The Impact on University Students Partnered With Secondary Teachers when Developing Authentic Learning Activities

Anant R. Kukreti [1], Thaddeus W. Fowler[2], Suzanne W. Soled [3]

Abstract **- The paper presents the teacher training program developed as part of the four-year Project STEP (Science and Technology Enhancement Program), which is a joint effort between the College of Engineering (COE) and College of Education, Criminal Justice, and Human Services (CECH) at the University of Cincinnati (UC), to partner with secondary schools in Cincinnati, Ohio, U.S.A. It connects engineering and science graduate and undergraduate students (called fellows) with middle and high school science and mathematics educators to help bring authentic learning activities into the classroom. The project is funded through the U.S. National Science Foundation's (NSF's) Graduate K-12 Fellows Program to enhance mathematics and science education. It involves 28 university students (18 graduates and 10 undergraduates) from the COE, College of Arts and Science (CA&S), and CECH; 8 urban and suburban schools of Cincinnati, Ohio; 31 secondary school teachers; 8 UC faculty members (principal investigators); fellow's research advisors; and a dedicated graphics/web developer. This paper presents the selection of the fellows, schools, and teachers; the training program for the fellows; activities developed by the fellows; impact on student learning; impact on fellows; and lessons learned.**

Index Terms - Engineering, mathematics and science; Secondary school students and teachers; Teacher training; Undergraduate and graduate fellows.

OVERVIEW

Track 1 of Project STEP was funded by the U.S. NSF's Graduate K-12 Fellows Program for four years (July 2002 to June 2006) to educate, nurture, and facilitate engineering and science university students (fellows) in order to bring their experiences and knowledge into the classroom and become educators. Additionally, project STEP recognized that effective science and mathematics education requires authentic and inquiry-based learning. Secondary students must be able to link the relevance of their education with issues occurring within their community. They must be able to experience how it allows them to participate as effective citizens in a technology-driven society. The paper presents the selection process used for the fellows, schools, and teachers; teacher training program developed for the fellows; activities implemented by the fellows and their impact; and lessons learned.

Track 1 of Project STEP had two goals to: 1) produce scientists, engineers, and secondary science and mathematics educators who were 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 related to the students' community issues, as vehicles to authentically teach science, technology, engineering and mathematics (STEM) skills. It included 28 university students (18 graduates and 10 undergraduates) from the COE, CA&S, and CECH; 8 urban and suburban schools of Cincinnati, Ohio; 31 secondary school teachers, 8 UC faculty members (principal investigators called PIs on the grant) from COE and CECH; research advisors of the graduate fellows; and a dedicated graphics/web developer. One fellow served as the grant coordinator and another was dedicated to assist in the evaluation activities. All constituents worked together to achieve the project goals.

RECRUITMENT OF FELLOWS

In order to elicit applications from the most talented fellows for Track 1 STEP, we developed and piloted a successful recruitment and selection process that was used and refined for recruiting thereafter. To recruit prospective graduate students, the Office of Graduate Studies at UC annually brings excellent students on campus and provides funds for travel and a weekend stay, and this opportunity was availed to recruit from incoming graduate students. Recruiting students already enrolled in a graduate degree program occurred through advertising in the campus newspaper, website, and by e-mailing key faculty members. Continuing Fellows were required to re-apply. During the early winter quarter, an article was run in the campus newspaper describing the work of the grant and alerting students and faculty that we would be accepting applications in mid-February and early March. E-mails were sent with job description and application requirements to following:

1. All faculty members in the COE and CECH.
2. Heads of Departments of Mathematics, Physics, Chemistry, and Biology in CA&S.
3. All students enrolled in the Graduate Engineering Minority Program (GEM).

