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STEMTEC Evaluation Report For Year 4 (Fall 2000/Spring 2001)

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EXECUTIVE SUMMARY

The Year 4 evaluation of STEMTEC was extremely comprehensive, involving surveys of students and faculty, interviews with faculty and campus coordinators, analysis of course evaluation data, and classroom observations. In the final chapter of this report we provide a brief summary and some recommendations. In this Executive Summary, we briefly describe some of the most pertinent findings.

1) <u>STEMTEC has had a positive impact on reinvigorating science and math teaching on college campuses</u>

The results conclusively indicate that STEMTEC has had a positive effect on getting math and science teachers to reform their teaching to facilitate student-active learning. The faculty survey, the student surveys, the campus coordinator interviews, and the classroom observations all provided data that the STEMTEC teaching philosophy is being successfully applied in STEMTEC classrooms. For example:

- A survey of STEMTEC faculty found that all of the responding faculty were using STEMTEC advocated teaching and assessment practices with 63% using them "to a great extent."

- The faculty survey also revealed that 85% of STEMTEC faculty have their students working in pairs or small groups more often than before STEMTEC; 70% are using more whole class discussions, and 61% are incorporating more hands-on activities.

- STEMTEC faculty rated the support offered by STEMTEC in a very positive light. All respondents reported that the course redesign and development was very good (85%) or good (15%). Ongoing course support was rated very good (50%) or good (38%) by the majority of respondents.

- Systematic classroom observations found that hands-on activities, teacher interaction with students, small group discussions, and writing work are being implemented in STEMTEC classrooms. Results of the student survey supported this finding. Seventy-five percent of student respondents indicated that they worked in small groups often.

- Seven of eight campus coordinators reported that the teaching reform aspect of STEMTEC is one of its most important accomplishments. STEMTEC professors' reformed teaching practices have filtered into their non-STEMTEC courses and into the teaching done by non-STEMTEC faculty, as well. The coordinators are confident that these teaching improvements will persevere, with faculty unlikely to return to their "old ways."

Executive Summary (continued)

2. STEMTEC has had a positive impact on the improvement of K-12 mathematics and science teacher preparation

The evaluation results suggest that STEMTEC is providing rewarding teaching experiences for many math and science students. The teaching scholars rated their teaching experiences highly, and the campus coordinators thought this was one of the most positive aspects of the program. In addition, many of the faculty incorporated teaching experiences into their classes or invited K-12 teachers into their classes. Other faculty reported that more needs to be done in this area and requested help from STEMTEC to coordinate K-12 connections.

3) STEMTEC has had limited success in fostering collaboration among its constituents

The Collaborative is operating on all eight campuses and participating faculty seem to be in touch with the program. However, it appears the program is running well on each individual campus, but that the inter-campus aspects of the program could be improved. Both the campus coordinators and STEMTEC faculty called for more inter-campus dialogue and professional development activities. Specifically:

- Top-down information sharing among the collaborative institutions is in place. Of the 28 faculty members who completed surveys, 88% felt that the mechanism for information dissemination established by the STEMTEC program was good or very good.

- Several campus coordinators felt that STEMTEC is not truly collaborative since there is not much inter-campus collaboration among faculty. These coordinators felt that the inter-campus dialogue STEMTEC created during its first two years has lost momentum.

4) STEMTEC has fallen short of its goal to recruit underrepresented minorities into the math and science teaching profession

Although STEMTEC is increasing math and science students' interest in teaching, it does not appear to be achieving success in recruiting underrepresented minorities into the math and science teaching profession. This finding was particularly evident from the campus coordinator interviews. The difficulty of this task is acknowledged, but the importance of this project goal warrants further efforts to try to improve recruitment and retention of underrepresented groups

STEMTEC Evaluation Report For Year 4 (Fall 2000/Spring 2001)

Introduction

In September 2000, we undertook evaluation of the Science, Technology, Engineering, and Mathematics Teacher Education Collaborative (STEMTEC) project. STEMTEC is a project funded by the National Science Foundation (NSF). The STEMTEC project is collaborative, involving eight colleges and Universities in Western Massachusetts, as well as several K-12 public school districts. The Collaborative officially began as a five-year project, with NSF funding beginning in the fall of 1997. The project is completing its fourth year of the grant.

