. The second challenge was getting student buy-in. Possible solutions: requiring attendance at PLTL session as part of the grade; providing incentives such as extra credit; using veterans of the program to recruit new students; giving potential exam questions to team leaders for peer review.

Insights/Suggestions: Insist on requirements for peer leaders. Suggestions: must have received A's; must have faculty recommendations; shadow current peer leaders; provide metacognition education; stagger training, with eight hours before the session and two hours per week during the semester; train on learning styles; teach scaffolding techniques. Good peer leader qualities include empathy for students who are having difficulties; willingness not to seek to be the center of attention; and focusing on the process and not the answers. Peer advisor training needs to include an emphasis on advising, not tutoring; role playing; working closely with at-risk students; privacy laws; and action planning.

NSF Evaluations

Sessions:
I-12 "Designing and Conducting an Evaluation of Your Project That Meets NSF Expectations"

II-3 "Creating a Community through Evaluation: STEP Evaluation FAQs and Helpful Resources"

A **list of FAQs** is available on STEP Central. Evaluations are mandatory, of course, but they also document outcomes and help define best practices. The list mentioned above discusses the importance of defining the purpose and the audience for an evaluation and identifies certain elements to consider when designing one: focus, type, method, question alignment, and rigor in both quantitative and qualitative research. It recommends creating a logic model for the evaluation and recommends working with a college or university's office of institutional research to get the data you need – plus drawing in an educational statistician if possible to help put the data in context.

Program Management

Session:
II-8 "Don't Reinvent the Wheel: Partners and Strategies to Effectively Manage Your STEP Project"

Strengths: Building buy-in through shared ownership of goals and strategies to reach them.

Challenges: Clear communication, internal as well as external, so your message is delivered in a context appropriate to the audience; coordinating multiple project components (it helps if you can develop a visual for your team that illustrates the interactions, synergies and potential among these components); time management and faculty burnout; managing conflict.

Insights: Be an active listener. Set priorities and schedule realistically. To manage project files and data, develop a data management plan, set up a shared drive with clear direction on what goes where – and protect privacy.

Suggestions: Consider including a social scientist in your team to help bind collaborations.

Recruitment/Retention

Sessions:
I-3 "Effective Practices for Recruiting and Retaining Minorities and Women in STEM"

I-4 "How to Implement an Early Alert and Intervention Program to Improve Students Success and Retention"

I-9 "Bridge Programs"

II-7 "Strategies for Implementing Structured Support Systems for Underrepresented Students"

Strengths: The University of Virginia's Center for Diversity in Engineering helps students along the process. It brings faculty to events to show their commitment and offers professional mentoring. The University of Tennessee, Knoxville has been connecting honors women to research in their first year. It also shows underprepared students it has a plan to help them.

Challenges: Lack of incentives for faculty to get involved; trying to develop a culture instead of training people ad hoc; lack not just of math skills but of reading skills as well, which makes reading textbooks difficult; difficulty of getting student data, for institutional or privacy reasons.

Insights: The target population for early intervention programs includes not just struggling STEM students but a very large number of native U.S. students in calculus classes – most international students don't seem to need this help. Also, there are various triggers for intervention: low placement test scores, low scores on a calculus test, low scores in pre-calculus, poor academic standing, and repeating class. Western Michigan University noted that GPA is not a reliable trigger.

Areas for improvement: Can NSF grants address encouraging faculty to mentor more? STEP Central can improve its user friendliness by adding in the subject line of messages what it is people are posting about. Also, the session on early alert programs recommended establishing a standing monthly meeting, online and posted to STEP Central, and a web conference group.

Student Engagement

Session:
I-8 "Teaching Flipped!"

I-10 "Encouraging Student Participation"

II-5 "Improving Student Success in Foundational Courses in the Sciences"

Strengths: "Teaching Flipped" – posting lectures on YouTube before class – allows students to get factoids before they come to class, from the lecture and the textbook. When this happens, questions in class are much better and more plentiful than they used to be, and they are often concept questions as opposed to "I don't understand" questions. It's also easier for the instructor to assess what students don't understand. Another huge plus: Students tend to love this approach.

