2013 NSF STEP GRANTEES MEETING:

IDENTIFYING BEST PRACTICES REPORT

MARCH 14-15, 2013 WASHINGTON, D.C.

HOSTED BY THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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EXECUTIVE SUMMARY

The 2013 National Science Foundation's STEP Grantees Meeting was held March 14-15, 2013 in Washington, D.C.

The goal of the NSF's STEP program (for Science, Technology, Engineering, and Mathematics Talent Expansion Program) 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 of Undergraduate Education in the NSF's Directorate for Education and Human Resources.

NSF has funded several annual STEP Grantees meetings over the past five years. The purpose of the 2013 meeting was to bring together faculty, administrators, student support specialists and evaluators involved in STEP-funded projects to identify best practices. A pre-conference meeting was devoted to STEP Central, the centralized web site (www.stepcentral.net) that supports all of these STEP participants.

MEETING FORMAT

About 400 people attended the STEP Grantees' meeting, a figure that includes representatives from NSF itself. The format was innovative, with five separate thrusts: plenary sessions, breakout sessions, lunch table discussions, poster sessions, and real-time discussions 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.

The core of the meeting was a series of three breakout sessions on 36 topics lasting ninety minutes each. There was some commonality of topics within the sessions – the second, for example, included sessions on STEP evaluations, managing projects, and collecting and organizing data – but many topics, such as undergraduate research, cropped up in different sessions. This gave participants flexibility over which sessions to attend. Breakout sessions followed several different formats; some incorporated poster sessions as well.

Both days of the conference opened with plenary sessions, and both sessions featured speakers whose remarks spurred considerable discussion at the conference and afterwards on STEP Central. On Thursday, Eduardo J. Padrón discussed the future of STEM education from his perspective as president of Miami Dade College. On Friday, Philip Uri Treisman, professor of mathematics and of public affairs at The University of Texas at Austin, offered thoughts on STEM based on his years of involvement in efforts to improve American education – a speech that kept participants talking for the rest of the day. 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 at tables with time to talk, which had the effect of mixing Grantees randomly. Lunch seating was arranged by discussion group. Some of these were by job function – project coordinators, for example. Others were by type of institution (community colleges, large universities, small universities, minority-serving institutions), or topic of interest, such as project sustainability.

Thursday afternoon featured two 75-minute poster sessions. Half of the posters were staffed for each session, so as not to tie up the exhibitors for the whole time. Projects were clustered by topic. The best-represented topic in terms of number of exhibitors was Learning Communities and Cohort-Building, with 20 posters.

An unusual feature of the 2013 Grantees 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. Within a couple of weeks, some of the topics raised had stirred dozens of comments or reactions.

MEETING OUTCOMES

A high level of engagement. Because of the way the STEP Grantees Meeting was organized, a large number of participants were engaged in explaining their own work to their peers, as presenters in the breakout sessions or in the poster sessions. The poster sessions alone drew more than 100 entries. More than 30 participants also served as scribes in the breakouts, uploading their findings to STEP Central. So one of the crit-

ical outcomes of the meeting was a high level of direct involvement by almost everyone who attended.

Identification of common themes. Despite the wide variety of topics covered in the breakout sessions, it was clear that certain themes recur in many different phases of STEP projects. Many grantees are grappling with institutional issues such as revolving personnel at the administrative level, how to institute peer mentoring, and lack of math skills among first-year students. The sessions provided new lenses through which to look for solutions to these common problems.

An increased role for STEP Central. The ability to carry on discussions from breakout sessions, go back to listen to what the two featured speakers had to say and read through posters online broadened the impact of the two days by supplying an ongoing source for comment and research.

Networking opportunities. The meeting brought together grantees who would otherwise never have met, sparking discussions and creating takeaways for all.

A chance to hear from NSF personnel. As well as formal presentations from the lead program directors, there was a chance to hear directly from other NSF staff who sat in on breakout sessions.

A reminder that we are all dealing with the lives and futures of the students we serve. Eduardo Padrón, the opening speaker, stressed the importance of living up to one's values in one's teaching. Lee Zia, the lead program director, emphasized this: "We need to see the numbers, but we need to tell the story around the numbers."

PRE-CONFERENCE WORKSHOP

Building a STEP Community of Practice Using STEPCentral.net

STEP Central's goal is to build a nationwide community of practice among the faculty, administrators, student support specialists and evaluators involved in projects funded by NSF's STEP program. Its director is Daniel Udovic, professor emeritus of biology and environmental studies at the University of Oregon, whose project, itself funded by NSF, also includes organizing the annual meetings of the STEP community through 2014. STEP Central's program manager and coordinator is Tania Siemens, who works with Oregon Sea Grant at Oregon State University.

The pre-conference workshop, held March 13, offered an introduction to the STEP Central website with an emphasis on recent improvements. These included customization tools ("We're trying to make your experience on STEP Central more like a social network," said Siemens), a growing database that allows users to add resources, and more working groups (previously known on the site as special-interest groups). To meet requests that users be able to distinguish public from private colleges and universities, a filter has been added to allow this. STEP Central webinars are growing in number, and the website welcomes suggestions for topics. A "contact us" button permits feedback.

A question-and-answer session after the presentation foreshadowed many of the issues around the STEP program that would come up during the conference itself, such as two-year to four-year transfers, mentoring programs,

and partnerships between industry and educational institutions. A request for better evaluation indicators was coupled with a request for better summaries of information on questions such as why many students are doing so poorly in math. A final question was also echoed in later sessions: "Why aren't we sharing what didn't work?"

