Sharing Strengths: Educational Partnerships That Make A Difference

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Abstract

A university-school district project designed to develop communication and teaching skills of graduate and undergraduate students, improve middle school math and science instruction and provide educational role models for students. Descriptive and statistical data were used to compare the performance of students before and after participation in the program. Participants included 17 graduate and 20 undergraduate students from area universities, 38 teachers from a large urban school district and the middle school students in their mathematics or science classes. In addition to survey data, observation, interview, reflections and rating scales were used. Fellows received positive ratings for instruction and for tutoring. Students rated their classroom behavior as better when the fellow was in the class. Teachers valued the fellow's participation in their classrooms and rated highly the technology learned as a result. Principals commented on the positive role models the fellows offered and over half of the students perceived the fellow as a positive role model. Academically, students in the classroom with a fellow showed a significant difference in performance on the mathematics and/or science subtests of the Stanford Achievement Test. Sharing strengths provides positive outcomes for learners across the educational spectrum.

Purpose of the Study

This paper presents findings based on an evaluation study of a project between two universities and an urban school district to form effective relationships with students and educators. The program funded by a National Science Foundation (NSF) grant was designed to develop instructional communication skills of graduate and undergraduate students, improve middle school math and science instruction and provide educational role models for students. Over the past three years 37 students from area universities were selected to participate in the Graduate Fellows Teaching in Kindergarten Through Grade Twelve Project (GK-12). These students worked with 38 teachers in eleven middle school classrooms in the district. With each Fellow affecting at least 100 middle school students over the past three years, the program impacted between 3,800 and 4,000 middle school students. The data presented in this paper reflect the three years of program implementation under the three-year grant combined with additional data analysis of the middle school students' standardized test performance.

Background and Program Description

Over the past decade, student interest in science and, consequently, in scientifically related careers has significantly declined in the United States (NCES, 2003). In order to meet the future demand for qualified personnel in space and health sciences, there is currently a demand to foster interest in pursuing scientific careers in young people. Moreover, the U.S can no longer ignore women and underrepresented minorities as potential workers in these fields (Claudio, 2001). It is in the country's scientific and economic interest to educate and mentor all to ensure a competitive domestic workforce and scientifically astute public. Middle school students are particularly well suited for recruitment in these fields. At the middle school level, students are

beginning to think about their future career choices and need to be guided toward courses that will prepare them to succeed in a university environment.

Teachers are often instrumental in inspiring a young person to pursue a career in science (Subotnik, Stone, & Steiner, 2001). Providing teachers with the opportunity to enhance their knowledge of science and technology enables them to further their professional development in both scientific and educational areas; implement more active curriculum in their classrooms; integrate appropriate technology into the instructional program and encourage their students to explore these avenues. The stages of change theory, which identified the psychological process of change and the stages reached toward integration of information provided a means of recording the progress of the participating university students (Prochaska, DiClemente & Corcross, 1992).

Overview

In March 2000 Rice University was awarded a three-year grant to implement an innovative collaborative agreement between Rice University (Rice), University of Houston (UH) and the Houston Independent School District (HISD). The program was designed to interest undergraduate and graduate students in learning communication and teaching skills, improve math and science instruction in middle school classrooms, and provide educational role models for middle school students. Through more direct contact, the program was also designed to strengthen the connections between the local universities and the school district.

Graduate students were recruited from Rice University to participate for 15 months to include an additional summer of service. Undergraduate students were recruited from the central and downtown campuses of the University of Houston to serve for 12 months. Professional preparation for the fellows took place between May and August with participation in directed training activities, teacher workshops, weekly seminars, and training with the teachers on the team. The fellows were assigned to a team composed of a science and mathematics teacher at one of four middle schools for the school year. These school-based teams were directed to produce an instructional implementation plan using a framework provided by program planners and customized to the needs and constraints of the middle school. They were also expected to participate in a seminar, which was required for the fellows and optional for the K-12 teachers. The fellows conducted tours of the university, prepared a career awareness presentation for students, provided instructional resources for teachers, and shared information with students. During the following summer, the graduate fellows provided instructional support for a series of professional development seminars and workshops.

Program Goals

The program was designed to develop a corps of future scientists prepared to participate in effective, collaborative relationships with K-12 educators in order to provide insight into the learning process within their discipline as well as into the multiple challenges faced by teachers.

There were four major goals around which the program was developed. The objectives were tailored to support the major goals.

Goal 1-**Communication**: Improve communications and teaching skills of fellows through:

- instruction about effective teaching practice in weekly seminars,
- experiences in the K-12 setting to increase insight into the learning process,
- writing journal reflections to develop personal insight, and

- discussion with campus team members and other fellows to develop an appreciation of the skills and expertise of in-service teachers.

Goal 2-**Instruction**: Provide enriched learning experiences for middle school students through:

- hands-on, inquiry-based activities in collaboration with experienced teachers,
- intellectual and material connections,
- service as role models for university study of science and mathematics,
- field trips to the university, and
- discussions with students regarding career opportunities provided by successful study in mathematics and science.