Our evaluation of STEMTEC (the Collaborative) is targeted to its stated goals and objectives. In designing the evaluation plan, we considered prior evaluation work conducted by other evaluators, as well as written and oral guidance from the external body that advises the Collaborative: the National Visiting Committee (NVC). The evaluation plan was presented to the principal investigators, revised based on their comments, and revised further still based on a November meeting with the NVC.

STEMTEC Goals

STEMTEC is comprehensive and multi-faceted. There are seven specific goals associated with the Collaborative:

1. Establish a functional educational collaborative.

2. Redesign the science and math curricula on the campuses of the Collaborative to incorporate new pedagogies and establish mechanisms for supporting faculty in their course redesign.

3. Improve preparation of future K-12 teachers of mathematics and science.

4. Recruit and retain promising students into the teaching profession, with special attention to underrepresented groups.

5. Develop a program to support new science and math teachers in their first year in the classroom.

6. Establish dissemination mechanisms.

7. Conduct strong programs of evaluation and assessment.

In considering prior evaluation work, and the comments of the NVC, it was decided that our evaluation for the 2000/2001 academic year would focus on determining whether the Collaborative has (a) reinvigorated the teaching of math and science, (b) increased the number of students who enter the math and science teaching professions, (c) increased the number of underrepresented minorities who enter the math and science teaching professions, and (d) supported K-12 science and math teachers. Therefore, we developed an ambitious evaluation plan. In this plan, we prioritized the STEMTEC goals as follows:

Priority 1: Redesign the science and math curricula on the campuses of the Collaborative to incorporate new pedagogies and establish mechanisms for supporting faculty in their course redesign (Goal 2).

Priority 2: Improve preparation of future K-12 teachers of mathematics and science (Goal 3).

Priority 3: Recruit and retain promising students into the (math and science) teaching profession, with special attention to underrepresented groups (Goal 4).

Priority 4: Develop a program to support new science and math teachers in their first year in the classroom (Goal 5).

Priority 5: Conduct strong programs of evaluation and assessment (Goal 7).

Priority 6: Establish dissemination mechanisms (Goal 6).

Priority 7: Establish a functional educational collaborative (Goal 1).

Although we present these goals and priorities as distinct components of the Collaborative, they are all closely related and so our four primary evaluation questions each address multiple STEMTEC goals. The specific evaluation questions we addressed are:

(a) Has STEMTEC facilitated redesign of the science and math curricula on the campuses?
(b) Has STEMTEC facilitated the incorporation of new pedagogies on the campuses?
(c) Has STEMTEC established mechanisms for supporting faculty in their course redesign?
(d) Has STEMTEC improved the preparation of K-12 math and science teachers?
(e) Has STEMTEC recruited new math or science teachers?
(f) Has STEMTEC improved the retention of math or science teachers?
(g) Has STEMTEC recruited under-represented minorities into the math/science teaching profession?
(e) Has STEMTEC improved the retention rates among under-represented minority math/science teachers?
(f) Has STEMTEC effectively supported K-12 math and science teachers?
(g) Are there important elements of STEMTEC that would benefit other K-12 and postsecondary institutions?
(h) Is the collaborative fully implemented?
(i) Is the collaborative running efficiently?
(j) What are the strengths and weaknesses of the STEMTEC program?
(k) What improvements can be made?

These questions are also presented in the “evaluation matrix,” which appears in Appendix A. This matrix indicates the types of data that will be collected and analyzed to evaluate the goals of the Collaborative. The timeline of this year's evaluation tasks is included as Appendix B.

This report summarizes the evaluation activities conducted from September 2000 through August 2001. Each chapter constitutes a separate report targeted to one or more of the evaluation goals.