[1] Associate Dean & Professor of Civil Engineering, University of Cincinnati, PO Box 210071, OH 45221-0071, U.S.A., anant.kukreti@uc,edu
[2] Director, Southwest Ohio Center for Excellence in Science and Mathematics Education, University of Cincinnati, ted.fowler@uc.edu
[3] Professor & Chair, Teacher Education and School Leadership, College of Education and Human Services, Northern Kentucky University, BEP 259, Highland Heights, KY, 41099, U.S.A., soleds1@nku.edu

4. All honors undergraduate students in the University.
5. All new graduate students admitted in the COE and CECH for the fall.
6. All juniors and seniors undergraduate students in COE;
7. Presidents of all engineering, education, mathematics, biology, chemistry, physics, and geology student associations.
8. All minority undergraduate engineering students enrolled with the Emerging Ethnic Engineering (E^3) Program in the COE, Yates Fellowship Program Office, Office of Ethnic Programs and Services, UC's African American Cultural and Research Center, and National Society of Black Engineers (NSBE) campus office.

Applicants completed an online application that included demographics, academic achievements (GPA $\geq$ 3.3/4.0), GRE scores ($\geq$ 1200/1600 in quantitative + verbal, and 4.0/6.0 in analytical), extracurricular activities, two recommendation letters, transcripts, and essays which described 1) interest in this program, and 2) activities that demonstrated interest in teaching and/or working with youth.

Online applications were rated by the Project Team (PT) using a 5-point scale for scholastic record, science and mathematics knowledge, technology experience, experience with U.S. students, extracurricular activities, project interest, letters of support, and fluency with spoken English. Selected candidates participated in an individual panel interview, taught a 7-10 minute mini-lesson, participated in a group problem solving activity and were rated on a 5-point scale for each activity. Details of these are presented next.

Effective fellows were seen to possess the following characteristics: critical thinking; a high level of enthusiasm; initiative; creativity; commitment; being a team player, effective communicator, and good time manager; ability to explain high level concepts at a lower level; experience with middle and high school students; being comfortable with technology; and being experienced with public speaking. To ascertain these qualities, a list of possible questions to be asked during the interview was prepared in advance and included: 1) How do you feel interacting with kids? 2) What is your experience working with diverse groups, particularly socio-economic as well as ethnic or racial groups? 3) What is your experience with technology, specifically websites and other technology? How can you incorporate them in the classroom? 4) Have you worked with the lower spectrum of capability, the kids who don't want to be in school and who don't care about learning? What is your philosophy about teaching and learning and how does it relate to you? 5) Describe a time in your past when you've been presented with an injustice and how did you deal with it? 6) What events in your past have required creativity? 7) How would you work independently? What projects did you do on your own? 8) How frustrated do you get with technology, are you willing to learn, rather than depend on the technology person? 9) What will you do different to accommodate STEP work with your ongoing studies? Describe an instance you had a time crunch and how did you juggle your responsibilities. 10) What you plan to do after you graduate?

In the mini-lesson (7-10 minutes), the applicant taught a secondary school science/mathematics lesson using engineering as a context and a hands-on activity or a prop. The PT and other applicants served as the audience to ask questions.

The group activity included a silent group exercise, the goal of which was for each member to assemble their square (cut into small irregular pieces, and each member given a mixed set) without talking or stealing each others pieces, but a member could give their piece if they observe it helped another member complete their square. This activity was revised through the different years and also included group discussion to develop a targeted lesson.

Demographic information was not used as selection criteria; thus, awards were made without regard to sex, race, color, nationality origin, gender, age, or disability. The fellow selection was completed by the third week of March. Preference was given to Ph.D. students who had completed coursework and had aspirations to be a faculty member. A fellow was appointed for a maximum of two years.

RECRUITMENT OF SCHOOLS AND TEACHERS

In this project the focus was on schools that were in need (all schools selected fall far below the State performance targets in science and mathematics performance), that show promise and commitment (each school has been reorganized to focus on recognized educational problems), where teachers are open to collaboration (each school was organized around teams of students and teachers), and that were representative of diverse urban populations (65-90% African-American with a high percentage of lower income families). These schools were representative models for the dissemination and sustainability of STEP activities.