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: DR. EDUARDO PADRÓN, MIAMI DADE COLLEGE

Thursday's opening session was the first formal event of the meeting. Lee Zia, lead program director for STEP, welcomed participants, and Joan Ferrini-Mundy, assistant director of the NSF›s Directorate for Education and Human Resources, offered an update on STEM education initiatives at the federal and state levels, including a focus by the Obama administration on graduating more students in computer science and engineering. Ferrini-Mundy also outlined goals for the conference itself, emphasizing the need to document and disseminate evidence-based best practices in STEM education.

The speaker for the session was Eduardo Padrón, president of Miami Dade College, which, with more than 174,000 students, is the biggest institution of higher education in the United States. Padrón praised what NSF and STEP bring to institutions such as his, but expressed concern at the way American high school students lag behind much of the world in math and science. He welcomed the Obama administration's initiatives to create 10,000 new engineers and 100,000 new math and science teachers in the next 10 years. His fundamental question, expressed several times, was: What do we value?

In keeping with the conference's focus on best practices, Padrón drew attention to Miami Dade's practice of elevating its outstanding STEM faculty members to emphasize their importance. And for students who are willing to persist in STEM fields, he said, the jobs future is very bright. He spoke of the joy of many STEM students who discover that despite the hard work, STEM is anything but a narrow endeavor, and spoke of the passion that goes into making their college experience useful and rewarding. These students, he said, are discovering what they value.

In remarks after Padrón's address, Udovic, the conference organizer, pointed out that in highlighting the experience of STEM students at Miami Dade, the speaker had touched on a subtheme of the STEP Grantees Meeting, which was the humanity that underlies the numbers that STEP programs are trying to help. "We focus on numbers in STEP … but each one of those numbers represents human beings who bring to the table their experiences, their values, and their aspirations and hopes, and it's our job is to bring those to fruition," Udovic said.

The session is available on STEPCentral.net at http://stepcentral.net/groups/posts/589/.

Participants wishing to continue the conversation with Padrón could do so in a breakout session immediately after his speech. In this session he outlined the impact Miami Dade College has had on its region and on its students, some of whom come from foreign countries even though the college does no recruiting outside its own county. The college maintains a maximum class size of 40 students.

Among the challenges he cited were declining public support for education funding in Florida and other states, the defunding of developmental education in particular, the concern that for-profit institutions are taking advantage of some students, and faculty unionization. Strengths of the college include scheduling for nontraditional students (classes run

seven days a week), the fact that it runs two high schools, and the focus on the institution as a whole as opposed to the multiple campuses within the system. The college has also de-emphasized sports.

One highlight from the breakout session: Put students first in every decision. Don't improve "efficiency" by increasing class size. Never use resource issues as an excuse not to do the right thing.

LUNCH SESSION, DAY 1: REMARKS FROM THE LEAD STEP PROGRAM DIRECTORS

At lunch, Lee Zia and Connie Della-Piana, the lead program directors for STEP, spoke of the successes and challenges of the STEP program so far.

Zia said that increasing degree attainment in STEM remains challenging, and said success will be measured by several indicators of progress, such as retention, enrollment and demand (expressed, for example, by a need for more STEM courses at existing colleges and universities). He pointed to several recent policy drivers at the federal level. One was the 2011 report by the President's Council of Advisors on Science and Technology (PCAST) that called for ways to improve STEM education during the first two years in college with the goal of producing one million additional STEM graduates by 2020, and another was the call by the Office of Science and Technology Policy for a cross-agency approach to investment in STEM education. As the pressure for more STEM graduates increases, Zia said, NSF is ideally positioned to contribute. He noted that Dr. Padrón had framed his message during the opening session around values, and commented: "We need to see the numbers, but we need to tell the story around the numbers."

Della-Piana stressed the need for quantitative data to tell STEP's story. What has changed, and why? she asked. What activities has the project supported, and what changes have resulted? Who is being reached by these initiatives?

Della-Piana announced that NSF may ask for a common data table for proposal submissions, and pointed out that there is a new outcomes report for NSF projects at research.gov. She said alignment is important to NSF not just for its own purposes but to make its data useful to schools and colleges. Challenges include the difficulties of working with institutions' own research offices, and a lack of homogenization around project data that makes it hard to correlate. As possible solutions, she suggested bringing Institutional Research officers to STEP Grantees Meetings, holding workshops for them, or using them to contract for IR services.

In a short question-and-answer session that followed, one participant asked that grantees who do file data be given feedback on how they are doing relative to the expectations of them, to help them benchmark themselves against their peers.

OPENING SESSION, DAY 2: ADDRESS: PHILIP URI TREISMAN, UNIVERSITY OF TEXAS

The tone for Day 2 was set with an address by Philip Uri Treisman, professor of mathematics and of public affairs at The University of Texas at Austin, who founded and directs the university›s Charles A. Dana Center, a research unit of the College of Natural Sciences. The center's website gives his research and professional interests as education policy, mathematics and science education, and community service and volunteerism, and he has influenced education policy at the state and federal levels.

Treisman began his speech by decrying the "huge disconnects" between high schools and higher education, using as an example the high attrition rate between high school and college among students who have calculus on their high school transcripts – an outcome he deplored, citing it as a wake-up call for the people represented in the room, whom he saw as advocates for the students in their programs.

Much of his speech focused on the nexus between science education and public policy.

Employers need STEM graduates, he said, and in some ways the debate over higher education funding is a fight over who should pay for what is essentially workforce training. In that fight, industry is exerting pressure on the public to pay for training its employees.

On a related topic, Treisman argued that education is the only real force for upward mobility in today's world, and warned that the social contract is threatened by a lack of upward mobility.

Treisman spoke of the four years he spent visiting 40 community colleges, during which he made a point of spending his first day teaching to get a real feel for them (as opposed to swallowing what their presidents said). Among his conclusions:

Pilot programs rarely scale up to work at a larger level; initiatives just die rather than becoming normative practice. He recalled one faculty member's explanation of why such initiatives wither: "They're about faculty development – they're not really about institutional change." "We need to end that mythology," Treisman said.