Campus Coordinator Interviews

Stephen G. Sireci, Joseph B. Berger and Sharon Cadman Slater

STEMTEC Campus Coordinator Interviews

The campus coordinators at each of the postsecondary institutional members of the STEMTEC collaborative were interviewed in late spring and early summer of 2001. The purpose of these interviews was to collect data from these individuals regarding their perceptions of how well STEMTEC functions as a collaborative and how well STEMTEC is progressing at each of the campuses. More specifically, these interviews were designed to inform the following evaluation questions:

- To what extent is the STEMTEC functioning as a collaborative?
- To what extent are the goals of STEMTEC being met?
- What type of influence is STEMTEC having on the climate for science and math education at each of the participating campuses?

Given that the STEMTEC campus coordinators are the most knowledgeable about the functioning of STEMTEC on their campuses, they are an ideal source of information regarding the strengths and weaknesses of the collaborative.

Interview Protocol

To inform the aforementioned evaluation questions, the evaluation team developed eleven open-ended questions to be used in the collection of narrative data from the campus coordinators. The protocol was partially adapted from the Principal Investigator Questionnaire developed by the researchers at the University of Minnesota working for the Core Evaluation of the Collaboratives for Excellence in Teacher Preparation (CETP) program. Other items were designed by the UMASS evaluation team. The eleven questions asked of the coordinators were:

- What do you believe are the most important things that STEMTEC has accomplished?
- Were there any mechanisms or processes in place on your campus before STEMTEC that facilitated the achievement of STEMTEC goals?
- Were there any inter-campus collaborative mechanisms or processes in place before STEMTEC that facilitated the achievement of STEMTEC goals?
- Were there any barriers on your campus that inhibited the accomplishment of STEMTEC goals?
- Were there any barriers that inhibited the development of a functioning collaborative?
- Please comment on the way the collaborative functions. Do you have any suggestions for improvement?
- In what way did your campus participate in the formation of reformed education policies and practices targeted towards science, math, and technology?
- What has STEMTEC done in the way of implementing special programs designed to increase (through recruitment and retention) the ethnic and gender diversity of students planning to become math or science teachers?
- How are STEMTEC faculty identified on your campus? Courses? Students?
- What evidence do you have that any of the changes begun by STEMTEC will continue?
- What has been the overall impact of STEMTEC on your campus?

Sampling and Collection Procedures

Each campus coordinator (representing Amherst College, Greenfield Community College, Hampshire College, Holyoke Community College, Mount Holyoke College, Smith College, Springfield Technical Community College, and the University of Massachusetts Amherst[1]) was interviewed using the protocol described above.

Results

Representatives from all eight campuses were interviewed. Each coordinator was interviewed separately and was asked to respond to each of the eleven questions described earlier. The interviews took about 60 to 90 minutes. A summary of the respondents' comments is organized by question.

What do you believe are the most important things that STEMTEC has accomplished?

Seven out of the eight coordinators thought the most important thing STEMTEC accomplished was the training of math and science teachers with respect to reformed teaching practices. All coordinators reported that STEMTEC had a very positive impact on faculty pedagogy. For example, STEMTEC trained faculty how to promote student-active learning. There was consensus that this accomplishment will persevere, that faculty would not go back to their "old ways" of teaching. Three coordinators reported that the STEMTEC teaching philosophy and practices filtered into the courses of non-STEMTEC faculty. One coordinator mentioned that STEMTEC helped bring Schools of Education and Math/Science departments together, which helped improve math and science instruction.

Four of the eight campus coordinators explicitly mentioned the teaching scholars program as being one of STEMTEC's most significant accomplishments. This program was cited as making students more aware of teaching as a profession and getting them important teaching experience. All coordinators spoke positively about the teaching scholars program and felt it helped accomplish the goals of recruiting new math and science teachers.

Another accomplishment cited by half of the coordinators was creating relationships among the colleges and local K-12 schools. As one coordinator put it, "STEMTEC helped put the right people in touch with each other." Another commented "I now know high school teachers I can call on." In general, the responses suggested that STEMTEC helped facilitate enduring relationships between colleges and local elementary, middle, and secondary schools.

Similar to the earlier statement regarding the teaching scholars program, three of the coordinators thought one of STEMTEC's major accomplishments was making math and science teachers more aware of teaching as a profession. They believed giving these students the opportunity to try out teaching as a career was invaluable.

[1] UMASS had two personnel coordinating STEMTEC on campus. Only one was interviewed.