The recruitment of teachers began with the development of the NSF proposal, as we sought feedback from the schools typical of those with which the project was envisioned to be partnered when the proposal was developed. A teacher was selected from each of the schools to be a coordinator or lead teacher for the project. In most instances, this person was someone with whom CECH had contact through its existing school partnerships. This lead teacher coordinator was asked to help with the recruitment of teachers. In some cases the coordinator emerged as one of the participating teachers.

In the first year of Track 1 teachers were recruited and selected based on recommendations from lead teachers. Even though we maintained continual contact with this group of lead teachers as we developed the grant proposal and thereafter, it was difficult to precisely identify the teachers with whom the fellows would be working. This was due to late notification of the award from NSF (end of May when the school year was ending) and to the uncertainty of the teachers' instructional assignments for the coming school year. Most of the schools that we chose to work with were typical of an urban school system: uncertainty about the number of students enrolling each year, shifting of instructional staff to meet school and district budget needs, shifting characteristics of student groups, and shifting emphasis within the curriculum. So, it took some time to determine which teachers would be able to emerge as participating teachers. Generally there were more volunteers than there were positions. An arrangement was worked out

allowing some teachers to defer their involvement. In this way by early August the teachers were identified to pair with fellows for the first year. These teachers were invited for an evening on-campus meeting in August end to inform them of the roles and expectations of all project constituents (fellows, teachers, PT faculty, grant coordinator, graphics/web developer, and research advisor). They were also informed of the financial remunerations for them and their schools, and were presented the final agreement packet and several details about teacher participation during the first school year. In addition, graduate fellow biographies were given to the teachers so that they could begin to understand the group they would be working with and indicate a preference for fellows and subject area expertise needed at their school.

During the first year, as the grant was rolled out for the second year, a meeting was scheduled in early February 2003 with the lead teachers to discuss the details of carrying out the goals of the grant and the recruitment of the teachers for the coming year. As done in Year 1, a pool of prospective teachers was created based on the recommendation of the lead teachers. Each teacher identified was sent a formal application to fill out committing to the project and also obtaining the Principal's approval. As before, this package also explained the financial remunerations and roles and expectations of each constituent. Thus, a similar application and selection process for the teachers was used in Year 2, except the on-campus evening meeting with the teachers was held in the end of March, by when the graduate fellows for next year were already selected. Much of the time was devoted to joint "show-and–tell" presentations by the current fellows and teachers. The teacher selection and pairing with graduate fellows was completed by April. They shared contact information for the summer so that they could interact during that period. Full teams were created at each school by Fall, beginning the first week of August, which consisted of a graduate fellow, an undergraduate fellow (for large schools with more teachers), and a UC faculty mentor from the PT (also the grant coordinator and evaluation fellow were members of each team). In Year 2 at the beginning of the school year, in third week of August, each team met with its school teachers and Principal at their school to review roles and responsibilities again. Each faculty mentor had weekly meetings with their fellows, who submitted individual progress reports prior to the meeting. The faculty mentors summarized their interactions in monthly reports. This team approach worked much better: there was less need for clarification of roles and responsibilities; more success in the classroom; and teachers were more aware of what is expected. Individual meetings at each school were held once each quarter to maintain excellent level of communication.

After the second year we recognized that it was important to interview teachers similarly to the fellows. So this was introduced for recruiting the teachers during the third and fourth years. We have learned over the past four years that there are teachers who are unsuccessful in the project. Teachers have to be flexible and willing to allow a fellow to teach in their classroom. In the fourth year we recruited some of the successful teachers for the summer as part of a NSF supplement for Research Experiences for Teachers (RET) program. This provided them an opportunity to work with the STEP fellows for six weeks during summer on campus.