Best practices matter, but you can't just export them from one institution to another and hope they work in their new environment.

It's a myth that remediation works. "Remediation is a burial ground for the aspirations of myriad students, mostly poor people hoping for a better education," he said. "It's become a cost center in most institutions." He called this unethical and said it was not helping the minority students it was designed to serve.

Blaming "decrepit American high schools" for students' shortcomings is wrong, he said, and focusing on their weaknesses "has turned a beacon of hope ... into a symbol of government failure." Treisman says the education community has not built the bridges that students need to pass from high schools to higher education. "We need to stop thinking of artificial barriers between high school and college," he said.

It's a myth that systems will solve the problems. Treisman pointed out that when you ask good students who or what was responsible for their success, they tend to single out a person, not a system.

In Texas, Treisman said the state is redesigning its curriculum to create gateway courses in math from high schools to higher ed (he stressed that changes such as these need to happen at the state level, not just the campus level). Course content and structure need to change, but there are no magic bullets.

In conclusion, he called on the people in the room to act as agents of change. Treisman's speech is on STEPCentral.net at http://stepcentral.net/groups/posts/785/.

As with Dr. Padrón the previous morning, there was an opportunity for participants to continue the conversation with Dr. Treisman in a breakout session following his speech. In this session, Treisman said those involved in STEM and STEP are well positioned to lead reform efforts because they have worked hard to determine and share best practices. Also, the emphasis of both initiatives is on retention and success, which is consistent with current political and legislative agendas.

Among the challenges he noted were the fact that some of the programs that don't work (he emphasized developmental education) are cost centers for universities, so eliminating them would have a major impact on funding

for higher education. He criticized existing systems for rewarding faculty for working against innovation and change, and he said the "placement industry" works against effective reform and uses instruments that are not reliable. He said he would like to rethink placement exams to aim at inclusion rather than exclusion, and called for the modernization of basic courses in math, biology and chemistry.

Treisman suggested gateway courses to bring students into programs of study and give them the resources they need to succeed, such as intensive tutoring and support from week one. Citing research that shows that immersion in complex structures early in college is a predictor of success, he said that perhaps students should take fewer courses but engage in them in more intense ways.

CLOSING REMARKS, DAY 2

The 2013 STEP Grantees Meeting ended with a plea from Daniel Udovic, the conference organizer, to keep the conversation alive on STEP Central, and an exhortation to participants from Lee Zia, the lead program director for STEP, to continue to share evidence beyond their own institutions.

BREAKOUT SESSIONS

OVERVIEW

The conference organizers scheduled thirty-six breakout sessions over the two days of the conference. The sessions took on a variety of formats, from presentations to panel discussions to 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 theme. However, to give a flavor of the sessions, here are three vignettes.

A session entitled "Using Undergraduate Research and Internships to Recruit and Retain STEM Students" took a poster-based approach, with a short introduction by the exhibitors followed by time for participants to ask questions at the posters themselves. Led by David Clark of Alma College, Wei R. Chen of the University of Central Oklahoma, Theresa M. Garcia of San Diego State University and Peter Tkacik of the University of North Carolina at Charlotte, and moderated by John Davis of Alma College, the session moved quickly into small groups. These gathered around the posters, which included a program run out of UNC-Charlotte's Motorsports Research Building, which opened in 2012 and permits undergraduate engineering research. Tkacik, an assistant professor of motorsports, answered a stream of questions from participants who flowed from one poster to another.

A session entitled "First-year STEM Student Cohorts: Assessment and Best Practices" illustrated the benefits of using STEP Central as a mechanism for preparing for the session in advance and advancing the discussion afterwards. The leaders of the session, Janet Callahan of Boise State University and Edmund Tsang of Western Michigan University, both posted introductory material and called for questions in advance of the STEP Grantees Meeting. Immediately afterwards, Callahan added three more posts, with discussion notes and participant questions.

Many of the sessions went into detail about how particular institutions had approached issues that commonly arise in STEP programs. In "What Counts? Articulation Agreements and Transfer Students," Carolyn Vallas of the University of Virginia and Patricia Taylor of Thomas Nelson Community College looked at five years of a cooperative partnership between the two institutions on student transfers. The discussion ranged over transfer and admission requirements, student tracking, and the provision of extra math work at Thomas Nelson to prepare students to switch from the fourth-largest community college in Virginia to the state's flagship university.

Some sessions sparked many comments on STEP Central. By early May, for example, a session on peer mentoring programs had drawn seven responses.

BEST PRACTICES

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

Admissions

Sessions:

I-11 "Strategies for Promoting Diversity"

II-2 "Supporting Community College Transfers"

III-6 "STEM Culture of Success: A Cultural Approach for Increasing Diversity and Inclusion in STEM"