Two coordinators thought that creating a multi-campus dialogue about teaching math and science was also one of STEMTEC's greatest accomplishments. It was also generally believed that this dialogue would endure for some time. One coordinator at a community college thought STEMTEC helped give four-year college faculty a greater appreciation for what community college faculty do, and helped bring community colleges into the local academic community. Another coordinator stated that the conference sponsored by STEMTEC helped create multi-campus dialogue about math and science teaching.

Were there any mechanisms or processes in place on your campus before STEMTEC that facilitated the achievement of STEMTEC goals?

Three of the coordinators reported that there were no such mechanisms or processes on their campus prior to STEMTEC. Two of the coordinators reported that they were not on campus before STEMTEC and so they were not sure. The other coordinators mentioned several special projects such as grants on universal design from the National Science Foundation or National Endowment for the Arts, FIPSE grants, special initiatives for teachers and workshops offered by the campus administration, teacher education transfer programs in continuing education, articulation agreements with schools of education, programs for recruiting minorities into the sciences, and learning communities.

One coordinator reported that there was a mindset on campus in support of reformed teaching prior to STEMTEC, which made STEMTEC immediately accepted on campus. Another respondent mentioned prior relationships with the Center for Teaching Excellence on campus. The STEM Institute seminars were also mentioned as facilitating the goal of reformed teaching prior to STEMTEC, as was a special January program at one of the colleges that gave students ten days of in-class teaching experience.

Were there any inter-campus collaborative mechanisms or processes in place before STEMTEC that facilitated the achievement of STEMTEC goals?

Half of the coordinators responded that there were no such inter-campus mechanisms in place prior to STEMTEC. Two respondents mentioned the 5 College Consortium. Articulation agreements between community colleges and universities were mentioned by two coordinators (at both UMASS and Westfield State). Also mentioned were recruitment programs for women from community colleges to go to Mount Holyoke or Smith College. One respondent mentioned a Community Service Learning Group that is designed to get college students into the community, but was not specially targeted to Science.

Were there any barriers on your campus that inhibited the accomplishment of STEMTEC goals?

Two coordinators said there were no barriers that inhibited the accomplishment of STEMTEC goals. Two others mentioned a lack of interest on the part of the faculty and a resistance to change by faculty. Two coordinators also mentioned problems with the administration (e.g., lack of support, lack of interest) on one or more of the collaborative campuses. One coordinator felt their Dean was uninterested and unsupportive. In addition, the "publish or perish" focus on research rather than teaching was mentioned by two coordinators as a barrier to the participation of non-tenured faculty. Other barriers mentioned were difficulties in disseminating information to students, getting faculty to respond, students' practice of postponing math and science courses until their junior or senior year, high teaching loads at community colleges, and faculty resistance to having their teaching observed or evaluated.

<u>Were there any barriers that inhibited the development of a functioning collaborative?</u>

Three coordinators reported that a real collaborative does not exist. Another coordinator stated that the Coordinating Council meetings were the only collaboration, but "It felt like the meetings and the group weren't moving anywhere…there were no goals." One of the three coordinators who believed a collaborative does not exist stated "Everyone gets along, but a functioning collaborative hasn't happened." Another coordinator commented "There isn't really a sense of a 'collaborative' for STEMTEC faculty. There are roundtables on specific topics, but not an organized sharing of methods or updates of other campuses." Although the other four coordinators thought an inter-campus network existed, none of them described it as truly collaborative.

Two coordinators thought that "micromanagement" on the part of the PIs and their lack of listening to feedback were barriers to the development of a functioning collaborative. Two other coordinators mentioned that traveling was a burden for the community colleges. One coordinator commented that competition for students among the private colleges was a barrier to forming a collaborative. Another barrier mentioned by one coordinator was the difficulty in getting administrators at different campuses to commit and coordinate.

All of the coordinators thought STEMTEC could be made more collaborative and some offered suggestions for doing so such as creating learning communities, decentralizing the communication among faculty across the institutions, and promoting more sharing among STEMTEC faculty.