EDUCATIONAL TRAINING OF FELLOWS

Teaching Training

To be successful in an urban high school environment, an understanding of the learning environment was necessary including the needs, responsibilities, and skills of teachers; district, state, and national standards; and resources for classrooms and labs. Communication and instructional skills needed to be developed and continually enhanced. The up-front preparation of the fellows occurred in a three-credit hour course "Authentic Learning and Inquiry-Based Activities for Teaching Science and Mathematics," taught jointly by a STEP PT faculty member from CECH and the grant coordinator (an urban science teacher engaged in Ph.D. teacher education study). The course consisted of three 50 minute sessions/discussions per week and addresses a range of topics, including the following: 1) Course and Program Overview: What Makes a Good Teacher? Facts, Concepts and Principles; 2) Research, the Wisdom of Practice, Student Motivation, and Establishing High Expectations; 3) Effective Planning; National, State, and Local Science / Mathematics / Technology Standards; and Lessons; 4) Accessing Instructional Resources and Materials, and Developing Effective Questioning Sequences; 5) Planning and Analyzing Questioning Model Lessons and Key Elements of Effective Lessons; 6) Skills Instruction and the Direct Instruction Model, Authentic Learning, and Authentic Examples; 7) Task Analysis and Procedural Skill Sequences, and Preparing Critical Thinking Skill Lessons; 8) Perspectives on Effective Teaching, Culturally Aware Instruction, and Time on Task; 9) Distinguishing Among Content - Facts, Concepts and Principles, and Standards; 10) Teaching Concepts Inductively and Deductively; 11) Toward Learner-Centered Instruction - Constructivist Approaches and Talking with Students; 12) Capitalizing on Social Interaction; Using Groups and Cooperative Learning; 13) Teaching for Higher-Level Outcomes; Problem Solving and Inquiry; and 14) Assessing Learner Understanding. Reading assignments were from Kauchak and Eggen [1]. The course had six assignments including four lesson plans, and a Final Examination: Microteaching Exercise - Pulling it Together.

In addition, the fellows also worked with the E^3 Family Science Academy during the summer. The Academy was designed to provide 4^{th} to 7^{th} grade students and their parents with hands-on experiences exploring fundamentals of physics and chemistry. For six weeks in the summer, the Academy was conducted on Saturday mornings from 9 a.m. to 12 p.m. While the students conducted laboratory physics and chemistry activities, the parents engaged in mathematics and science activities that they duplicated with their children during the week at home. The fellows worked in the Academy as teaching assistants and developed and conducted a competition for the parent-child team.

Practicum and Seminar

As each school year began, new fellows enrolled in Field Practicum I & II and Seminar Series in the Autumn, Winter,

and Spring quarters, respectively. The practicum courses supported fellows as they (frequently) encountered unfamiliar territory upon entry into the schools. Fellows were required to focus on important aspects of the teaching-learning situation and the school and student culture as well as their developing relationships with their teachers. Structured and focused discussion was managed through an on-line Blackboard® discussion group, leading to community building among the group of new and returning fellows. This process worked well in the past both with fellows and AEL (Alternative Education Licensure) candidates. [NOTE: The fellow training courses fulfilled Ohio requirements to become AEL teachers if they take an adolescent psychology course and a teaching field content test.] A one-hour seminar was held weekly during the Spring quarter for the fellows and teachers to present results and assessment of the development and implementation of their activities. Seminar also included presentations by faculty, teachers, and educators of noted distinction on authentic learning and application of hands-on activities in STEM curriculum. These seminars were managed by the grant coordinator.

Participation in Dissemination

All lesson plans were disseminated through a dedicated project website: http://www.eng.uc.edu/STEP/. Each year the fellows organized and team-taught "Teaching with Technology" workshop and an "Open House" for STEP. Invitations to both these events were sent to over 300 K-12 schools in the Greater Cincinnati and Northern Kentucky region. The "Teaching with Technology" workshop was designed to provide hands-on technological training to middle and high school teachers interested in improving their technology skills and incorporating these skills into their classroom. We based our workshop offerings on the feedback concerning the needs in classrooms from the current STEP teachers. Each workshop series consisted of several seminar periods where participants were able to experiment with the tools and reflect on how it could be incorporated into their classroom. In each seminar, participants were guided through applications of a particular type of technology and encouraged to examine ways in which their students could utilize each program. Our vision was for the educators involved in this workshop series not only to learn about and practice with a variety of software and hardware, but also be able to create technology-based lessons for use in their own classrooms. STEP fellows, who were currently in classrooms throughout the city, presented these technology lessons and were able to help develop lessons that relate directly to the standards based on these technologies. The seminars topics for the various workshops held in different years included the following:

- 2004: Power Point, Calculator Based Lab, Computer Based Lab, and Sketchpad/PDA.
- 2005: Web Quests, Concept Mapping, Digital Story Telling, Excel, and Word with Graphics
- 2006: Advanced PowerPoint, Web Quests, Excel, and Podcast/Wiki/Blog.

