The Georgia Tech Student and Teacher Enhancement Partnership (STEP) Program:

A Set of Models of Graduate Students Working in High Schools

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In 1999 the National Science Foundation initiated a new type of graduate student support through the *NSF Graduate Teaching Fellows in K-12 Education* (GK-12) program (see http://www.nsf.gov/cgi-bin/getpub?nsf02042 for the current RFP). Students receiving GK-12 fellowships are required to interact directly with K-12 teachers in an attempt to improve both K-12 education and the pedagogical and communication skills of the Fellows. In return graduate Fellows receive an annual stipend and a tuition waiver. In the spring of 2001, Georgia Tech received a GK-12 grant to support its ***Student and Teacher Enhancement Partnership*** (STEP) program and to place twelve graduate students per year in Atlanta area high schools.[1]

The ongoing challenge of the GK-12 initiative is to design a program that best advances the multiple goals of the program:

1. To broaden the education of science, technology, engineering, and mathematics (STEM) graduate students to include intensive experiences in educational pedagogy and process;
2. To encourage the participation of STEM faculty and students in the difficult issues facing K-12 educators through the nurturing of university-school partnerships;
3. To assist K-12 teachers in their endeavor to improve classroom instruction; and
4. To help schools improve K-12 student achievement in STEM.

The first of these goals is accomplished in STEP through the graduate-Fellow summer training program detailed below and through the direct interaction of the Fellows with teachers and students in their assigned schools. Our approach towards the remaining goals is through the creation and nurturing of partnerships between Georgia Tech and area high schools.
We propose that aggressively pursuing the development of meaningful and sustainable university-school partnerships, is the strategy most likely to produce long-term success in the K-

[1] NSF Project Number DGE-0086420

12 arena for Georgia Tech's GK-12 program. We also suggest that to be most effective, these partnerships must be grounded in the belief that the dedicated professionals at the K-12 schools and school district offices know best the needs of their schools and students; and that many schools and school districts have strategies in place to improve student achievement. We believe that the most effective role of the university is to work within the agenda set by the K-12 schools themselves, not within an agenda conceived on the outside by university personnel.

STEP Program General Details

The STEP program is designed to work with the school systems' central offices to create at each of the participating schools a STEP School Team consisting of two STEP Fellows, a Teacher Coordinator, and a variable number of additional teachers. The Teacher Coordinator is always a teacher chosen, and vouched for, by the school system's Science Coordinator, and the Teacher Coordinator is paid $2,500 for coordinating the STEP program at his or her school for the year. The individual STEP School Teams create action plans that address needs identified by the school and that take advantage of the talents of the particular STEP Fellows within the team. Each of the Fellows, as well as the Teacher Coordinator, is provided with a modest budget ($500 per Fellow, $2,000 per Teacher Coordinator) to draw from in support of the program. The specific in-school activities are pulled from the menu of acceptable activities described below, with details modified to address specific school situations.

- **Student Instruction**--STEP Fellows can assist participating teachers with instruction in the classroom. STEP Fellows receive training during the summer as to the importance of inquiry learning techniques and hands-on experiences for effective learning, and participating teachers are briefed as to the most appropriate instructional situations in which to involve the STEP Fellows. These include hands-on laboratory experiments, group research project work, active group discussions of science topics, and short lectures on content. Teachers are discouraged from having STEP Fellows perform tasks such as grading exams or copying papers.

- **Student Enrichment and Mentoring**--STEP Fellows can be involved in direct tutoring of students, and/or involved in school-day or after-school student enrichment activities such as Science Olympiad, Math Counts, or after school science, mathematics or computer clubs at their host school.

- **Teacher Professional Development**--Some STEP School Teams will design staff development activities specifically tailored toward promoting the academic goals of the school, as determined by the school action plan, and towards disseminating novel class activities or teaching resources developed by the team. Funds were included in the STEP grant to provide teachers with professional development stipends.

- **Educational Technologies**—STEP Fellows can provide teachers with assistance in implementing educational technologies in classroom projects and curricula, including initiating web-based classroom resource pages, implementing science simulation units, and helping with the use of educational technologies such as the Calculator-Based Laboratory (CBL) system.

- **Student Research Projects**-- STEP Fellows can provide invaluable assistance to students in conceptualizing a viable science experiment, providing feedback on the appropriate uses of the scientific method, and reviewing experimental progress and data. They can also sometimes provide students with access to experimental techniques out of reach of most high school students, but easily available at Georgia Tech. This participation in student research can vary from high level projects bound for the state science fair and for national research competitions, to small projects with at-risk students and general classes where the goal is to better prepare the students to pass the science process skills section of the Georgia State Science Graduation Test.