<u>Please comment on the way the collaborative functions. Do you have any suggestions for improvement?</u>

Many of the responses to this question elaborated on the general feeling that STEMTEC falls short of being a true collaborative. One coordinator described the way the collaborative functions as "[The PI] has something to accomplish, he e-mails it, everyone does it." One coordinator stated that STEMTEC functioned well within the faculty of each campus, but there was no feeling of collegiality among faculty from different campuses. There seems to be a need to get the STEMTEC faculty across campuses together more often. The general feelings expressed by the coordinators may be summed up by one coordinator who commented STEMTEC "functions as a faculty-driven, day-to-day, pedagogical and curricular project; [however] it doesn't function well in regard to institutional transformation."

Other comments on the functioning of STEMTEC mentioned that the project started off very well, but seemed to lose its momentum after the first two years. As one coordinator put it "The novelty is wearing down, which is why collaboration outside the institution is diminishing.

Sustaining [STEMTEC] is hard to do. There were lots of carrots at the beginning, but now there are no more rewards, no more summer workshops."

Although the descriptions of the way the collaborative functions were mostly on the negative side, most of the coordinators conceded that it was hard to coordinate across campuses and to keep the energy level of STEMTEC sustained for four years. However, all of the coordinators had one or more *suggestions for improving the collaborative*.

Two coordinators recommended holding regular meetings of faculty from different campuses *within the same discipline* to improve the collaborative. Two coordinators also recommended improving the coordination of the teaching scholars program by involving the campus coordinators. These two coordinators stated that they did not even know all of the scholars on their campus. One coordinator recommended that the scholars be required to meet the campus coordinator for discussion, advice, and feedback.

One coordinator suggested that STEMTEC be housed at the 5-college consortium instead of at UMASS. This change was suggested to improve intercampus communication, particularly in regard to facilitating cooperation among the administrators at the different campuses.

Suggestions were also made in regard to getting new faculty involved in STEMTEC and improving the K-12 connections. With respect to the first issue, one coordinator recommended hiring an additional part-time staff person on each campus to recruit new STEMTEC faculty. As for the second issue, the coordinator recommended adding someone to help set up K-12 connections for the campus. One coordinator recommended that, to improve the K-12 collaboration, one of the PIs for STEMTEC should be a K-12 teacher.

Some of the coordinators expressed the feeling that they were not as well respected as they would like to be. One theme that emerged was that the PIs asked for feedback, but they did not act on it. As one coordinator commented "if you ask for feedback , try to implement it or tell people why you are not going to do it." Another coordinator commented that a lot of the good work done on the campuses was labeled "STEMTEC" when it was really the work of one or more faculty. Thus, there was some feeling that credit was not always given where it was due.

Another suggestion was to simplify the STEMTEC course designation paperwork. Most coordinators conceded that identifying STEMTEC courses is problematic. One coordinator suggested giving incentives to faculty for having STEMTEC designation.

To summarize the responses to this question, it appears that although the coordinators see weaknesses in the way the collaborative functions, they also realize how difficult it is to coordinate across campuses. However, they have very good ideas for addressing this difficulty.

<u>In what way did your campus participate in the formation of reformed education policies and practices targeted towards science, math, and technology?</u>

One coordinator pointed out that their campus did not participate in the *formation* of reformed education policies and practices, but that they did learn reformed teaching approaches, which the faculty selectively applied to their classrooms. The application of reformed teaching practices, such as student-active learning, was a common response to this question. Another commonly cited example of how a campus participated in reformed educational practices was giving college students a chance to teach in K-12 classrooms. One coordinator reported that they also invited K-12 teachers into their math and science classes to talk about teaching. In general, several coordinators thought that by participating in STEMTEC, they were able to "turn more students on to teaching math or science."

Other examples of campus-specific teaching reform initiatives included periodic lunch meetings with science faculty on one campus, adding an education studies program at another, and the initiation of awarding students credit for a teaching practicum.

On the negative side, three coordinators commented that although individual faculty learned STEMTEC teaching policies and practices, there was no mechanism for passing it down. Thus, it appears that the dissemination of STEMTEC polices and practices could be better.

What has STEMTEC done in the way of implementing special programs designed to increase (through recruitment and retention) the ethnic and gender diversity of students planning to become math or science teachers?