Each year, near the end of the Spring quarter, the PT and fellows planned and held an "Open House" for teachers, faculty, community members, and university and secondary school administrators from the Greater Cincinnati and Northern Kentucky area to share the results and products of STEP with the community at large.

ACTIVITIES IMPLEMENTED BY FELLOWS

Activity themes focused on: innovations in construction materials, civil infrastructure renewal, and transportation for the future in Civil Engineering; and the water cycle**,** water quality, and stream biology and ecology within the context of a river watershed in Environmental Engineering and Science. Activities were incorporated into lessons, demonstrations, lab exercises, individual and group projects, and field experiences to: 1) enable middle and high school students to directly experience authentic learning practices that requires them to use higher-order thinking skills; 2) encourage creative problem-solving skills that require collaborative learning, teamwork, writing, and presentation; 3) cultivate an interest in service learning, in which students are active participants, achieve outcomes that show a perceptible impact, and engage in evaluative reflection; and 4) better motivate and prepare secondary school students for advanced education.

Each fellow taught in the classroom for a minimum of ten hours per week and devoted about the same time in preparation for the classes. Eighty-two (82) quality modules were developed over the four years, which were posted to a dedicated website for dissemination and use by educators. The subject distribution was as follows: Biology (3), Chemistry (9), Environmental Science (4), Life Science (7), Mathematics (34), Physical Science (8), Physics (11), and Design and Technology (6). A few examples of activities included the following: *The Cell As A City* (7^{th} Grade) - Engineers approach problems by breaking down complex systems into smaller pieces which can be easily related to one another. With regards to the human biology, the cell is the unit on which more complicated systems are built, thus the study of human biology begins with this topic. This lesson taught students how the cell works by relating its components to elements that make up a city. *Experimenting With Sound* (8^{th} Grade) - Abstract concept of sound is connected to physical world through instruction, demonstrations, measurements, and hands on activities. *Viva Las Vegas* (*An Energy Project)* (9^{th} Grade) - Students researched their own power generation technology, the technologies of other groups, and wrote and presented a detailed report describing how their power plant best fit the community. *Everyday Genetic Engineering* (10^{th} Grade) - Students were introduced to genetic engineering and its impact on society. A review of basic genetics concepts and discussion of genetic engineering allowed students to understand biotechnology and the role it plays in the production of the food products found in the market. The students also participated in the first step of genetic engineering, DNA extraction, by extracting DNA from their own cheek cells. *Toy Maker* (11^{th} Grade) - Clearly written procedures are critical to the manufacturing process because the person/machine who builds the product is not co-located with the designer. In the era of computer-aided design, instructions are communicated directly to the machine using

a logical sequence of commands. This activity allowed students to experience the relationship and attendant pitfalls between the initial design concept and the final manufactured product. Students were placed in the role of a toy design engineer and are required to write an algorithm using angles, locations, and directions to properly construct their toy design. *Skidmarks (An Accident Scene)* (12th Grade) - This activity reinforced the concepts of velocity, acceleration, friction, motion (Newton's First and Second Laws), and slope (grade). It also required students to be able to read a graph (speed nomograph) and make inferences on their observations. Students measured given skidmarks, calculated the coefficient of friction between the tires and the road, calculated the grade of the road, and used this information to determine how fast a vehicle was traveling when it started braking. Students learned about abstract concepts such as acceleration and velocity by role-playing as an investigator of a car accident scene. For web dissemination of each activity a standard template was used.