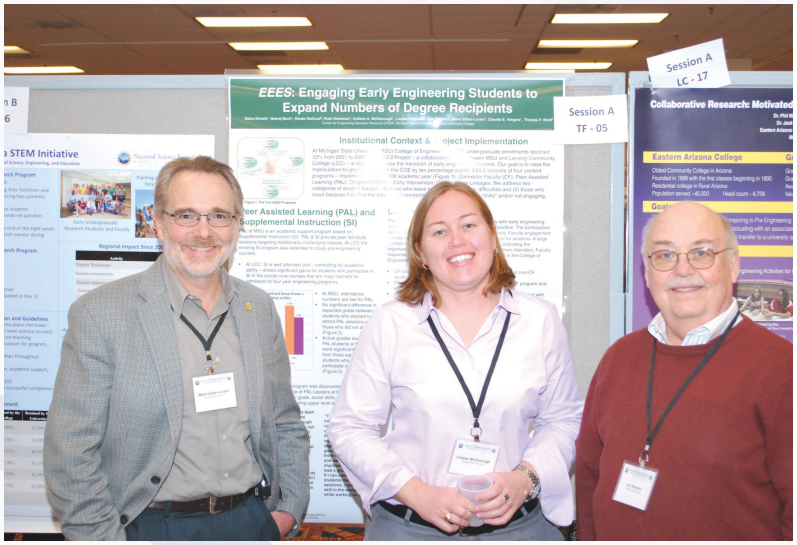
Strengths: The existence of diversity officers, counselors and advisors who can make connections. Institutions need a "STEM mom" or "STEM dad" to form a cohort and keep it together. In addition, a STEP coordinator who has constant contact with students and a detailed knowledge of opportunities is invaluable because he or she offers one-stop shopping. When it comes to community college transfers, undergraduate research experiences and exposure are particularly successful in STEM retention.

Challenges: An incomplete picture of the student body (don't forget the transfer students, part time students, etc.). The lack of diversity in the engineering culture, making it harder to hold on to diverse students. Retention. Senior administrators with a fixed mindset. Persuading parents to become involved. Students who are working or raising a family. The difficulty of implementing learning communities in commuter schools. Lack of faculty buy-in to support community college transfers. Institutional barriers to community college transfers, such as high admission standards, lack of articulation agreements, high tuition, lack of SATs. Tracking community college transfers is difficult because both partners need to work together to make this possible.

Insights: Females lead males in persisting in courses and graduating. Many Hispanics are very persistent; if you can keep them around long enough, they will graduate. Many students lack role models in STEM. Students develop bonds as freshman, and these last throughout the four years of college. For community college transfers, retention is significantly better among those who take calculus and pre-engineering courses before transferring. And having two- and four-year faculty collaborate to develop shared curricular materials pays off.

Areas for improvement: Better incentives for faculty to reach out to minority students. Instituting admissions policies at four-year colleges that don't present roadblocks to community college transfers.

Suggestions: Work with community colleges to recruit diverse students. Make sure the diversity officer has the passion and commitment to succeed. Present diversity as a work-force, economic issue to administrators (it's more persuasive). Consider other STEM degrees as a pathway to engineering. Find a shepherd for your group: One kind word from a professor can turn a student around. Implement weekly Academic Excellence Workshops; data suggest that students who participate in these have a higher GPA. Hire a STEP-specific recruiter who is multicultural and bilingual. Provide community college students with explicit information about which classes to take to succeed as transfer students, coupled with an explicit explanation of expectations.



Bridge Programs

Sessions:

I-8 "Developing Effective Bridge Programs"

II-1 "Building Bridges for STEM Success: Implementing Effective Summer Bridge Design"

Strengths: In one case, four different schools are involved in a single program – three four-year schools plus a community college. Scholarships are offered to students who attend the summer program; half of the money is awarded at the end of the summer program and the other half if they stay in a STEM major. Summer bridge programs can be geared in length and topic to the needs of students. Including students who don't really need it can model good student behavior and habits.

Challenges: Getting the data under control. Knowing your audience – remembering your students' needs. Cost; some institutions offer scholarships but not all can do that. Hard work for staff (but data suggest these are among the most effective programs for STEM retention).

Insights: Use mentors (upper-level undergraduate teaching assistants) to assist students in classes and form study groups in the evenings. Structure the day so students are in class in the morning and work on projects in the afternoons. If possible, hire those who will teach the students in the fall to teach the bridge programs too. Find someone on campus for the students to connect with while they are at summer programs — those are the people they will seek out in the future. Go after donors through your development officers to support bridge programs. And don't be afraid to charge for the programs themselves.

Areas for improvement: Find incentives for students to attend. Develop a college culture for first-generation students who don't know understand the college's mechanics, its culture and language, and the difference between general education courses and those required for a major. Articulate the benefits to both students and parents (some saw this as the most difficult hurdle to overcome). Take family finances into account in timing courses.

Suggestions: Post videos of former students talking about their experience. Offer scholarship funds to make up for the money lost by students who would otherwise be working during the summer. Share templates such as applications, brochures, and orientation materials. Start with team building. Use peer mentoring during the summer and throughout the year. Provide a review of calculus concepts. Above all, deliver a good math program during the bridge session. Use outside activities such as amusement park or industry visits to enliven the program. Try to move students from bridge program housing directly into their housing for the semester. Have the institution pay for the program but make the student liable if he or she doesn't show or doesn't produce.

Changing Institutional Culture

Sessions:

I-3: "Fostering Changes in Institutional Culture and Practice"

Strengths: Session participants displayed a wide diversity of grants, programs, and goals. Of the programs discussed in detail (Rutgers-Camden, University of Washington, Northeastern University Center for STEM Education), changes appeared multifaceted and interdisciplinary, using peer mentors and learning communities, student orientation, collaborative learning, research experiences and curriculum reform.

Challenges: Sustainability, and resistance by faculty and some students.

Insights: Institutional change takes time. Presenters suggested working in stages, focusing initially for example on first-year students. But true partnerships can evolve in the later years between faculty and students. Be transparent — share data and communicate.

Areas for improvement: Professional development, institutional buy-in.

Data Collection and Dissemination

Sessions:

I-12 "Data Collection, Publishing, and Dissemination of Results"

II-6 "Amplifying the Ripples: Disseminating Your Educational Project to a Larger Audience"

II-11 "Collecting and Organizing Data: How and Why"

Strengths: STEP has a narrowly defined goal to increase the number of STEM graduates, which is a simple goal to measure. And there are many avenues for dissemination, including STEPCentral.net, web vignettes, and newspaper articles. Dissemination is important in getting others to adapt and adopt educational initiatives.