The responses to this question were overwhelmingly negative. Seven of the eight coordinators stated that STEMTEC recruitment initiatives in this area were essentially nonexistent. The other coordinator mentioned the teaching scholars program. Two coordinators mentioned one-time events during the first year: an ALANA[1] pizza party and a talk about recruiting minorities given by Shelia Browne from Mount Holyoke. About half of the coordinators acknowledged the difficulties in recruiting minorities. One coordinator summed up the consensus by stating "There is not a concerted effort to recruit." Another commented "I haven't seen one initiative implemented by STEMTEC. All of the PIs are white, and they tend to be more reactive than proactive." Still another lamented that the recruitment of ethnic diversity was "such a neglected part that STEMTEC struck out on."

To address this problem, one coordinator suggested hiring someone whose primary responsibility is recruitment. Another commented that the establishment of a task force early on could have helped. On the positive side, two coordinators thought STEMTEC was successful in recruiting more women into the profession of teaching math and science.

How are STEMTEC faculty identified on your campus? Courses? Students?

Half of the coordinators stated that faculty and courses are *not* identified as STEMTEC courses on their campus. Three coordinators said that STEMTEC faculty were defined as anyone who participated in cycle 1 or 2 (i.e., received $8K for course revision and attended summer workshop(s)). One coordinator had the most liberal interpretation of a STEMTEC faculty that was "anyone who took part in one of the conferences or revised a course due to contact with existing STEMTEC faculty."

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[1] ALANA is a minority student organization at UMASS

Two coordinators responded that posters and mailings were used on their campus to advertise STEMTEC courses and the teaching scholars program. One coordinator stated that faculty were supposed to describe STEMTEC on their course syllabi, if the course were a STEMTEC course. One coordinator defined a STEMTEC course as "official" when a final report was submitted for the course.

Two coordinators indicated that STEMTEC students were not identified on their campus. However, three coordinators stated that the teaching scholars were "the STEMTEC students." One coordinator stated that they would like to define a STEMTEC student as someone in the teaching scholars program or who has taken three or more STEMTEC courses.

One coordinator commented that it may not make sense to identify courses or faculty with a STEMTEC designation because it may create an "us" versus "them" mentality (e.g., STEMTEC faculty have special status or STEMTEC courses are better than other courses).

<u>What evidence do you have that any of the changes begun by STEMTEC will continue?</u>

Five of the eight coordinators believe that the effect of STEMTEC on science and math teaching practices will endure. They described STEMTEC's efforts in reinvigorating the science and math curricula as a success and stated that the faculty who participated in STEMTEC will not "go back to their old ways." One coordinator mentioned that STEMTEC courses are becoming entrenched and that the STEMTEC ideas are spreading to non-STEMTEC courses.

Two coordinators expressed the hope that the teaching scholars program would continue based on funding from another source, perhaps within their campus. Other enduring features mentioned by at least one coordinator were teaching equipment, collegial links and co-sponsored activities such as women in science, on-campus gatherings such as biweekly lunches, more performance assessment within the classrooms, the idea that teaching is a profession within math and science, and K-12 teaching connections. One respondent commented that K-12 teaching components will be incorporated into future grant proposals. Another coordinator commented that the teaching certification option on their campus would continue.

<u>What has been the overall impact of STEMTEC on your campus?</u>

Similar to the responses to earlier questions, the effect of STEMTEC on science and math teaching was the most popular positive impact reported by the coordinators. Five coordinators reported that STEMTEC transformed science and math teaching on their campus to facilitate student-active learning. In addition, two coordinators credited STEMTEC with forming enduring links with K-12 schools. Other positive benefits of STEMTEC that were mentioned were shifting of attitudes to the idea of teaching as being a valuable profession, opening dialogue among the math and science faculty at the five colleges, and providing rewarding professional development for faculty. A comment from one coordinator provides a succinct summary of the respondents' comments to this question: "There is increased awareness and dialogue that teaching style and pedagogy matters, just as research matters. That will be the lasting legacy of

STEMTEC." It is interesting to note that no negative effects of STEMTEC were mentioned by any of the coordinators.