IMPACT AND FINDINGS

The project involved: 18 graduate fellows (10 male and 8 female, including 2 minority, 13 engineering, 1 biology, and 4 mathematics and science education students), 10 undergraduate fellows (6 male and 4 female, all from engineering) and 31 teachers (10 male and 21 female, including 5 minority). Teachers were from 8 schools (5 urban and 3 suburban) in 3 school districts in the first two years and 5 urban schools (one district) in the 3rd and 4th year. Annually about 10,000 students were taught in these schools in the grade levels (7 to 12) taught by the fellows. Only 52% of the students participating in STEP reported demographics, which included: 72% African American (37% male and 35 female), 21 % white (11% male and 10% female), 5% multi-racial (2% male and 3% female), 1% Hispanic, and 1% Asian.

All activities were developed by fellows through collaboration with the teachers, faculty mentors, and grant coordinator. The activities were evaluated by the grant coordinator prior to classroom implementation and modified if needed. In addition, when the fellows implemented the activities in the classrooms, grant coordinator, teacher, and faculty mentor provided formal evaluations. All evaluation questions received a compilation rating between 'strongly agree' to 'agree'. These ratings indicated that the grant coordinator, faculty mentor, and teacher felt that the lessons were of quality design and implemented through quality strategies.

Although students were not the primary focus of this study, some results regarding the impact that the fellows had on the students they taught bears attention. Students were asked to provide anonymous feedback about an activity immediately following its completion. The first result of interest is that and the result are as follow: Student Confidence about Ability to Learn from Lesson indicated that most student responses fell in the 'sort of' (42%) and 'definitely' (28%) categories; Student Levels of Learning from Lessons indicated that most student responses fell in the 'a little' (42%) to 'a lot' (48%) categories; Affect of Learning on Student Interest in Engineering indicated that most students' responses fell into the categories of 'did not affect interest' (53%) and 'increased interest' (38%).;. The Student Overall Interest in Engineering had the most student responses in the 'somewhat interested' (38%) and 'very interested' (25%) category.

Data collected through survey instruments indicated the grant had a significant impact on the fellows particularly regarding experience with best teaching practices, implementing authentic lesson plans, and connecting their education with pre-college science education. This is triangulated with the focus group data where the fellows make repeated references to their work in the classrooms and university and how these have impacted their understanding and ability to teach mathematics and science. Fellows participated in start, mid-year, and end-of-year focus groups. They also provided weekly feedback on their experience. Highlights of their responses are presented below.

1. How did program impact you and your professional pursuits?

- Challenging/stressful to coordinate school and program.
- Changed view of a focus on teaching not research for university faculty.
- Gained patience in dealing with education and other areas.
- Gained importance of documentation for research.
- Gained skill of adaptability.
- Gave understanding of students and skills coming to university. (An eye opener for fellows).
- Increased self confidence in dealing with groups of people/leader/speaker.
- Opened awareness of education issues and will continue to care.
- Opened graduate possibilities due to variety of experiences that were diverse.
- Reaffirms I could teach in various capacities.
- Reaffirms I don't want to teach secondary school.
- Reaffirms I want or could teach and like to teach.
- Reaffirms importance of different teaching styles.
- Realization that I can teach.
- Teaching is important in all aspects.
- Understanding of high school age students.

2. What contributions do you think you have made to your teachers and students? Give some examples.

- Experience for students to know someone who went on for graduate degree.
- Exposure to open-ended problems – okay to have different answers in mathematics.
- Exposure to person as university student.
- Give students awareness of research.
- Link for students for global perspective via research and activities.
- Link to UC for students – college/engineering exposure – how to get to college.
- Mentor/role model for students as engineer – answer questions.
- One-on-one tutoring with students to aid learning.
- Student understanding of work after high school.

- Teach teacher how to be efficient on technology to focus time more on education.
- Teacher using curriculum developed by Fellow to improve curriculum.