Goal 3-**Professional Development**: Extend learning opportunities for HISD teachers through:

- daily interaction with classroom teachers to sharing knowledge of the field and assistance in mastery of instructional technology,
- invitations to seminar and university functions,
- presentations of innovations in science and math during the annual spring symposium,
- support of teacher efforts to participate in career-building activities with paid membership in professional organizations and attending conferences, and by
- provision of instructional materials to enhance classroom instruction.

Goal 4-**Extension**: Strengthen relationships with the universities and HISD through:

- engagement of university faculty with the progress of the fellows,
- field trips to the university campuses to increase awareness of the accessibility of working with middle schools within HISD,
- arrangements with various departments in facilitating participants' funding, course credit and activities
- dissemination of information about the program, and by
- following the progress of fellows to observe future involvement with K-12 education.

Program Staffing

The Dean of the Wiess School of Natural Sciences provided leadership and support for the GK-12 Fellows program faculty in the departments of Natural Sciences and the George R. Brown School of Engineering. A management team was put in place to assist in selection and decision-making. The team was composed of the Dean, the Executive Director of the Rice University School Mathematics Project, a representative from the Department of Computational and Applied Mathematics, the Outreach Coordinator, and the GK-12 Project Coordinator. The Outreach Project Coordinator was responsible for the functional interpretation of the proposal to assure that the objectives outlined in the proposal were followed. The daily program implementation activities were the responsibility of the part-time GK-12 Project Coordinator. The GK-12 Project Coordinator's duties included assisting in planning the initial training, scheduling the summer training experience for each of the fellows, conducting regular seminars, coordinating information exchanged about the program, collecting program documentation, and providing requested supplies to the fellows and teachers. Funding from NSF provided the undergraduate fellows with a 12-month fellowship, which included tuition, fees, and a $10,000 stipend. Graduate fellows who completed at least the first year of their program qualified for a

15-month fellowship, which included tuition and fees up to $10,500 and a $1,500 monthly stipend. The fellows were enrolled in a Rice University "Special Projects" course for three semesters. Through matched funds and the school expected district's support, the participating teachers received a $1,000 stipend with each team receiving $500 for materials to implement the campus plan. Teachers were paid for two days to allow the participating teachers to be out of the classroom. For the university field trip, two buses were made available for transporting the students. Additionally, each teacher received a professional development stipend of $700 and up to $300 to attend a professional conference.

Methods

Program Participants

The annual recruitment and selection of K–12 Graduate Fellows formally began in November with a letter from the Principal Investigator inviting students to apply for one of the Rice University/NSF fellowships. A brochure was included with the letter with specific directions for application. On the Rice University campus, annually approximately 325 graduate students in all departments in the Wiess School of Natural Sciences and the George R. Brown School of Engineering received the letter. The students were identified through a database in which all graduate students in these departments were listed. This was obtained from the Office of Research and Graduate Studies. Students within the University of Houston system were notified through their departmental offices and academic advisors. During the spring semester applicants to the K–12 program were interviewed by the project directors. Each candidate was interviewed for approximately 20–30 minutes, using a list of prepared questions with each applicant.

A total of 17 Rice University students participated in the three-year program along with another 17 undergraduate students from the UH main campus. Three undergraduate students from the downtown campus of UH also participated.

Most of the Rice graduate participants were white and two were African American. The majority of undergraduate fellows were African American. One graduate student returned for a second year of service to the program. The highest percent of undergraduate students selected for participation were Biology majors. In each of the graduate/undergraduate pairs, at least one Fellow assigned was from a group historically underrepresented in these careers.

Schools were selected based on literature supporting the need to impact students during middle school, since this is a crucial time for developing positive attitudes toward mathematics and science (Martin & Debus, 1999). Middleton and Spanias (1999) noted that gender differences in achievement, particularly in mathematics, began to emerge starting in seventh grade. Some evidence attributed the decline in student interest and achievement to the changes in classroom instruction and climate that students experience during the transition from elementary to middle school (Nolen, 1988).

Four schools were selected each year for placement of the fellows for a total of 11 schools. These middle schools were recruited in a variety of ways. The first year the teachers were recruited based on past participation in Rice University-sponsored professional development programs. During the second year, principals were recruited and asked to select teachers on the same grade level teaching the same students; and during the third year presentations were made to schools and teachers were recruited based on individual interest in the program.

The 11 HISD middle schools selected for participation reflected the district's student population. On eight of the campuses where the GK-12 Fellows were assigned, the student population had on average approximately 1,200 predominantly Hispanic students. However, on three of the campuses, the highest percent were African American. At two of the schools the student population was almost evenly divided between Hispanic, African American and white students. During the third year, two other teachers applied and were accepted from The Rice School/*La Escuela Rice* making this the only site selected for a second year. Most of the schools demonstrated high economic need with over 80% of the population qualifying for free and/or reduced lunch, and all had over 50% on reduced lunch. With the exception of The Rice School/*La Escuela Rice,* over 30% of the student population at the selected schools was identified as at-risk of dropping out of school with the majority identifying over 50% of their students as at-risk. Students selected as the comparison group were from the same schools with the same teachers so the populations were very similar with only a higher percentage of females (53%) in the control group, compared to 51% in the selected classes with fellows (HISD, 2004).

Data Collection and Analysis

Interviews, review of program materials, data from HISD publications, and surveys and rating information regarding program activities was collected through interviews and meetings with the investigators. Descriptive data were collected relating to each of the program components.