Discussion

As expected, the campus coordinator interviews revealed many positive aspects of STEMTEC as well as some of its limitations. On the positive side, STEMTEC's goal to "redesign the science and math curricula on the campuses of the Collaborative to incorporate new pedagogies and establish mechanisms for supporting faculty in their course redesign" appears to have been achieved. There was strong consensus among the coordinators that STEMTEC faculty learned important teaching techniques that facilitate student-active learning, and that these techniques are successfully being applied in the classroom. Another positive finding was that K-12 teaching experiences were provided to college students and appear to have turned many of these students on to teaching. There was less consensus regarding the establishment of cross-campus dialogue, but some of the coordinators thought some academic networking occurred and that it would continue beyond STEMTEC.

There were two areas of weakness identified by the coordinators. The first was STEMTEC's inability to address the minority aspect of the goal "Recruit and retain promising students into the (math and science) teaching profession, with special attention to underrepresented groups." Seven of the eight coordinators felt STEMTEC could be doing more to recruit underrepresented minorities. The eighth coordinator admitted a lack of progress in this area, but thought STEMTEC was doing as much as it could to recruit minorities. The second area of weakness was building collegiality among the faculty at different campuses. It appears that the summer institutes held during the first two years worked well in this regard, but there was nothing to sustain it. Should further funding be secured for STEMTEC, building a minority recruitment program and running annual summer workshops appear to be two important activities.

The coordinators also had several other suggestions for improving STEMTEC. These ideas included involving the Deans at the different campuses from the start, create a standardized attendance sheet for all STEMTEC activities, teach faculty how to assess their own teaching, and listen more closely to the feedback provided by faculty.

STEMTEC Faculty Survey

Mary L. Zanetti and Stephen G. Sireci

Introduction

A survey of all STEMTEC faculty was conducted in May 2001. The purposes of the survey were to gather the impressions of STEMTEC faculty regarding the strengths and weaknesses of the program and to determine the effects of STEMTEC on classroom instructional practices. The data gathered through this survey address the following evaluation questions:

> Has STEMTEC facilitated the redesign of science and math curricula on the campuses of the Collaborative?
>
> Has STEMTEC facilitated the incorporation of new pedagogies on the campuses?
>
> Has STEMTEC established mechanisms for supporting new faculty in their course redesign?
>
> Has STEMTEC improved the preparation of K-12 math and science teachers?
>
> Has STEMTEC effectively supported K-12 math and science teachers?
>
> Is the Collaborative fully implemented?
>
> Is the Collaborative running efficiently?
>
> What are the strengths and weaknesses of the STEMTEC program?
>
> What improvements can be made?

A copy of the faculty survey appears in Appendix D.

Method

Procedure

All STEMTEC faculty were mailed a survey along with a cover letter explaining its purpose. There was no space on the form for faculty to put their name and so all survey responses were anonymous. The survey was initially mailed in early May 2001. Two follow-up mailings were conducted in late May and early June.

Participants

Seventy-two surveys were sent out and 28 were returned yielding a response rate of about 39%. It was disappointing that the response rate was this low as we hoped to get all faculty to participate. The time of year may have contributed to the low response rate.

Fifty-nine percent of the responding faculty were male and 41% were female. Seventy percent were full professors, 19% were associate professors, two (7%) were assistant professors, and 1 was a lecturer. Unfortunately, data regarding institutional affiliation and department were mistakenly omitted from the survey. However, some faculty from all eight campuses responded.

Survey Instrument

The survey contained 66 items, 10 of which were open-ended. The rest were selected-response items following the Likert format (see Appendix X?), so that the survey could be filled out quickly. Some items were borrowed from evaluation instruments used by the researchers at the University of Minnesota working for the Core Evaluation of the Collaboratives for Excellence in Teacher Preparation (CETP) program. In addition to the demographic information described above, faculty were asked to rate STEMTEC on a number of criteria such as support for redesign of courses, providing evaluative feedback, and general strengths and weaknesses of the program. Faculty were also asked about the degree to which they applied STEMTEC teaching practices to their classes, the types of assessments used in their classes, their connections with K-12 schools, and the degree to which they talked about and encouraged teaching as a career.

