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Institute Self Study

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To: Institute Evaluation Committee cai@provost.umass.edu
Date: February 10, 2012
From: Morton M. Sternheim
Subject: STEM Education Institute Self Study (revised)

The Science, Technology, Engineering, and Mathematics Education Institute (STEM Ed) was created in 1995, but its origins go back to 1986 when a \$10,000 Telecommunications Demonstrations grant was received from the President's Office to support an electronic bulletin board for teachers. This bulletin board grew into a regional bulletin board network and ultimately in 1993 into UMassk12, a pioneering effort that introduced the Internet to thousand of teachers statewide via modem pools. It also led to many teacher professional development programs supported by federal grants, first through the Five Colleges Western Massachusetts Public School Partnership and then directly through UMass.

The actual creation of the STEM Ed Institute grew out of a Science After School Task Force (SAS) established to consider how it might be possible for Western Massachusetts teachers to take science, technology, engineering and mathematics courses at the University. The task force included faculty and staff from the University and from area schools. SAS soon discovered that there were related issues waiting to be addressed, including preservice teacher education. SAS also learned that there are many members of the University community working in the area to improve K16 STEM education. These groups are spread across the campus in various departments and in many cases are not aware of other local programs related to their own interests.

STEM Ed was formed to bring these people together, facilitating joint efforts. Above all, the Institute was formed to play a major role in meeting the University's goals in academic outreach, teaching and learning, research, diversity, and multiculturalism. Coordinating these efforts would increase the opportunities to obtain external grants and to allow the University to play a leadership role in the national and state efforts to reform and improve science, technology, engineering, and mathematics education.

The population served by the Institute includes students in elementary and secondary schools and their teachers, community college, college, and university students enrolled in introductory STEM courses, college students interested in education or issues concerning learning, and college and university faculty and staff.

The Faculty Senate documents have been used to organize the following Self Study. We are also attaching our last two annual newsletters which give more details about some of our programs.

STEM Education Institute

1. Comment generally and cite a few examples showing how your C/I contributes to the mission and goals of the Amherst campus.

STEM Ed has had many very successful programs serving the educational, outreach, and research missions of the campus.

- Education (co-PIs or PI in parentheses)
 - We had a series of NSF grants totaling over \$6,000,000 in 1997-2006 to support the STEMTEC program (Yuretich, Geosciences; Feldman, Education; Thrasher, Five Colleges; D'Avanzo, Hampshire). This program was designed to produce more numerous, more diverse and better prepared secondary science and math teachers. We conducted summer and academic year programs that helped over 200 UMass and other faculty from 21 colleges to improve their introductory courses. The goal was to model good teaching for future teachers and to also reduce the attrition in STEM majors. 250 students with an interest in teaching were given scholarships under this program.
 - Subsequent NSF programs included a GK12 project which supported 30 UMass grad students and placed them in area middle school classrooms where they worked with teachers and students to do environmental research (Tyson, Chemistry; Davis, Education); a Noyce scholarship programs which supported future teachers (Feldman, Education); IPY STEM Polar Connections, a teacher professional development program (Bradley and Brigham-Grette, Geosciences); STEM RAYS, after school science clubs at 20 schools (Feldman, Education; Adams, Greenfield Community College); and STEM ACT, a conference on alternative certification (Feldman and Berger, Education). Two NASA funded programs dealt with earth science issues (Yuretich, Geosciences; Schneider, Astronomy) – Planet Earth, STEM Earth Central (Yuretich, Geosciences; Schneider, Astronomy).
 - Massachusetts STEM Pipeline funds were also received to expand the STEM RAYS program.
 - Current NSF funded programs include STEM Digital (Schneider, Astronomy; Tyson, Chemistry; Reckhow, Engineering) and Nanotechnology Summer Institutes (under the Center for Hierarchical Manufacturing (CHM) grant, Tuominen, Physics).
 - Other current programs include Science and Engineering Saturday Seminars for K12 teachers, funded by user fees; Tuesday afternoon STEM talks, funded from overhead; and STEM Solar Labs, funded under a Small Business grant to a local contractor from the US Department of Education.
 - UMassK12 was a pioneering Internet service for teachers when started in 1993. Few people outside academia and corporate environments had Internet access at that time. We offered access regionally, and for a while, statewide via modems. The service was initially free and later supported by modest fees. Ultimately we were able to phase out the modem pools. Today we use the server for websites and discussion forums related to our programs.
- Outreach.
 - STEM Ed manages the Pioneer Valley STEMNET, one of seven regional networks funded by the Board of Higher Education Pipeline grants.
 - We frequently advise representatives of other schools and colleges who want advice on STEM education related matters.

- We use our UMassK12 internet server to send out email announcements of educational programs and opportunities to over 2000 educators. These announcements are forwarded into other local, regional, and national mailing lists and websites. This is a no-cost service to the providers and the potential participants.
 - We assist other colleges and Universities in staging teacher development programs. This summer we will host an earth and space science institute on this campus offered by Professor Linda Elkins-Tanton (MIT, Carnegie Institute), and will present a nanotechnology institute at SUNY Albany on behalf of the Northeast Advanced Technology Education program.
- Research
 - We have been active in helping faculty members in developing their broader impact statements and the associated educational outreach components of their career or other proposals. During the past year, we have assisted 14 faculty members with their proposals.
 - The STEM ACT conference aided science education research.
 - As noted, we offer Nanotechnology Summer Institutes for teachers for the CHM. Outreach to the K12 community is an important part of their mission.