- **Georgia Tech Lab Tours and Visits by Georgia Tech Faculty**-- STEP Fellows can coordinate field trips for students and/or groups of teachers to Georgia Tech research laboratories, to introductory math and/or science classes, and to special events on campus. They can also encourage visits to the participating school by Georgia Tech professors and by fellow graduate students.

Though the STEP School Teams are encouraged to create a detailed action plan during the summer prior to the Fellows' arrival at the schools, these plans must remain flexible as conditions and circumstances are liable to change during the school year. In our experience, maintaining open communication pathways between all parties is crucial for successful experiences for all members of the team.

Recruitment and Placement of Fellows

The STEP Fellows were recruited from the Colleges of Computing, Engineering, and Sciences. Since there was a very short lead-time in this first year of the program, we relied most heavily on those academic units where the graduate coordinators were familiar with our proposal and who had already pledged their support. A short application was e-mailed to the relevant academic units, and posted on the Center for the Enhancement of Teaching and Learning (CETL) web site (http://www.cetl.gatech.edu). Within the two-week open period, we received 25 applications. Each applicant was given a fifteen-minute interview by the project team, and a brief reference was required from their advisor and the graduate coordinator of their unit. We believe it is critical that the Fellows have the full and unqualified support of their advisor for this type of assignment.

Ultimately, we chose twelve Fellows to participate this year. They are from the fields of Civil Engineering, Electrical Engineering, Mechanical Engineering, Nuclear Engineering, Chemistry, and Physics. We were extremely fortunate to have a diverse applicant pool, with the top candidates equally represented by women and men, and by Caucasians and African Americans. As a consequence, the 2001-2002 STEP Fellows are three Caucasian men, three Caucasian women, three African-American men, and three African-American women. For each school placement, we selected a male-female pair, trying to ensure that those who had expressed an explicit desire to provide role model and presence in a minority urban environment were given this opportunity.

Summer Training Program

During the summer months, we provided the Fellows with training on a variety of topics. We began with an assignment for all of the students to become certified in human subjects research protocols. Then we moved into basic classroom strategies and classroom management techniques. We provided each pair of Fellows with a laptop computer and a digital camera with the expectation that they would prepare a web site about their school projects and interactions. We then gave them some basic web site design training as well as an introduction to how the K-12 teachers use technology in their classrooms. The Fellows attended a two-day training workshop provided by one of the school districts on inquiry-based science education, and we followed that up with a discussion on problem-based learning. A seminar was held on the "at-risk classroom" and on diversity and equity. The rudiments of classroom assessment techniques were covered along with a primer in Bloom's Taxonomy. Finally we had a basic lesson on sexual harassment and their legal responsibilities.

Project Evaluation

At the conclusion of the summer training sessions, one of us (GK - the project evaluator) interviewed each of the Fellows. These interviews included a structured component with a written survey, and a semi-structured component with open-ended questions discussed orally. The Fellows were interviewed with their partners. The issues addressed in these interviews spanned two primary topics: the fellows' expectations and comfort with participating in the program, and the summer training sessions.

Fellow Participation and Expectations

The reasons Fellows expressed for participating in STEP were quite similar, even to the point of sharing a similar paradox. First, they were all attracted by the challenge of teaching in the public schools. The primary motivation for most of the Fellows was to make an impact in the lives of high school students. However, there was also a paradox in their motivation. Few of the Fellows entertain any notion of teaching at the high school level and the majority didn't exhibit a strong interest in teaching at any level (except perhaps later in their research career). But most of the Fellows described being attracted to the program as a means of improving their teaching skills. For the majority of the Fellows their only previous experience at teaching had been in tutorials or as a teaching assistant.

The expectations of the Fellows were influenced strongly by discussions with high school coordinators and teachers regarding their assignment. The Fellows had some idea of what their assignment would be in the high schools as all had some contact with the high school coordinator (if not the teachers). It was clear that the more specific and detailed the assignment, the stronger the influence on Fellow expectations.

We asked whether STEP Fellows sought the counsel of their major professor before pursuing the program. Advisor support for the participation was very high across the campus. No Fellow was discouraged from participating in the STEP program. Similarly, classmates, friends, and even family were cited by STEP Fellows as strong sources of support for the participation in the program.

The chief concern expressed by the Fellows about teaching was that they would not be effective. There were two ways of articulating this concern. First, the majority of Fellows expressed worry that they might be a burden to the high school teacher. Second, a few of the Fellows articulated concerns that their assignment was likely to lead them to work with students that might not need their help. Instead they would have preferred an appointment in a high school with fewer science resources.