The surveys were created by the evaluators and reviewed by the program staff for face validity. Questions ranged from open-ended items to opinion items put on a five-point likert-type scale of agreement. Data from the surveys were summarized using descriptive statistics. Qualitative analysis based on emergent categories was used to summarize the data from the open-ended questions.

The fellows completed a pre-test at the beginning of the program, another test at the end of the two-week orientation and a follow-up at the end of the academic year. To determine the significance of any gains in the fellows' content knowledge, a *t*-test for matched pairs (two-tailed) was performed. All of the fellows also responded to a structured interview and the graduate fellows completed a short e-mail survey at the end of their 15-month contract. The faculty advisors at Rice University answered questions about the performance objectives regarding the expected commitments to the university.

Each fellow was observed in the classroom by the evaluator using an observation sheet designed for the project. The accompanying interview consisted of a series of open-ended questions. At the end of the spring semester, the participating teachers were given a Teacher Rating Form and asked to complete an assessment of each fellow's performance. Another rating scale to assess the professional development component was completed by two professional development instructors at the end of the summer sessions. At least one Instructor Rating Form was completed for each fellow. The teachers were also asked to complete a survey about the usefulness of the program and the implementation on their campus. The participants who attended the Saturday Spring Symposium completed a short survey on the presentations. The HISD school administrators and the project staff were also interviewed.

The attitudes of the students were reviewed using a Student Survey. A sample class was selected for each fellow, based on the amount of time the fellow spent in class. In May, each fellow was given a packet with 30 copies of the questionnaire. Over a two-week time span,

students in one classroom for each fellow completed the questionnaire. A total of 917 were completed over the three-year period.

To show the impact of the program on student performance standardized test scores for this group of students were selected and compared with the performance of similar students in other sections of the same class having the same instructor, but without a fellow in the classroom. The classes without the fellows provided the control group. Student results on the Math and Science subtests of the state mandated Texas Assessment of Academic Skills (TAAS) and/or Texas Assessment of Knowledge and Skills (TAKS) were used. As criterion-referenced tests they were designed to determine the percent of students meeting the accepted standards in reading, mathematics, writing, social studies and science based on criteria established in the Texas Essential Knowledge and Skills (TEKS). Student performance on the Science and Math subtests of the Stanford Achievement Test (Stanford-9) were also used. For each year of the program, subtest performance for selected samples of students were compared.

Limitations

This quasi-experimental study was conducted in classrooms throughout the district using standardized test data collected during the spring of each academic year. The science and math classes in which the fellows worked were part of the core curriculum and therefore were required. Students were assigned to particular sections and teachers based largely on scheduling decisions. The fellows scheduled time in the school was based on their individual course schedule with an effort to work with the same groups of students as much as possible. Since most of the middle schools were on a form of block scheduling the fellow worked with at least three different classes of students each week. Because the state test changed from the spring 2001 year to 2002, student performance comparisons were made by year and school. Other factors such as other programs and interventions may also affect the student performance.

Findings

Communication Component

As stated in the proposal, the focus of the communication component was to improve the fellows' communication and teaching skills. It was also designed to affect their attitude toward K-12 education.

Implementation

The ongoing support for the fellows included direct instruction on effective teaching practice, experiences in the middle school setting, reflection through journal writing and discussion with peers. Fellows began their fellowship by participating in a two-week, approximately 70 contact hour seminar as their introduction in May entitled *Issues in K-12 Science, Mathematics, and Technology Education*, led by members of the management team and guest speakers. The seminar took place on a K-8 campus, which allowed the fellows to observe both students and teachers. During the summer months, fellows also met weekly with Program Coordinator and other members of the management team to make presentations about and discuss their experiences in these professional development programs. Two-hour, bi-weekly seminars continued throughout the academic year. At each point practice and theory were integrated through the seminars to maximize the fellows' contact with students and teachers.

Effectiveness

To determine the effectiveness of the component as implemented the fellows completed a written assessment of their knowledge of K-12 education before and after the two-week seminar in May and again at the end of their academic year experience at the beginning of May. The assessment instrument contained open-ended, short-answer questions about learning and learning differences, instruction, assessment, and standards. Additional questions asked the fellows to describe how they would handle specific school-based problems.

Fellows Content Knowledge

Over the three years the pre and post test the questions as well as the course content remained similar and during that time, all of the fellows increased in the number of items answered correctly from the pre-test to the post-test. At the end of the school year, the participants were again given a similar short-answer test with the same number of items. The results of the pre and post tests were compared statistically using a paired *t*-test analysis on the participants' content scores. **Table 1** provides an overview.

Each year test performance between the pre- and post-test scores on the short answer test was statistically significant. The majority of fellows increased in content knowledge of the educational environment.

Table 1

Results of Paired *t*-test Analysis on Content Assessment

	200-2001			**2001-2002**			**2002-2003**		
	Pre	Post	Year	Pre	Post	Year	Pre	Post	Year
Number Tested	13	13	13	14	14	13	9	9	9
High Score	72	96	98	80	100	100	70	88	100
Low Score	30	78	80	20	76	68	20	45	79
Average Score	51	87	89	59	85	92	39	73	81
Number Increased		14	12		14	10		9	7
t-test statistic		4.68	6.04		6.15	6.44		4.91	7.97
Significance		$p<.005$	$p<.005$		$p<.001$	$p<.005$		$p<.001$	$p<.005$

Based on a paired *t*-test analysis, the fellows' scores showed a statistically significant increase across the academic year. This was evidenced for each of the program years.