2. Comment on how successful the C/I has been in meeting its own goals and objectives in terms of type and scale of activities or other accomplishments and in terms of organizational structure or change.

Our program has been highly successful overall.

Our broad mission is to aid the campus in improving STEM education at all levels. The specific programs evolve over time as needs and funding sources change, but the Institute continues to be successful in serving the campus and larger community. Our Science and Engineering Saturday Seminar series, begun 11 years ago with Raytheon funding and now supported by modest fees, recently held its 100th seminar. Over 50 teachers are registered so far for one or more of the five sessions, each of which has over 20 preregistrations at this time. We had 57 teachers attend summer institutes in 2011, and will have a similar number this year.

We might note that about 50 teachers per year elect to receive graduate credits for their participation in our programs. This represents approximately \$17,000 paid annually to Continuing and Professional Education for “response courses” which involve no significant costs to CPE.

See remarks under item 6 about evaluation.

3. Have financial and other resources been adequate over the time period for the activities pursued? (or is the operation running a deficit?) Other than money, what other resources has the campus provided (space, in-kind labor, access to phone, computer, other office machines, etc.)?

We have been successful in obtaining federal and other grants to support our programs. The campus provides adequate space for offices and workshops, but little else at this time – no clerical help, phones, Xerox, etc. We have received over \$15,000,000 in grants, and have paid almost \$2,000,000 in overhead to the campus. We did get some campus financial support in the early years of STEM Ed, but overhead return is our only present assistance.

Our present grant funding includes the NSF supported STEM DIGITAL (\$967,000 over 3 years) and the Nanotechnology (CHM) grant (\$65,000 per year plus overhead). We also get \$40,000 per year to manage the PV STEMNET.

Only our STEMTEC and STEM RAYS grants included any federal funds for our secretary/bookkeeper, who serves a critical role. She is presently supported partially by the PV STEMNET and nanotech grants but mainly by overhead. These funds will run out unless we get another large grant with a line for the secretary/bookkeeper. We do have one such grant pending and will submit more.

4. If applicable, has any investment from the campus operating budget leveraged other resources, financial or otherwise for the campus? If no campus funding resources are involved, have the external funding resources served to supplement campus funding for research, graduate support, anything else?

The original \$10,000 grant from the President's office was directly responsible for the evolution of our program and the many federal grants totaling over \$15,000,000. Matching from the campus also was required for the large STEMTEC grant which more than paid for itself in overhead.

Over the years, we have been able to support a large number of graduate students – approximately 30 via GK12 fellowships, 25 via Noyce scholarships and fellowships, and another 30 to 40 research assistants under the various grants. We also awarded 250 undergraduate scholarships under STEMTEC.

5. Describe those you would identify as users, clients, or beneficiaries of the activities of the C/I (students, private sector CEOs, other faculty, general public, etc.) and provide some sense of scale in terms of numbers for each grouping in a typical year.

K12 teachers – as noted, we will serve over 50 teachers in our Science and Engineering Seminars this semester, and another 60 or so next summer. Some unknown number will also attend our Tuesday seminars. These are typical of recent years. We include exemplary K12 teachers as part of our institute staff. They provide expertise in school culture and implementation that the UMass faculty lacks. This also represents a professional development opportunity for these teachers.

K12 students – apart from the students in the classes of the teachers attending our workshops, we are supporting three after school science clubs started under STEM RAYS with an enrollment of about 50 middle school students. We also typically arrange campus visits for school groups with a total of a few hundred students.

Graduate students – we support graduate research assistants when possible, although the current fees associated with them limit our ability to do this. Currently we employ one 10 hours per week student. In the preceding academic year we employed four 10 hours per week grad students. Grad students attend our Tuesday seminars, and some School of Education grad students enroll in our Saturday Seminars or summer institutes.

Faculty – we work with ten or more faculty annually on their broader impact and outreach plans in their proposals. We offer nanotechnology summer institutes for the CHM as noted. Many attend our Tuesday seminars.

Private sector – we are aiding a local contractor by developing curriculum for solar photovoltaic learning labs installed at area schools under a small business grant from the US Department of Education.

6. Comment briefly on how you expect those users would evaluate the quality of activities of the C/I.

All of our grant funded programs have external evaluators. Recent programs have been evaluated by SageFox Consulting Group, formerly Peterfreund Associates. Participant responses are overwhelmingly positive. Here, for example, is a quote from the recent STEM DIGITAL evaluation.

The response of the eight focus group participants was positive overall. Teachers described the week as “running well,” full of “excellent content,” and “a good combination of sitting and [lab] activities.” Teachers found the institute curriculum to be balanced with relevant content that was well-presented and engaging activities. Teachers also found the program staff to be “incredibly professional,” available, and supportive.

We will be happy to provide the full text of this and other recent summer institute evaluations if requested.

We also conduct less formal evaluations of our Saturday seminars. Here is a sample of the responses from an end of semester questionnaire.

- It is the best professional development that I have ever attended
- I find this program among the best that I have attended. I really like the formula of different topics each week. I learn about topics that I normally would have no exposure to.
- Keep up the great seminars! Glad to see more variety in the offerings
- Terrific – very practical and adaptable to varying situations. Great to interact with other teachers and compared notes/share strategies
- This was an incredible opportunity to meet with colleagues, learn about new topics, and get lesson plan ideas. One of the best classes I’ve taken! Highly effective for STEP science students