Time emerged as a major theme for the Fellows on both the survey and in the interviews. Most of these students are actively engaged in research projects either for their major advisor or in preparation of a thesis or dissertation. The acceptance of the Fellowship was not seen as a substitute for the research they pursue under a GRA, but rather an additional activity in which they could engage. None of the fellows planned to cut back on their research commitments to engage in the Fellowship. Consequently, time is a major issue.

Summer Training Program

Interestingly, during the interviews the Fellows did not point to the summer training program as shaping their expectations about the teaching. Rather they viewed the training program as a resource for information about the craft of teaching rather than an explicit guide to what they would experience in the high school classroom.

The overwhelming assessment of the Fellows was that the summer training program was useful as a preparation for teaching. One student put it this way, "After a summer of training, I feel confident entering my high school and I am looking forward to my first teaching experience." This perception was explored through several questions on the survey and in the interviews. When the question was put as a simple up-or-down vote eleven of the twelve Fellows felt that the training program had helped them plan for the upcoming year.

A major issue for the Fellows was the need for greater practice at applying many of the things that they learned during training session. Ironically several Fellows suggested that not enough attention had been paid to their own learning style of absorbing theory through application in the laboratory or in simulation. Modules where the information presented did not advance beyond the text (Information Technology and Learning Styles) were particular targets for improvement. In contrast, the Inquiries meeting was cited by many Fellows as their favorite session (in spite of the emphasis on educational and institutional politics).

Based on both these interviews and our experiences during this year, we plan to modify the summer program for the second cohort of STEP Fellows in the following ways.

- We will have a workshop on building partnerships and teams with the Fellows, the STEP coordinators, and as many of the participating teachers as possible. We have learned that it is imperative that the group of individuals at each school see themselves as a team and that from the beginning they work on their group dynamics and communication.
- We will have a session on basic first aid techniques. This year a student was hurt during a lab that was being supervised by a STEP Fellow, underscoring the importance of first

aid and lab safety knowledge. We may also run a lab safety program specifically for the high school teachers who wish to learn more.
- We will extend and expand the microteaching exercise. It was very popular with the Fellows, but they wanted more feedback so we will add a second iteration in order to allow them to use the feedback to improve their skills within our safe environment.
- We will move much of the educational technology lessons to self-paced individual assignments as the Fellows complained that they could easily learn this on their own.
- Perhaps most importantly, we will recruit and place the students early in the spring this year so that the teams will have the opportunity to start work on their action plans before the teachers leave for the summer.

Models of STEP Fellow/School Interactions

As part of Georgia Tech's STEP program, six teams were established in high schools in three different metro-Atlanta school systems for the 2001-2002 school year. As the year has progressed, four distinct models of university/school partnership have emerged based on the varying needs of the schools and the inclinations and interests of the team members. Each model has potential strengths and weaknesses, rewards and frustrations. Four of the schools will remain with the program for the full three years, while two of the school placements (within one school system) will rotate to different schools each year. These different models will allow us to assess the effectiveness of different types of graduate student work within high schools, and also will enable us to evaluate which type of activities and interactions lead to the establishment of the most stable, trusting, long-term partnerships.

Model #1—(Classroom Instruction)

STEP Fellows assist the school in fulfilling the need for a content-knowledgeable teaching staff. Fellows plan and implement new classroom and lab activities, engage in direct classroom instruction, and fill in when the teacher is absent.

Strengths of model

- For Fellows—The graduate students gain extensive experience in direct classroom instruction.
- For Partnership—The close contact with a small number of teachers leads to strong personal ties with those teachers.
- For K-12 students and teachers—The students and teachers receive knowledge about content, access to new materials and activities, and generally benefit from the Fellows' enthusiasm and energy in the classroom.

Weaknesses of model

- The interaction is temporary, leading to the possibility that when the Fellows are gone, the teachers will revert to their original classroom styles and lesson plans. This is particularly true if the teachers do not gain confidence to implement the new materials themselves.
- The Fellows are put into the role of a teacher-figure, and this weakens their role-model potential.
- The close contact between Fellows and teachers can lead to interpersonal tensions and conflicts.

Model #2—(Research Facilitation)

STEP Fellows work one-on-one over a long period of time with students on research projects to increase the research and science process skills of the students.

Strengths of model

- For Fellows—The graduate students gain leadership skills. One-on-one mentoring can be a very rewarding experience, particularly when Fellows can observe changes in student attitude.
- For Partnership—The high schools can gain access to university facilities to promote their students' research projects.
- For K-12 students and teachers—Interaction with the Fellows helps the teachers to implement classroom research as a standard component of their curriculum. This, in turn, should lead the K-12 students to a better understanding of science research and process skills. Students also have the unique experience of interacting closely with young science and engineering mentors.