Fellows Expertise and Comfort

At the beginning of the program in May, the fellows also completed a self-assessment of their teaching and communication skills. This was administered again near the completion of their classroom service. They were asked to report their perceived level of both expertise and comfort in carrying out a variety of communication and teaching related activities. A scale from 0 indicating 'no experience' and/or 'comfort' to 4 showing 'expertise' and/or 'comfort' was used.

The results indicated that overall, the fellows increased their level of expertise in almost all of the communication activities and reported that their levels of expertise and comfort performing the same skills increased. At the beginning of the program, they reported having 'Little Expertise' in collaborating with professionals, working with middle school students and teaching middle school students. For each program year, their ratings increased during the program year.

By the end of the program, the majority reported having 'Expertise' in collaborating with professionals and teaching middle school students. Prior to the program fellows' rated there level of comfort, at '3' or above in all categories. At the end of the program, fellows' comfort ratings indicated that the majority felt comfortable in working with middle school students as well as in teaching the class.

A Wilcoxon Signed Rank test was performed on the changes in median scores. When the fellows' responses at the beginning were compared with those at the end of the next school year, the reported changes were significant in both the expertise and comfort level. The 2003 participants showed a significant difference in both confidence and expertise from the beginning of the training to the end of the classroom experience, whereas in 2001 and 2002 the fellows showed significant difference in reported confidence but not expertise.

Fellows' K-12 Attitudes

K-12 teachers and faculty advisors commented on a change in the fellows' attitudes toward the challenges of working in the schools and the impact it had on student progress. Fellows were given an attitude measure at the beginning of the training, at the end of the training and again at the end of the academic year. On a scale of 0–7 with 7 as the highest, fellows were asked to value 20 statements about education and instruction. A Wilcoxon Signed Rank Test was used to determine whether the two differed significantly from each other, using the fellows' responses at the beginning of training and at the end of the year. Although a significant difference was exhibited only during the third year, when reviewed by item the fellows' ratings increased on several items from the pretest to the year-end responses indicating a positive change in the fellows' attitudes toward education and toward the role of the teacher within the K-12 system**.**

Instructional Component

According to the funding proposal, the instructional component included enhancing instruction through hands-on inquiry-based activities, providing students with intellectual and material connections, offering positive role models; conducting field trips to the university and discussing career opportunities in math, science and/or technology.

Implementation

Directed by the Campus Implementation Plan (CIP), the experience was implemented somewhat differently on each campus. The team, composed of the fellows and the participating teachers, designed a plan focused on the needs of the teachers and students as well as on the strengths of the fellows. The process was initiated during the Orientation Workshop in August before the beginning of the K-12 school year and revised as needed through the year. The CIP provided structure and measurable objectives for the team's performance throughout the academic year.

Effectiveness

To determine the effectiveness of the instructional component as implemented attitudinal surveys were administered to the teachers and students who participated in the program. Teachers also completed a Rating Form on each fellow. Using a control group standardized test

scores were also compared. Where appropriate, data from the all program year is provided for comparison purposes.

Teacher Survey

The teacher survey consisted of a set of value questions, open-ended questions and two series of Yes/No questions. The open-ended questions invoked the following responses.

How did you get involved in this program? During the first two years the majority of the six respondents indicated that they participated in the program because their principal asked them to do it. During the third year the common response was that they volunteered to participate.

Overall, what was the best thing about having a Fellow working with your students? Responses to this question ranged from helping students complete their assignments to creating an interesting and useful class materials, instruction using technology and software, to "Everything."

What was the biggest obstacle to overcome in working with the GK-12 program? Responses to this question were either "nothing" or time-related issues. Scheduling the team meetings was seen as a problem, particularly during the second semester. Each year at least one teacher reported that the Fellow working in the room had trouble filling the 10 hour weekly commitment during the second semester due that the Fellow's academic schedule. When asked about the quality of the work with students over 80% answered that they had exceeded their expectations.

The formal Teacher Rating was completed at the end of the spring semester. All of the fellows were assessed by at least one of the teachers on the team. The scale was from 0 for 'Not Applicable' to 5 as the highest or 'Excellent' rating. The fellows' median scores were analyzed as a group and then by level. For the group, the median rating was a 5 for 'Excellent' in most of the areas except for a rating of 'Good' in rating their general knowledge of education, ability to teach the whole class and overall contribution to the class. **Table 2** provides the percent of teachers who responded positively to the following items by the program year.