Challenges: Prep, including making the videos in advance; making videos at the right level for the students; persuading students they'll learn better this way; technology issues for both students (many worksites block YouTube) and teachers (new technology); the fact that this approach doesn't address the need for reading skills.

Insights: Videos can actually speed up the presentation over traditional lectures. Students who take notes as well as watching the lectures in advance do better than those who just watch it. Provide a CD with lectures for students who have issues with their computer connections. Don't ever repeat the video in class – if you do, students will stop watching online. Assign a "portfolio question" that students have to respond to after watching a lecture and must turn in later in the semester for credit. A flipped classroom means flipping what you used to do outside the classroom as well as inside (so homework can be done in class).

Areas for improvement: The need to integrate lots of real-world examples.

Suggestions: Assess your class constantly and stress that there are no stupid questions. Try phasing in Teaching Flipped by flipping the last third of the semester the first time, the second third the next time around and finally the first third, which gives you a fully flipped class with less work.

Key insight: Using a flipped classroom increases student engagement with and retention of material and allows for the development of higher-order thinking skills.

Sustainability/Institutionalization

Sessions:
II-2 "Sustaining and Institutionalizing Best Practices Identified in Your STEM Project"

III-2 "STEPWork: A Workshop on Sustainability of STEP Grants Through Workforce Board Collaboration"

III-6 "Using Mini-Grants to Increase Sustainability, Faculty Buy-In, and Institutionalization"

Strengths: The ability to strategize to ensure success by bringing in different stakeholders: the advisory board, the vice president for student affairs, the dean. The forging of partnerships across campus (so student cohorts can take classes together or live together). Aligning your project with your institution's strategic plan.

Challenges: Changes of leadership require strategic planning; interpreting data – causation or correlation?

Insights: First-year and summer bridge programs can lead to a marked improvement in grades. It may be possible to reallocate dollars from existing programs.

Areas for improvement: Too often, the plan for sustainability comes along far down the pipeline; it's better if it's part of the planning. The STEP community needs designs and instruments for measuring success that are shared and accepted by all. There should be reverse transfer of credit to community colleges so they too get credit for transfer students who complete their degrees.

Suggestions: Community colleges are in a good position to look for local media coverage, and also to encourage investment from local businesses.

Undergraduate Research Experiences

Session:
II-4 "Resources to Improve Your Undergraduate Research and Internship Program"

II-6 "Undergraduate Research: Implementation in the Community College"

The session on resources to improve undergraduate research drew on two experts: Elizabeth L. Ambos, executive officer at the Council on Undergraduate Research (CUR; ***www.cur.org***) and a geologist, and Kelly Mack, vice president for undergraduate STEM education and executive director of Project Kaleidoscope, a nonprofit at the Association of American Colleges and Universities (AAC&U; ***www.aacu.org***).

Dr. Ambos described CUR's mission and the ways it can help institutions and scholars. Its resources, which are available to nonmembers as well as members, include professional development for faculty and conferences for undergraduates; it holds an annual conference, the National Conference on Undergraduate Research. Its services include consulting, grant preview, listservs and mentor awards. It publishes a free guide, Characteristics of Excellence in Undergraduate Research, available on its website.

Kelly Mack described Project Kaleidoscope, or PKAL, founded as an NSF initiative in 1989 and focused on STEM education in liberal arts institutions via seven regional networks. These host annual or semiannual meetings to discuss STEM pedagogy, and their themes have included active learning experiences, collaborative learning experiences and faculty interactions.

POSTER SESSIONS

Ninety-nine STEP programs signed up to display posters at the STEP Grantees Meeting, which featured two hour-long poster sessions. Half of the posters were staffed for each session, and projects were clustered by topic, with Two-Year/Four-Year Partnerships especially well represented, with 16 posters. Last year's leading topic, learning Communities and Cohort-Building, drew 13 posters this year, down from 20, perhaps representing a slight shift in focus among the topics of interest to STEP.

Many of the posters drew lively discussion, and the sessions added an extra dimension to the proceedings by allowing one-on-one discussions with the people directly responsible for implementing STEP programs.

All of the posters are collected on STEPCentral.net at the following link:

www.stepcentral.net/conferences/5/posters/

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