Weaknesses of model

- Teachers can cede the research component completely to the Fellows, thereby reducing the likelihood of long-term benefits.

Model #3—(Educational Technology Implementation)

STEP Fellows help implement educational technology at the school by creating web pages, researching and implementing web-based science modules and simulations, identifying online educational resources, and providing necessary teacher professional development.

Strengths of model

- For Fellows—The graduate students gain increased competence with using educational technologies in the classroom.
- For Partnership—The schools gain access to technological assistance and links to the high tech aspects of the university. Web-based resources can be made available to other schools and school systems.
- For K-12 students and teachers—The school receives valuable web-based resources for use in classes, which should lead to increased educational technology use in the school. The teachers will benefit through professional development on the technologies.

Weaknesses of model

- There is less direct Fellow-student contact than with other models.
- Ongoing maintenance of web links is required.

Model #4—(Flexible Assignments)

STEP Fellows work with the Teacher Coordinator to develop a flexible and variable week-by-week schedule of activities that addresses the school needs for that particular week.

Strengths of model

- For Fellows—The graduate students are exposed to many aspects of education—different situations, different types of students, etc. Due to the program's flexibility, it can shift to meet Fellow desires and interests.
- For Partnership—Many teachers and students participate in the partnership, which develops multiple avenues for continued and expanded partnership with the school.
- For K-12 students and teachers—Partnership responds to real-time student and teacher needs. Fellows can impact a large number of students.

Weaknesses of model

- Unfocused nature of plan has risk of diluting the impact.
- Because of the large number of students involved, the individual Fellow-student connections are potentially not as strong as in other models.
- Requires a strong coordinator willing to take an active hand in the day-to-day scheduling.

Conclusions

Successful school-university partnerships are dependent upon developing a culture of shared responsibilities, upon nurturing open and frank communication pathways, and upon a willingness to respect the interests and concerns of all participating and impacted individuals. This type of partnership is necessarily flexible and dynamic, evolving in somewhat unpredictable ways to meet the unique needs of the individual schools, teachers, and students. The STEP program will attempt, over its 3-year time-span, to use the Georgia Tech STEP Fellows to help develop and enhance partnerships with the participating schools that are sustainable well past the duration of the NSF-funded program.

The STEP program creates teams consisting of graduate students and teachers, and relies on each individual team to develop goals, objectives, and a plan of action. Experiences during Year One have emphasized the importance of

- Helping people learn how to work in teams, and emphasizing teambuilding activities during the summer training period;
- Including school system central office personnel in the program decision-making process and administrative structure so that the school systems have true ownership of the program and can assist with communication and compliance with program expectations;
- Being honestly willing to pull graduate students out of particular school placements if conditions become untenable.

Eventually the school-university partnership must consist of multiple components that strengthen the initial bond formed by the Fellow-teacher partnership. These connections are already being established with the STEP schools and can be of many different types such as:

- Providing summer research experiences at the university for teachers from the partner school. Georgia Tech coordinates a well-established teacher research internship called "Georgia Industrial Fellowships for Teachers" (GIFT) which places teachers into 6-8 week research internships. Some of the STEP schools already have teachers who have participated in the GIFT program, whereas others do not. We will encourage STEP teachers from all schools to

participate in GIFT, specifically linking them to faculty who will be most likely to take a personal interest in the school and to thereby enhance the university-school partnership.
- Recruiting students and teachers from STEP schools to participate in events and activities on the Georgia Tech campus. These opportunities range from student participation in science and technology competitions, to teacher participation in staff development workshops, to students attending career awareness-type activities.
- Coordinating school visits by Georgia Tech admissions officers and members of the minority recruitment team to encourage SMET career expectations among underrepresented populations.
- Encouraging the development of personal relationships between teachers and members of Georgia Tech labs, thereby providing high school students and teachers with connections to people who can answer science questions, give advice, provide use of equipment, etc. In several cases the STEP Fellows have brought high school students to their labs to enable them to conduct an experiment for their science fair project.
- Setting up a tutoring program at a school and recruiting additional Georgia Tech students to help with the student tutoring. The school must coordinate the school component that ensures that students will be present to receive the tutoring.
- Assisting schools with additional fund-raising through help with grant writing.
- Linking school personnel to Georgia Tech through our Teacher Listserv that highlights opportunities for teachers, students, and schools.

The success of these partnerships will depend upon the willingness of people at both ends to take the initiative, to explore the possibilities, and to take responsibility for nurturing the relationship.

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