Table 2
Percentage of Teachers Rating Fellow 'Good' to 'Excellent'

The Fellow's	**2001**	**2002**	**2003**
Knowledge of K-12 Education (general issues)	63	89	50
Knowledge of science or math content	94	100	88
Ability to communicate effectively with colleagues	81	78	88
Ability to teach the whole class of students	75	100	69
Ability to tutor individual students	75	100	88
Ability to work collaboratively with your team	81	78	87
Ability to interact and share expertise with teachers	75	89	88

Overall, the fellows were highly valued with the highest ratings given to the 2002 fellows. Additional analyses of teachers' ratings compared those of the undergraduate and graduate fellows. Both the graduate and undergraduate fellows received an 'Excellent' rating in content knowledge. The median rating for the undergraduate fellows for contribution to the class and knowledge of K-12 issues was a '3' or 'Acceptable.' Knowledge of educational issues and overall contribution to the class were the only areas that showed a difference between the graduate ad undergraduate participants. In rating their ability to communicate with colleagues,

the median rating was 'Excellent' for both groups as was the rating for tutoring individually. However, the graduate fellows were rated higher in their overall contribution to the school as well as in their knowledge of general educational issues.

Student Survey

The students were also positive in assessing the fellows. **Table 3** illustrated the data on the students' perceptions based on the response of over 800 students on the Student Survey. Using a grading scale with the letter 'A' as 'Excellent, to E' for 'Unacceptable' students rated behavior.

Table 3
Student Rating the Fellows' Performance and Student Behavior

	Year	A	B	C	D	E
What is your overall evaluation of the Fellow in your class?						
	1	54%	32%	7%	5%	1%
	2	47%	39%	9%	3%	2%
	3	45%	37%	11%	7%	0%
What was your behavior when the Fellow was in your class?						
	1	49%	37%	9%	1%	1%
	2	45%	43%	7%	3%	1%
	3	44%	42%	10%	4%	0%

A= Excellent, B=Good, C=Acceptable, D=Needs Improvement, and E=Unacceptable

Students rated their own behavior as better when the Fellow was in the class. This would support the observed behavior and could be explained by the reduced number of students per adult in the room, as well as to the responsiveness of the Fellow and teacher in working to answer the students' questions. **Table 4** presents the student response to the fellow as a teacher.

Table 4
Student Survey Results Rating The Fellow as Teacher

Always response to the statement, 'As teacher to the whole class, the Fellow…'	**2001**	**2002**	**2003**
speaks clearly and can be easily understood*	62%	70%	61%
challenges you to think about the subject	36%	33%	34%
makes the class interesting	39%	45%	39%
asks questions that help you understand the topic	48%	56%	53%
gives clear directions about assignments	59%	68%	55%
treats you with courtesy and respect	83%	85%	83%
is patient when working with you	70%	79%	73%
encourages you to participate in class discussion	44%	42%	35%

*Three highest rated areas highlighted in **Bold**

The student responses were similar over the three years with the three highest rated areas highlighted. The responses indicate that the highest percentage of students valued the fellows' courtesy and respect, patience and clarity. The results of the student survey indicate that the students also appreciated the personal connection. **Table 5** illustrates how the students viewed the fellows on a more personal level.

Table 5
Surveyed Students' Positive Response to Fellows' Mentoring Activities

The Fellow is…	2001	2002	2003
A good listener	87%	89%	85%
Fun to talk to	85%	85%	80%
A positive role model	61%	81%	69%

As illustrated in the table, a large majority rated the Fellow as 'a good listener' and 'someone fun to talk to.' Although the majority rated the fellow as a positive role model, at 80% the fellows in 2002 were perceived as role models by the highest percentage. When asked to write what they liked best about having the Fellow in their class, the majority wrote statements about the Fellow's ability to assist them in understanding the material. When asked what one thing they would like to say to the Fellow, 85% wrote, "Thank you."

The career presentations were another way that the fellows worked to lead students in positive directions. They were presented in a variety of techniques. Some of the fellows used PowerPoint to highlight aspects of their career and presented it to one class of students, others had several classes that attended a presentation either in the classroom or in the auditorium. **Table 6** illustrates the student response to the fellows' presentations. The program Coordinator collected the presentation materials for each Fellow.

Table 6
Percent of Students' Positive Response to Fellows' Career Activities

	2001	2002	2003
Explaining how success in class relates to the future	73	57	57
Talking about his/her college experiences	68	87	77
Giving advice not just on math or science	61	87	77

As illustrated, the students were positive about how the fellow provided support for academic career information. Results from the first year brought greater attention to the need for the fellows to listen and offer support and advice on subjects other than focuses exclusively on class content.

Standardized Test Performance

Throughout HISD, both the state assessment and the Stanford Achievement Test (Stanford-9) were administered to students in grades 1-11 during the spring semester. Both measures offer information about the progress over students from 200-2003.

Stanford Achievement Test Performance

As a norm-referenced measure it provided a means of determining the progress of students when compared a nationally representative sample. A *t*-test was used to compare the Stanford-9 math and science performance of students instructed by participating teachers during the fellows' year in the classroom. To a control group taught by the same teacher without the presence of the fellow. Normal Curve Equivalent (NCE) scores from students in each school.