3. Explain the ways in which you were able to fulfill or not fulfill your role in the program.

- Bottleneck getting lessons to web.
- Can't say no to teacher to teach more lessons and then paperwork and research/class work suffers.
- Competent at developing and implementing lessons in classroom, time to create supporting documents was limited so supporting documents are not always present when lesson presented. Had to create afterward.
- Forms not turned in a timely manner.
- Grading causes bottleneck to some fellows.
- Have been moving towards degree.
- Often feel that I should work more towards degree or program; hard to juggle both.
- Placed in role not educated for (i.e., biologist in geometry classroom). Could accomplish more if in role educated for.
- Planning was strength; weaknesses exist in various areas for each fellow (i.e., rubrics).
- Teacher and student schedules and student absences hindered fulfilling goals of program.
- Weekly reports not timely.

4. Explain how the instructional component of the programs prepared you for your work with teachers and students. In what ways could it be improved?

- Classroom management was good – great to hear.
- Liked to have sessions those are directly applicable in classroom immediately.
- Micro teaching gave somewhat false sense of security for first experience in classroom due to so much positive feedback. Not prepared for what seen in classroom from students. Make micro teaching more realistic. Include forms and full experience.
- Micro teaching prepared for first teaching experience.
- Observing other fellow's classrooms was helpful to know I am not alone in how classroom experience is. (From a new fellow)
- Observing other teachers was valuable and informative to view other teaching styles and content taught in different
- RET teachers – spending time with them to hear their perspectives and what they do in classrooms.
- Rubrics, other assessments, and linking to standards session were valuable.
- Speakers increased awareness of existence of items.

5. To what extent do you feel part of a team and how did this impact your involvement in the project?

- Fellows have been good team support.
- Greater team member at school.
- Growth through observing teacher teaching fellow lessons.
- Teacher has been great collaborator. Teacher was willing to collaborate during and after school and through email, phone, or in person. Teacher gave up planning bells to work with me. Give me added confidence. Stronger relationship with teacher.
- Teacher was obstacle to cooperation/collaboration. Felt had to fend for self.

6. What was the most valuable thing you learned from this experience?

- All human, all make mistakes, perfection is not possible. Don't get down on self; it will be better next time.
- Always have a backup plan for the classroom.
- Can't freak out, be positive, be flexible, do what you can, can't be perfect. Be positive with students, don't take things personal.
- Don't assume anything about any students.
- Flexibility – plans don't always work.
- Learn that not all lessons are perfect.
- Learn to deal with paperwork, bureaucracy – it exists everywhere so learn to deal with it.
- Learn to laugh. Be a more effective communicator.
- Time management; more improvement needed.

The above observation and comments were supported by the coordinators' classroom observations and teacher feedback.

CONCLUDING REMARKS

Fellows became much more skilled in developing and implementing lesson plans and showed continuous improvement. They learned about classroom management issues and broader issues that arise with different schools and administrations. Teachers were supportive and engaged the Fellows to different degrees. An online tracking form has been used to obtain feedback on how the grant has impacted the fellows' careers for up to five years after leaving the grant. Fellows are placed as follows: 3 are tenure track faculty members at universities, 3 are working as research/adjunct faculty, 4 are high school teachers or administrators, 9 are working in industry, and 10 are in graduate school. The successes of the Track 1 grant led to the funding of a five-year (2006-2011) Track 2 NSF GK-12 Fellows project, which is in progress.

ACKNOWLEDGEMENT

The authors acknowledge NSF for a four-year (5/02-5/06) GK-12 Fellows grant (NSF-0139312) and all others who worked on the project, including the principal investigators, Drs. Richard Miller, Shafiqul Islam, Karen Davis, Ed Prather, and Daniel Oerther, the grant coordinators, Drs. Debbie Jackson and Kelly Obarski, the evaluation fellows, Dr. Laura Koehl and Ms. Patricia McNerney, and all the fellows and teachers whose names are numerous to list.

REFERENCES

[1] Kauchak, D., and Eggen, P.D. Learning and Teaching: Research-Based Methods, Boston: Allyn and Bacon, 3rd Edition, 1998, Chapters 1, 3-5, 7-12.