Work In Progress: Successes And Lessons Learned From A GK-12 NSF Grant Project

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***Abstract* - This paper presents the lessons learned as a result of the NSF funded GK-12 Fellows Project STEP – Science and Technology Enhancement Program, which is designed to educate, nurture, and encourage university engineering, science, mathematics, and education students in secondary math and science instruction. The students are trained and expected to bring their experiences and knowledge as well-developed activities into urban and sub-urban schools in the greater Cincinnati area. This paper presents the lessons learned related to the training, recruitment, and selection of the graduate fellows.**

Index Terms – education, STEM activities, K-12

DESCRIPTION

This GK-12 Fellows NSF funded project has two goals to: (1) Produce scientists, engineers, and secondary science and mathematics educators who are experienced in developing and implementing authentic educational practices into current secondary science and mathematics curricula; and (2) Design, develop, and implement hands-on activities and technology-driven inquiry-based projects, which relate to the students' community issues, as vehicles to authentically teach STEM skills. The project includes: 14 university students (9 graduates and 5 undergraduates) from the Colleges of Engineering (COE) and Education (COEdu); 7 urban and sub-urban schools of Cincinnati (16 secondary school teachers), 7 University of Cincinnati faculty members (from COE and COEdu), and a dedicated graphics/web developer. All of these constituents worked together to achieve the project goals. This paper describes the training provided to the fellows, the selection process developed to recruit the best graduate students on campus, and the lessons learned related to selection of teachers and fellows.

EDUCATIONAL TRAINING IN YEAR ONE

During year one, the graduate fellows enrolled in a course titled *Instructional Planning*, which was originally developed for students in the COEdu who were planning to be teachers. For the grant, it was tailored to engineering students and included various topics related to educating secondary math and science students. Specific topics included content and thinking skills, goals and objectives, Bloom's taxonomy, planning for instruction, procedural skills, deductive and inductive lessons, inquiry, nature of students, and standards. During this course, the graduate fellows wrote, prepared for, and taught a mini lesson to their peers. It was through this course that the graduate fellows began to develop their teaching skills.

After completing the course, the fellows enrolled in *Field Practicum I* and *Field Practicum II* during the winter and spring quarters of year one. The fellows worked with university faculty in developing activities, and devoted 10 hrs/wk in the schools with teachers in refining the activities to suit their curriculum, developing relationships with the students and teacher, and implementing activities. In addition, the fellows participated in online discussions and weekly seminars to discuss what they were learning in the classroom. The discussion topics included: authentic learning practices, standards, assessment methodology, motivating students, effective use of technology to enhance learning, teaching portfolios, etc. It was during these quarters that the fellows were teaching and improving their instructional skills.

After a year of instruction specifically related to secondary math and science students, the fellows engaged in reading and analyzing *"How People Learn: Brain, Mind, Experience, and School"* by National Academy Press. Each fellow was responsible for reading a chapter of the book and leading the discussion. This allowed the fellows to continue to improve their instructional repertoire and understand better how and why students learn. In addition, the fellows assisted in a 6-week Summer Family Math and Science Academy, in which parents and children (4-8 grades) jointly participate during weekends. The fellows taught "hands-on" lessons related to math and science, and developed a "rocket launching" competition. This provided them an opportunity to practice their teaching skills to a broader audience, and in

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implementing projects that excites students and their parents to STEM education early on.

FELLOW RECRUITMENT AND SELECTION

In order to elicit applications from the most talented graduate students on campus, we restructured our recruitment and selection process for graduate fellows during year two of the project. All interested continuing fellows were required to re-apply. We began by advertising the positions in the campus newspaper, campus website, and various campus listservs. Messages were sent to key faculty members, presidents of student organizations, and recommended students. While we were advertising the position, we also met with all of the constituents to develop a list of characteristics for an ideal graduate fellow. The following characteristics are a sample of what we selected: critical thinker; high level of enthusiasm; shows initiative; creative; committed; team player; effective communicator; good time manager; flexible; able to explain high level concepts at a lower level; experience with middle and high school students; comfortable with technology; and experience with public speaking. Once this list was compiled, we created an application and interview process that would enable us to look for these characteristics in our applicants.

An online application was developed which included demographics and academic achievements, past experiences with youth, extra curricular activities, interest in the project, two letters of recommendation, and college transcripts. After receiving 50 completed applications, the applications were reviewed online and discussed in a meeting. Each application was rated (using a rubric with five point scale) for the following: scholastic record; science and math knowledge, technology experience; experience with American high and/or middle school students; extracurricular activities; interest in the project; recommendation letters; and fluency with speaking English. There was a lengthy discussion among principal investigators and the grant coordinator to determine which applicants to interview. We narrowed the list from 50 applications to 10 interviews for 5 slots. A list of possible questions to ask during the interview, but not limited to, was also prepared for guidance.

The interview process included individual panel interview, teaching a mini lesson using engineering as a context to teach math and/or science to secondary school students, and participating in a group problem solving activity. From these activities, 5 applicants were selected. We are confident that we have the most talented graduate students on campus as part of our 2004-2005 Project.

LESSONS LEARNED

Through the training, recruitment, and selection of two years of graduate fellows, we have learned many lessons. The graduate and undergraduate fellows in engineering need specific educational training. Through this project, the engineers take graduate level courses in general instructional methods and theory. However, after an analysis of the course evaluations and surveys completed by the fellows, we have learned that the fellows need more specific educational training in classroom management, student assessment, district and state standards, and instructional technology beyond what we provided during the first two years of the project. In addition to the education of the engineering students, the math and science students need education in engineering, possibly an introduction to engineering course.

The evaluation undoubtedly points to the need for more effective explicit communication between the teachers, faculty and fellows. Ensuring that all faculty, fellows and teachers are attempting to reach the same goals and have the same direction is invaluable, and without a team approach the project would fall apart. Pairing of the fellows and teachers for the continuing year before the end of the current academic year is essential.

Overall, the work of the past two years has been successful and we continue to work to attain our goals. We have developed and implemented several engineering application activities, which have been distributed at several national conferences and tested. Fellows will be holding 3-day technology workshop for STEP teachers, and an Open House for all math and science K-12 teachers in June 2004. We have also had an impact on graduate and undergraduate students from the COE. In fact, one graduate fellow has decided to pursue a master's degree in education and become a teacher. Another fellow wants to obtain an engineering position with a company who does work in secondary schools. Two STEP undergraduate fellows decided to become graduate fellows. Five graduate fellows and one undergraduate fellow are pursuing Ph.D. degrees with aspirations to become a faculty member in a comprehensive research university and develop outreach projects for systemic reform in K-12 STEM education.

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