Table 7
Test Results of Performance on 2001 Stanford-9 Math and Science Subtests

Groups	Number	Mean Difference	Std Deviation	*t*-value	*p* value
2001	346				
Grade 6 Math Fellows' Classes vs Control		9.47	20.77	8.48	.000
Grade 7 Math Fellows' Classes vs Control		11.30	23.25	9.04	.000
Grade 8 Math Fellows' Classes vs Control		10.75	22.60	9.26	.000
Science Fellows Classes vs Control		8.15	22.03	6.88	.000
2002	343				
Grade 6 Math Fellows' Classes vs Control		3.41	22.24	2.84	.005
Grade 7 Math Fellows' Classes vs Control		2.59	20.46	2.35	.019
Grade 8 Math Fellows' Classes vs Control		3.23	20.89	2.86	.004
Science Fellow Classes vs Control		4.23	23.66	3.32	.001
2003	194				
Grade 6 Math Fellows' Classes vs Control		3.80	17.53	3.02	.005
Grade 7 Math Fellows' Classes vs Control		4.90	18.55	3.69	.013
Grade 8 Math Fellows' Classes vs Control		4.52	17.85	3.53	.001
Science Fellow Classes vs Control		3.14	19.85	2.20	.029

On the nationally normed Stanford-9 test, students of teachers with fellows in the class showed a statistically significant difference in performance on both the Science and Math subtests when compared to the students with the same teacher but without a fellow in the class.

Texas Assessment Measures

The Texas Assessment of Academic Skills (TAAS) followed by the current Texas Assessment of Knowledge and Skills (TAKS) has been the state-mandated test used as a means of monitoring student performance for students in grades 3-8 now 9 and 10. The TAKS is a criterion-referenced test designed to determine the percent of students who meet the accepted standards in reading, mathematics, writing social studies and science based on criteria established in the Texas Essential Knowledge and Skills (TEKS). During the 2000-2002 school years 2003, reading and mathematics were tested throughout the grades, whereas science was assessed at grades 5,10 and 11. However, during 2003 Science was assessed in grade 8. Texas Learning Index (TLI) scores were used for comparison. The raw scores were used for the item analysis of the objective-level data.

Overall a slightly higher percent of students with fellows in the class passed the TAKS math subtest. At each grade tested, a higher percent of the students with fellows in the classes passed the test.

Table 8
Percent of Students Meeting Expectations on State Measures

	Grades Tested	Subject	Number of Students	Districtwide % Passing*	Students in Classes with Fellows % Passing	Students in Control Classes % Passing
Year 1	6, 7, 8	Math	299	76	90	84
Year 2	6, 7, 8	Math	310	74	87	81
Year 3	6, 7, 8	Math	258	68	86	80
Year 3	8	Science	158	54	95	86

*Passing score is set at two standard error of measures (SEM) below the mean

When the test objectives were further analyzed it appeared that over the three years, the fellows had been particularly instrumental in assisting students with an understanding numbers operations and quantitative reasoning. Students in their classes also scored higher on concepts and uses of measurement. During the first year students also excelled on the algebraic reasoning and spatial reasons objectives.

Professional Development Component

The objectives involved broadening the teacher's content knowledge, providing an opportunity to explore current research, increasing pedagogical understandings and collaborating with teachers across grade levels.

Implementation

The primary way in which the fellows assisted in accomplishing this goal was through the Saturday Spring Symposium, which offered an opportunity to share information on the current directions in the field. Additionally, the fellows provided support and ideas within the classroom setting and provided encouragement for teachers attending professional development opportunities at the universities.

Evaluation

The fellows' research-based presentation was evaluated in terms of how effectively it met the professional needs of the participating teachers. Along with the information on the Saturday Spring Symposium, documentation on the invitations and material offerings sent out by the program staff supported the goal of extending professional development opportunities. Survey information and contact with the Coordinator provided information about the effectiveness of the fellow in expanding the teachers knowledge and use of technology.

Spring Symposium

The fellows worked in groups to plan the Saturday Spring Symposium entitled *Current Ideas in Science and Mathematics* held at Rice University during the spring semester. One-hour sessions related to either the biological, physical or mathematical sciences engaged a group of approximately 20-25 area middle school teachers, all of whom completed the survey. The sessions were held on the Rice University campus and presented in rotation to groups with approximately 10 people in each. Of those, almost all indicated that they would recommend the Spring Symposium to a co-worker and that it was a worthwhile use of time." As one participant wrote, "It was stimulating, educational and informative." Another respondent added, "The presenters were very energetic and pleasant and the information was very educational." Participants were asked to rate the content presented on a scale of 1-4, ranging from least to most favorable. **Table 9** presents the participants' response to the presentations. The survey responses were positive, particularly in terms of new information learned as a result of attending the presentations. In all three sessions, most or all of the respondents also indicated that much of the information was applicable to and useful for their classrooms.

Table 9
Positive Participants Response to Overall Value of Spring Symposiums

	2001	2002	2003
	% Above Average	% Above Average	% Above Average
New Information	96%	91%	100
Application to real life	94%	96%	100
Communication of Content	94%	96%	91
Usefulness to your classroom	81%	91%	83

On the Participant Teacher Survey, 73% of the teachers indicated that they attended the Spring Symposium. Comments such as "It was great," "Excellent presentations," and "Great setup/structure," were representative. One suggested that the presentations be filmed so that they might be shared with the incoming teachers and teams during the August Orientation. One participant asked if there were a way to extent the information to teachers on their campus, for those teachers who could not attend the Spring Symposium. Making a video of the presentation would also serve to extend the learning to the campus level.