Challenges: We're swimming in data. At the beginning of a project, it's challenging to decide which data to collect, and many people are collecting far more than they need. While it's relatively easy to measure the success of strategies for recruiting, it's far more difficult to collect the data needed to examine why a particular approach worked. Practical difficulties include the need for IRB approval when working with high school students, cost, and the difficulty of establishing control groups. Leaving some students out of a program to allow for randomization comparisons raises its own issues and can invite an angry phone call from a parent. When it comes to dissemination, educational innovations often require many years to take hold and show success.

Insights: STEP is an experiment itself, designed not just to increase the number of STEM graduates but also to address the question of why a particular approach is successful. And it's not necessary to reinvent the survey; good ones already exist. Some suggestions for successful dissemination: Examine your results rigorously and publish truthfully; send out invitations so you get an audience; encourage administrators to reward good results; allow others to adapt and adopt, not just copy; collaborate locally and regionally, and use scientific societies and professional organizations. To decide which data to keep, think about who needs really needs what.

Areas for improvement: Plan data collection and analysis from the beginning so it's truly useful. Do include control groups.

Suggestions: Create a video for the web on what your students have accomplished; host brown-bag luncheons to discuss best practices; hold hands-on workshops on campus, and reach out to stakeholders to explain what you are doing. Use a Facebook page for a cohort to track them during and after the project.

Faculty Engagement/Development

Sessions:

I-6 "Strategies for Promoting Faculty Engagement with Early STEM Students"

III-9 "Creating a Faculty Fellows Community: Developing Collaboration Through Facilitation"

Strengths: The development of strategies for faculty-student interaction and the study of lessons learned, including how interactions form. Some integration of courses helps, by providing linkage. Creating a Faculty Fellows Community offers a good model for interdisciplinary theme-based experiences, with a service component for STEM faculty (one way this has been achieved is by linking a one-credit-hour interdisciplinary course with the traditional course cluster in the first two years of study).

Challenges: Some students leave STEM because they perceive low empathy from faculty in the early semesters. Creating a support structure to tackle this is difficult. Faculty must be motivated and rewarded, industry must be convinced that student work projects are worth sponsoring, and large-classroom courses must engage the students who take them. There can

be a high burnout rate for faculty who devote a lot of time to making things work. There is a tendency among faculty members to assume that students need to be like them to succeed. One challenge with creating a Faculty Fellows Community is the need to work with the registrar's office to construct a workable schedule to link course clusters; and it needs departmental support to help with the extra time involved in the interdisciplinary courses.

Insights: Articulating programs to increase faculty-student engagement can help. So can creating a faculty team whose members care deeply about special subjects (one team was dedicated to early-stage engineering students). A targeted questionnaire is a good way to initiate faculty discussion about common interests and developing learning outcomes. Weekly lunch meetings engage faculty and build community. A focus on research and inquiry is important; the interdisciplinary course mentioned above involves important partnerships with local community organizations, centers, and environments. Also, it was scheduled so that students take it with the same instructors who teach the introductory courses in their respective disciplines. On the plus side, a Faculty Fellows Community is easier than most initiatives to scale up and institutionalize.

Suggestions: Develop freshman courses such as Introduction to Design that will make the faculty part of a team and provide a large group of related activities. Train faculty to relate to the age group of incoming freshmen, and hold meetings to troubleshoot problems.

Learning Cohorts/Communities

Sessions:

I-4 "First-Year STEM Cohorts: Assessment and Best Practices"

III-4 "Learning Communities and Cohort Building"

Strengths: The second of these breakout sessions heard from three different projects: CASAR at St. Edward's University (Community for Achievement in Science, Academic, and Research), SEEDS at the University of Maryland (Successful Engineering Education and Development Support), and TOPS at Towson University (Towson OPportunities in STEM).

At CASAR, the most effective strategies were the Pre-College Accelerated Research Methods Workshop (a one-week enrichment program) and the Follow-up Summer Research. The enrichment program forms a good community. The research project builds confidence, and the students see themselves as researchers.

SEEDS incorporates a one-credit seminar in each semester of the first two years. In the first semester, students must attend student society meetings, and there are sessions on college life. The second semester focuses on career clarification and career building. The second year focuses on leadership. Students move in two days early; they learn about campus, and do a ropes course.

TOPS offers a one-week summer experience that is critical in terms of cohort building. A math instructor gives a representative syllabus for the two days that she teaches during the summer experience. The learning community is organized by major, so students at all levels in a given major are together. There is mandatory tutoring, with financial implications if the student does not attend. And there are research opportunities.

Challenges: Comparing groups that may be inherently different; small sample sizes; difficulty in scaling small cohorts up to larger programs. Getting the word out; students often don't pay attention to information given to them. Scalability is a challenge, as is getting faculty and administrators to acknowledge the need for student support.

Insights: Community-building must take place in the environment that exists already (on the plus side, software exists to compare cohort member engagement). Sending information

about programs to all admitted students, not just those who have indicated they are coming, seems to be effective. Have previous participants call potential participants. Add information about the learning community to the housing application. Peer mentoring works in living learning communities. The TOPS program includes a weekly half-hour meeting with an advisor. And one often-overlooked aspect of community is recognition.

Areas for improvement: Shared experiences must suit the cohort; an outdoors adventure might not work for some students. It would be good to have National Society for Experiential Education (NSEE) data to assess social engagement in a cohort community. Try to obtain funding from outside organizations for sustainability. Note: TG's Charley Wootan Grant Program (www.tgslc.org/) provides some funds for institutions even outside of Texas.