Classroom Technology

A unique aspect of the program was the regular weekly interaction of the fellows with usually one teacher and classes of students. The time allowed for informal sharing opportunities. Fellows brought materials, which included new software or presentations requiring the use of computers. These were integrated into the lessons. To evaluate this, teachers and students were asked similar questions on the surveys. Responses are summarized in **Table 10.**

Table 10
Teachers and Students Rating Fellows' Technology Use

	Year	Teacher Ratings	Student Survey
		% Answering Positively	
Used technology (computers) for instruction			
	1	50	43
	2	57	70
	3	81	45
Assisted students to use the computer for instruction			
	1	31	38
	2	44	49
	3	32	39

Comments made by teachers indicated that, particularly in terms of the use of technology in class presentation, the teacher learned from the fellow and were more willing to inject appropriate computer use into the curriculum when the fellow was in the classroom. The following comments are representative:

> "The graduate Fellow not only taught my classes about various software, she presented several in-service workshops. She was great."
>
> "It was wonderful to have someone who knew the technology and could prepare and set up presentations for the class."

Extension Component

The final goal called for the program to strengthen relationships with the universities and the K-12 school community. It was envisioned that the engagement of university faculty with the progress of the fellows, field trips to the university campuses to increase awareness of the accessibility of working with middle schools within HISD, and arrangements with various departments in facilitating participants' funding, course credit and activities would result from the interactions.

Implementation

Each fellow was expected to share program information and highlights with their advisor, particularly on the graduate level. The school district sponsored the field trips as part of the district's contribution and the participating students were assigned to reflect on the experience. In producing the website, preparing posters to advertise the program and in dealing with various offices and departments on the university campuses and the school district, formal and informal networks were strengthened.

Evaluation

The responses to the Advisor's Survey was used to measure of effectiveness, as was the recruitment data. Survey information was used to evaluate the field trips in addition to the students' pictures and reflections on the event. Information from the Principal Interview was used to determine if the links had been strengthened between the university and the school district. The website was compared to other GK-12 websites and reviewed for effectiveness in dissemination program information. Former fellows were contacted to determine what if any connection they continued to have with K-12 education.

Advisor Survey Results

Additional information about graduate Fellows' communication and teaching skills is provided by written comments from the student's faculty advisor. Over the three years there were 16 graduate faculty advisors of which 10 responded to the survey. Those who responded were positive about the program. One pointed out that the stipend allowed the Fellow to continue doing research for an additional year and that the interest generated helped by improving the Fellow's attitude. All answered "No" when asked if participation in the GK-12 program affected the Fellows' research in a negative way. However, they attributed that to the hard work and dedication of the Fellow. As one pointed out, "Participation in this program must be based on selecting special students and advisors who are committed to K–12 education." The following comments are representative.

"I think that the fellowship is very positive from an overall graduate training viewpoint. I believe that this experience is helping [Fellow] significantly become a better teacher."

"My Fellow is an enthusiastic and hard-working student and I am pleased with his accomplishments so far."

"I cannot judge whether the GK-12 program has improved [Fellow's] training, but I firmly believe that it has not slowed down the rest of the academic progress."

On the University of Houston campus the Director of the Scholar Enrichment Program was interviewed. She was a graduate Fellow during the 2000–2001 school year. She explained that their program assists mainly minority students with advising, study skills, encouragement and tutorial assistance in order to help them become more successful in their university classes. She was able to direct several to complete the application process and four of the undergraduate fellows had become aware of the GK-12 program through participation in Scholars program.

University Field Trip

On the student survey the majority of the students surveyed responded positively that the fellows talked about their college experience. Much of this conversation began with the field trip to the campus. The field trips also provided a way for the Fellows to interact with the students on a more personal level. They also offered an opportunity to share personal highlights and stories about the college campus. As an assessment each of the teams had students complete an activity related to the experience. For one the focus was on what had been learned in the lab portion of the trip, another emphasized the impact on career plans and two had students reflect on the overall experience.

Principal Interview

In the interview, principals were asked about their involvement in the program, their perception of the fellows and how the program affected the school. All the principals were positive about participating in the program. They were also asked '*If given the opportunity, would you participate in the program again?'* Over the three years, all of those interviewed expressed the hope that the program would continue for an additional year on their campus. Due to location and teacher interest, the Rice School was selected for a second year. When asked about the program during the first and third year, the principal responded with the comment, "Although the fellows had been more visible during the first year, this group of fellows fit almost seamlessly into the school." All commented that the age of the Fellows and the extended time spent on campus provided positive role models for the students. They also expressed an interest in continuing the relationship with the universities. Several had suggestions for continued interaction with university-level students. Attending career day presentations was cited often as were additional tutorial assistance. The principals were indirectly aware of Fellows' activities in the school. The most visible activities were the campus visits and the career presentations. All thought the GK-12 program was worthwhile and wanted to continue participation. They added that participation made a connection with the university. When asked of they had any problems with the program several mentioned the additional district contribution. This was considered a problem during the first and second years of the program. It was highlighted during the second year with the early scheduling of the buses for the students' annual field trip and was due to misunderstanding the budgetary agreements, which had been contracted at the district level. The third year the problem was addressed when the Coordinator initiated a contract, clearly stating the obligations of program participation, which was then signed by teachers and principals.