Math Programs

Sesssions:

I-10 "Successful Experiences in First-Year Mathematics Courses"

III-4 "Increasing Student Success in STEM through Application-Based Math Instruction"

FIRST-YEAR COURSES

Strengths: One program had eight math faculty members involved in its boot camp; this increased the engagement of both students and faculty. Different approaches are possible: A summer course led to positive outcomes, and so did a reconceptualization of math courses during the school year. The verbalization of math concepts by students led to deeper student engagement, and so did an emphasis on graphical methods.

Challenges: Poor math prep. Difficulty in persuading those students who most need intervention to sign up for it.

Insights: Holding students accountable and making them verbalize concepts learned seems to have a significant impact on engagement. Interventions that promote deeper learning, such as working with concept maps and verbalization, may appear to students to be leading to slower progress, but in the long run they're highly effective. Even if students enter college needing background in Algebra and Trigonometry, data show that if students make it as far as Calculus II, they are approximately as likely to succeed in that course as students that came in with preparation in pre-Algebra or Calculus I.

Areas for improvement: Getting students who need help but don't ask for it to seek assistance. Scaling up faculty-intensive interventions to reach larger numbers of students.

APPLICATION-BASED INSTRUCTION

Arcadii Z. Grinshpan of the University of South Florida presented a project-based approach to Calculus II for life science calculus and Calculus II and III for engineering calculus. Students do a project in place of the final examination. The strengths of this approach are numerous: Students can apply calculus to a problem from work, internship, or research experience, students spend more time on the project than they do studying for the final examination, and there is an online record of the projects. The best projects are published in the Undergraduate Journal of Mathematics Modeling.

Nathan Klingbeil, associate dean in the college of engineering at Wright State University, presented a math course required of all engineering students. It covers some pre-calculus material, applied calculus, and differential equations. It's taught by an engineer, and the math is directly linked to how math is used in science and engineering. (Students later take the traditional calculus sequence in the mathematics department). The strength of this approach is that it "uncorks the calculus bottleneck": Students can move to engineering curriculum more quickly, and they still obtain the traditional calculus skills needed for high level engineering courses. This curriculum has been adopted by at least 17 other institutions around the country.

Scott Campbell, an engineering professor at the University of South Florida, discussed the projects in Calculus II and III presented earlier by Grinshpan from the perspective of an engineering faculty mentor who oversees student projects. He says that many students already have ideas for calculus projects, and if they don't, just talking with them can often lead to ideas.

Challenges: Creating a culture of change in a mathematics department to allow the final exam to be replaced by projects. The Wright State curriculum may lead math faculty to feel that it's the beginning of engineering taking over calculus.

Mentoring

Sessions:

II-5 "Developing and Sustaining a Successful Peer Mentoring Program: Positive effects on student retention"

III-3 "Utilizing Peer Mentors in Supplemental Instruction"

Strengths: There are different ways to make this work, and supplemental instruction (SI) and the use of peer mentors seem to increase retention and success rates. For students, peer mentoring can be more important than interactions with professionals.

Challenges: Training is necessary in responsibilities, emergency awareness, leadership, boundaries, diversity and team building. Mentors can find themselves dealing with issues they're not trained for, such as Asperger's, accidents or illnesses that require medical care, and drugs or alcohol. Some students will not interact well with their mentors and some may encounter sexism. Students may complain about faculty members, and peer mentors need to know how to respond. Some students don't take advantage of the peer mentoring that is offered. It's hard to make sure the program has an effect beyond the first year, and reaching out to transfer students from community colleges can be difficult. Mentors are compensated, making it difficult to institutionalize the practice. Faculty sometimes push back against any kind of supplemental instruction.

Insights: Peer mentors can serve as assistants in bridge programs and introductory courses and can lead and define new initiatives. Mentors should in fact be expected to come up with solutions for issues, with faculty input. Policies can be put in place that protect peer mentors

from abusive or disruptive behavior. Expectations need to be communicated clearly to both students and peer mentors so neither takes advantage of the other or asks for things outside of their duties. And policies are needed to protect against romantic involvement between mentors and students (signed contracts work).

Areas for improvement: There are mixed opinions about whether supplemental instruction is effective if it's optional as opposed to required. Administration support is key to making SI work. A clearinghouse of best practices for SI would be useful.

Additional: Cal State-Fullerton offers Supplemental Instruction leaders priority enrollment.

NSF Evaluations

Sessions:

II-4 "Six Steps to Your STEP Evaluation"

II-10 "Preparing for Your Third-Year Review"

The first of these breakout sessions recommended six steps to preparing for an evaluation:

STEP 1 Project leader collaboration

STEP 2 Documenting achievements

STEP 3 Challenges/adaptations/assessment/sustainability

STEP 4 Advisory board involvement

STEP 5 Lessons learned/overall impact

STEP 6 Dissemination of results

Notes on all six steps are posted at http://stepcentral.net/groups/posts/855/

The second session produced the following report:

Insights: Plan in advance and make sure you read the internal advisory report. Submit a 10-page report (no more) and include a bulleted summary. Provide clear documentation. Make sure the data in the report and the spreadsheet agree. Address sustainability and scalability. Highlight midcourse corrections and new initiatives, and refer to previous reviewers' questions. Submit the external evaluator report with the FastLane report. Bring anyone to the review who has something to contribute. The report should be data driven and should note projected graduation rates, enhancement in student learning, enrollment data for the college and the project. The internal review board should meet every six months and the external advisory board every year.

Areas for improvement: More timely distribution of third-year review questions and schedules by NSF; improve spreadsheet to make it easier to enter information.

Program Management

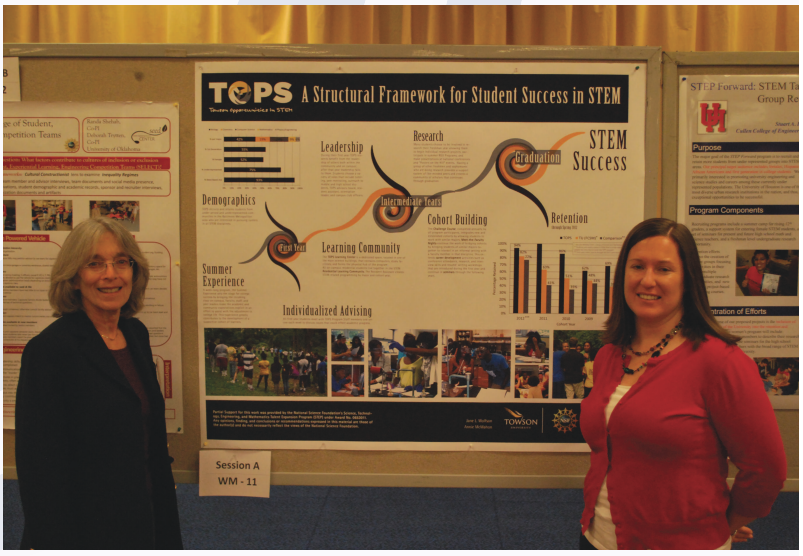
Sessions:

I-5 "Identifying Deficiencies in Your STEP Program"

I-7 "Working Smart: How to Build, Evaluate and Sustain a Portfolio of Strategies"

II-9 "Effectively Managing Your Project"

Strengths: The experience of the University of Central Florida's EXCEL program (Extended Classroom for Enhanced Learning) for STEM students suggests it is doing a good job of retaining students compared with students who do not belong to the program. Hispanic and African American students are exhibiting



measurable learning gains. One recruitment tool is direct-mailings to UCF applicants with follow-up emails, plus open houses. EXCEL has recruited some undecided non-STEM majors to STEM programs. Another institution, Salisbury University, has a portfolio approach to increasing STEP majors and graduates. The strongest enrollment increase has come in computer science.

Challenges: Comparison groups need to buy in to any special programs. UCF changed its program after the first year after discovering that not all students had pre-calculus. Recruiting at high schools was not productive. Some transfer students were not prepared for four-year institutions. Sustainability, as always, is an issue, and so is the risk of faculty burnout. Communicating with advisory boards may not be easy. Administration personnel can change, and so can program directors.

Insights: UCF's program evolved over time, and assessment was key in evaluating where the program could make improvements. A first-year seminar now leads to a paid research experience in the sophomore year, but this was not in the original proposal. It was also suggested that assessment of success in STEM initiatives should include measures of student attitudes, confidence and understanding of STEM fields. Your internal advisory committee may matter more than your external one.

Areas for improvement: Increasing the proportion of underrepresented students, and retention. Transfer programs need to take into account the major differences in life style, needs and viewpoints of nontraditional students. Literature on best practices can be riddled with education jargon and difficult to understand (it was suggested that someone read relevant articles and excerpt them at STEP Central).

Suggestions: Second-year housing options may work. Keep your advisory boards lean to facilitate good communication, and involve your external evaluator immediately. Get your dean and provost involved; after all, a successful project may be crucial to further NSF support.

Recruitment/Retention

Sessions:

III-8 "Improving Retention, Transfer, and Successful Graduation"

III-10 "Recruitment and Retention in Foundational Science Courses"

Strengths: The existence of undergraduate research opportunities, which help with both retention and recruitment. The fact that foundation courses are common to all STEM majors. For transfer students, collaboration between two-year and four-year institutions: Arizona State University says it replaced "transfer shock" with "transfer ecstasy."

Challenges: Student boredom, lack of self-efficacy, lack of support. Financial burdens. The difficulty of courses such as geosciences that don't dovetail with high school courses. For transfer students, the "imposter" syndrome they're sometimes tagged with. There is some mistrust between community colleges and universities and a reluctance to identify and such myths.

Insights: Students need to do science, not just read or hear about it. Make it an objective to go on to graduate school right away (encourage students who take up internships to ask people about the importance of grad school for career advancement). Stress the importance of gaining an associate's degree at the community college before transferring (in some cases this

may require redesigning the associate's degree requirements). City community colleges can hold a "Be an Engineer Day" and get good turnout; this is much harder for rural community colleges.

Areas for improvement: Better courses for freshman STEM majors. Assemble a diverse team of faculty members to design curricula, stressing both diversity and intellectual discipline. Encourage STEM students to engage in outreach, such as visiting K-12 schools to talk about their studies and attending professional conferences.

Student Engagement

Sessions:

II-8 "Sparking and Sustaining Student Engagement"

III-7 "The E-Portfolio: Using Technology to Increase Student Academic and Social Development"

Strengths: Using financial aid as bait to recruit students; instant immersion through a one-week live-in experience that models faculty expectations for the students; creating a community with strong expectations (preparation, high expectations, diversity, respect, support, etc.) that are communicated in a contract with the students; expanding research opportunities beyond the lab-based experience typically offered only to high-performing students. The opportunity to engage in entrepreneurial activities inspires students. The E-Portfolio can help; it allows STEP students, faculty, and staff to track student program requirements, academic progress, and program participation, and to assess the impact of the program as a whole. E-portfolios facilitate tracking student progress and can highlight areas where interventions are needed. They are also helpful when students are constructing their resumes.

Challenges: Transforming content-driven curricula such as engineering. Sustainability beyond NSF funding. Engaging urban students in field work. Providing safe opportunities for failure. Using E-Portfolios if you have only a small number of students to track; it may not be worth the effort. An E-Portfolio can be overwhelming when a student first opens it up, and it's subject to technological problems such as a slow wireless connection, which can frustrate students.