Dissemination Activities

As part of the project, a website was created to disseminate information about the project, provide links to resources, and promote the program. The website, which is accessible at http://gk12.rice.edu has a program description, explanation of the teacher participant application

process, contact information, and a list of participants for the first two years of the project. Additional materials were made available through a link to the NSF site. In reviewing other websites at universities that have similar GK-12 projects, most of those sites have pictures of the participants, pictures of program activities and information about key aspects of the program.

Update on the Fellows

In an effort to follow the professional progress of fellows an email survey was sent in May 2003 to all the participating fellows, of which 21 responded. The survey asked about the completed of coursework and graduation status, the impact of the program and their plans for the future. All of the undergraduate fellows reported that they completed their studies. Two of the graduate fellows from year one and three from the second year were working on their dissertations and hoping to graduate in 2004. Two graduate fellows were completing their coursework. Three undergraduate fellows had applied and were accepted to medical school programs. Of those responding, three reported accepting teaching positions in the K-12 educational system. Four reported having found university-level teaching positions in their field and were looking forward to meeting those challenges. One commented that he had been told that the experience with the GK-12 program had been a deciding factor in the committee's acceptance of his application over other candidates. Several who had stayed in the area reported volunteering at career day presentations in "their school." One reported that she is still intending to run for the school board. As one former fellow stated, "The GK-12 Program hasn't exactly changed my view of public education, but it has given me a greater respect for teachers."

Conclusions

This paper presents results from a university/district project created to extend the skills of fellows, teachers and students. Through the four goals, middle school students and teachers were engaged in an extended professional relationship. Using the data from the three years of implementation it was apparent that the program was implemented as proposed and that the results were positive.

When tested on content knowledge related to teaching within the K-12 educational system, test performance between the pre- and post-test scores on the short answer test was statistically significant. Over the course of the year the majority of fellows also increased in content knowledge of the educational environment. The results also indicated that the majority of fellows increased their level of expertise in almost all of the communication activities and reported that their levels comfort also increased. K-12 teachers and faculty advisors commented on a change in the fellows' attitudes toward the challenges of working in the schools. Fellows were given an attitude measure at the beginning of the training, at the end of the training and again at the end of the academic year. Although a significant difference was exhibited only during the third year, the fellows' ratings increased on several items from the pretest to the year-end responses indicating a positive change in the fellows' attitudes toward education and toward the role of the teacher within the K-12 system**.**

Teacher ratings, completed near the end of the academic year were positive. During the first year a difference was noted in the way graduate and undergraduate fellows were perceived. As a consequence during the subsequent years during the fellows' preparation, more time and attention was spent on strengthening the presentation skills of the undergraduates toward

preparing them to relate to the students as content specialists. For the second and third years of the program, overall, the teachers rated the undergraduate fellows almost as highly as the graduate fellows in content knowledge and as highly as the graduate fellows in other areas such as working with the team.

Students rated their own behavior when the fellow was in the classroom as better than when instructed only by the teacher. What the majority of students liked best about the fellow was that the fellow treated them 'with courtesy and respect.' They also appreciated was the patience the fellows demonstrated when working with them. However it is most noteworthy that students with fellows in their classes demonstrated higher performance on the standardized tests than their counterparts. When the state test performance was analyzed by objective the scores indicated that generally these students did better on operations, algebraic and geometry concepts and measurement.

The principals were positive about the program and were interested in participating for a second year. Due to location and teacher interest the Rice School/*La Escuela Rice* was selected as a site for a second year. The principal of the Rice School commented that the fellows' transition to the school had been smoother during the second year. The additional district support particularly in paying transportation costs for the university field trip was perceived as a problem, and was remedied during the third year by clarifying the contractual agreements.

The responses of university faculty and advisors on the Advisor Survey were also positive. Graduate advisors stated that participation in the program was not expected to delay completion and graduation timelines, due to the dedication of the fellow in meeting the expectation of the program personnel and the university. Therefore, each of the indicators offer evidence regarding the effectiveness of the implementation activities.

References

Claudio, L. (2001, Summer). Reaching out to the next generation of scientists. *Thought & Action, 17*(1), 77-86.

Houston Independent School District (HISD). (2004). *District and school profiles*. HISD Department of Research and Accountability Houston, TX:

Martin, A., & Debus, R. (1999). An alternative factor structure for the Revised Self-Consciousness Scale. *Journal of Personality Assessment,* 72, 266-281.

Middleton, J., & Spanias, P. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticism. *Journal for Research in Mathematics Education, 30*(1), 65-89.

National Center Educational Statistics, (NCES) (2003) The High School Transcript Study: A Decade of Change in Curricula and Achievement, 1990-2000, [On-line]. Available: *www. nces.ed.gov.*

Nolen, S. B. (1988). Reasons for studying: Motivational orientations and study strategies. *Cognition and Instruction*, 5(4), 269-287.

Prochaska, J. DiClemente, C. & Corcross, J. (1992). A transtheoretical model of behavior change. *American Psychologist*, 47 1102-1114.

Subotnik, R., Stone, K., & Steiner, C. (2001, Fall). Lost generation of elite talent in science. *Journal of Secondary Gifted Education*, 13(1), 33-43.