Insights: Text messages are much more effective for communicating with students than more traditional methods. The involvement of the president of a partnering four-year institution was powerful for students in a two-year program; the president got them student IDs so they could feel connected to the university and use the gym and library. Recognizing and celebrating student work and success is critical, and students' sense of ownership also matters. Having advanced students mentor early-stage students builds momentum. Regarding the E-Portfolio, giving students feedback (thumbs up or thumbs down) can personalize this approach. Good program triggers (such as red text) provide early warnings if students are falling through. With E-Portfolios, you don't need to know exactly what you want when you start – you can modify the features as you go.

Areas for improvement: Finding engineering faculty who can teach and engage students in entrepreneurial activities. And E-Portfolios would be more useful if they sent an automated e-mail to the STEP advisor the moment a problem is identified; currently, the advisor has to log in and search for red flags.

Suggestions: Epicenter, the Stanford-based National Center for Engineering Pathways to Innovation, has developed online resources to train faculty to teach entrepreneurial courses and units. Reach out to local industry: Even small partners can help with internships and funding.

Key insight: Students need to feel connected to a community and engaged in real-world research or projects.

Sustainability/Institutionalization

Sessions:

I-9 "Strategies for Sustainability/Institutionalization"

Strengths: The use of teaching methods such as SI (supplemental instruction) and peer mentoring to assisting struggling students. Better placement examinations. Use of internships. Solidifying programs from the point of view of the academic institution in terms of longevity and visibility. Administrators who see the value of the changes (return on investment — using a business model) with data to support the value of those changes.

Challenges: Changes in administration that require reteaching administrators about the value of STEP-type projects. Differentiating the foundational differences between community colleges, smaller colleges, and large universi-

ties, where the culture of faculty, administration, and students may differ widely. Observing and addressing the profound differences between pre-matriculation programs and those transitioning between college freshmen and sophomore levels. Getting and keeping students engaged in STEP programs. Aligning programs with ever-changing campus processes. Management problems connected with large-scale peer mentoring. Developing small pots of money to fund a spectrum of interventions and assistance to students and faculty. Lack of successful models to attract and maintain external partnerships. Legislative requirements. Getting good data.

Insights: A trick-or-treat model where the faculty go door to door asking for money can quickly exhaust resources. The best external partnerships begin with a personal relationship between faculty and a key member from the external organization. Advanced Technological Education (ATE) (www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464) provides support for establishing external partnerships (it focuses on community colleges). Using and developing peer mentoring enhances student engagement. Holistic approaches involving offices such as Student Affairs can win support. Students who provide Supplemental Instruction can be offered limited tuition waivers; this assures a supply of good tutors and allows students to progress to SI tutors themselves. Share data with students about the tutorial program. Don't be afraid to reveal their misconceptions about preparedness. Tell local high school teachers about the collegiate process. Give students in the tutoring programs priority registration. Use interdisciplinary programs with hot-button topics to involve students, particularly in the second and third years.

Areas for improvement: Greater communication with NSF on what other projects are doing and how other programs fit under the STEP aegis. Gaining faculty support, perhaps via stipends or travel. Using supplemental instruction to help the faculty succeed by increased student performance.

Suggestions: Develop industry support for programs. Sustain outreach by faculty. Expand and sustain the program when the grant is over. Work with other colleges. Use data to impress administrators.

Undergraduate Research Experiences

Sessions:

I-2 "Introductory Research Experiences for At-Risk Freshman-Sophomore STEM Majors"

II-3 "Characteristics of Excellence in Undergraduate Research (COEUR): A guide for undergraduate research initiatives"

III-2 "Using Undergraduate Research and Internships to Recruit and Retain STEM Students"

Strengths: Undergraduate research experiences can help at-risk students, who might not otherwise get this exposure, and they draw faculty who might otherwise see only high-achieving students into programs involving at-risk students. They enable students to become accountable and to take ownership of their own education within the limited framework of the research experience; students gain confidence, and they're exposed to the fun

part of science early. Research programs seem to help retain students at a higher rate than either STEM non-research programs or non-STEM programs.

Challenges: One program lasted only three weeks, and few students went on to further research. Assessing and tracking students is very important and should include persistence to graduation, success in going to Ph.D. programs, quality of presentations and quality of research projects. Compensation for faculty may be a sticky issue. Sustainability and scalability are problematic. And perhaps those students who select research projects would have succeeded in college in any event.

Insights: There is a widespread belief that freshmen and sophomores don't have the foundation to succeed in research; the presenters found this was not the case. As far as mentors go, they must be approachable, dedicated and able to set rules and a structure that students can follow (if they are from an underserved population themselves, so much the better). A successful research program includes a curriculum that prepares students for the research. Students who are considering STEM fields want to be engaged early and not have to wait until they are juniors or seniors to collaborate with faculty. And it's a huge plus when first-year students are able to publish papers and present at conferences with faculty mentors.

Suggestions: Disseminate research results to recognize the activities and make them more visible, using poster sessions, university symposia (present awards for good work), journals (send to alumni), or an institutional repository. Disseminate the results from the assessment and tracking of students.

Areas for improvement: Funding.

Additional: During one session a summary of best practices was presented. It identified the following characteristics of a successful program: alignment with campus mission and culture, institutional commitment, administrative support, research infrastructure, professional development opportunities, recognition, external funding, dissemination, opportunities for early and sustained student involvement, meaningful curriculum, assessment, and evidence of strategic planning.

POSTER SESSIONS

One hundred and eleven projects signed up to display posters at the STEP Grantees Meeting, which featured two 75-minute sessions dedicated to these. Half of the posters were staffed for each session, and projects were clustered by topic, with Learning Communities and Cohort-Building especially well represented (it featured 20 posters). 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 projects at the level of two- and four-year colleges.

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

stepcentral.net/conferences/3/posters/

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