Results

Perceptions of STEMTEC Support

Faculty were asked six questions about the degree to which STEMTEC supported their reformed teaching activities. A summary of the responses to these questions are summarized in Table 1. The responses were generally very positive. With respect to STEMTEC support for course redesign and networking with colleagues, all of the faculty responded "acceptable" or better, with 85% responding that the support offered for course redesign and development was "very good" (the highest possible rating). The program was rated lowest on the criterion of providing evaluative feedback. Over 20% of the respondents felt STEMTEC was "poor" or "very poor" on this activity, and only 37.5% rated STEMTEC as "good" or "very good."

Application of STEMTEC Pedagogy

Faculty were also asked about specific STEMTEC teaching practices and the extent to which they applied them in class. First, faculty were asked "To what extent do you apply teaching and assessment practices advocated by STEMTEC *in your STEMTEC-affiliated classes*? The response scale ranged from "not at all" to "to a great extent." Sixty-three percent of the faculty responded "to a great extent" and 37% responded "somewhat." Faculty were then asked "To what extent do you apply teaching and assessment practices advocated by STEMTEC in your other *classes that are not affiliated with STEMTEC*?" Forty-four percent responded "to a great extent" and 56% responded "somewhat." Next, faculty were asked about the *number* of courses in which they were applying STEMTEC pedagogy, in addition to those for which they received STEMTEC funding. Responses to this question ranged from 1 to 4, with a mean of 2.75.

Faculty were also asked "to what extent have STEMTEC practices had an effect on the teaching methods *used by other faculty in your department that are not affiliated with STEMTEC*?" Only 14% responded "to a great extent," while 57% responded "somewhat," 25% responded "very little," and 4% responded "not at all."

Table 1

Summary of Responses to Selected-Response Questions Regarding Faculty Support

How do you rate the:	% Very Good	% Good	% Acceptable	% Poor	% Very Poor
support offered by STEMTEC for course redesign and development?	85.2	14.8			
the ongoing course support offered by STEMTEC?	50.0	37.5	12.5		
STEMTEC's mechanisms for networking with colleagues?	33.3	55.6	11.1		
the Roundtable talks organized by the STEMTEC staff?	40.9	45.5	9.1	4.5	
mechanism for information dissemination established by the STEMTEC program?	34.6	53.8	7.7	3.8	
evaluative feedback you have received from STEMTEC?	12.5	25.0	41.7	16.7	4.2

In addition to these general questions, faculty were presented with a list of 25 teaching strategies and classroom activities. They were asked to consider how often they used each strategy/activity before and after becoming involved with STEMTEC. A summary of their responses to these questions appears in Table 2.

The faculty responses overwhelmingly supported the notion that STEMTEC has facilitated student-active learning. For example, 85% of the respondents indicated they have students work in pairs or small groups since becoming involved with STEMTEC. Other examples of STEMTEC's effect on teaching practices were noted in the areas of in-class problem solving, whole-class discussions, and hand-on activities, where 78.6%, 70.4%, and 60.7% of the respondents, respectively, indicated they use these practices more now relative to before they become involved with STEMTEC.

The influence of STEMTEC pedagogy was also evident in several other areas such as allowing students an opportunity to give faculty feedback, using technology in the classroom, and performing activities that include data collection and analysis. For each of these activities, at least half of the respondents indicated they used them more after becoming involved with STEMTEC. The faculty responses also indicated that just over half the faculty now talk about teaching as a career. Virtually none of the activities associated with the STEMTEC teaching philosophy were used more before the faculty became involved with STEMTEC. However, many of the responding faculty indicated there was no difference on many of these activities before and after STEMTEC. For example, only 35.7% indicated they collaborate more now with

K-12 teachers, and only 25% reported that they now do more work on problems related to real world or practical issues. It is possible that many of the respondents were also doing these things before becoming involved with STEMTEC and so the opportunity for improvement was small.

Table 2

Summary of Responses to STEMTEC Teaching Strategies and Classroom Activities

How often did/do students:	**% Used More Before STEMTEC**	**% No Difference**	**% Use More After STEMTEC**
Work in pairs or small groups?		14.8	85.2
Work on in-class problem solving?		21.4	78.6
Participate in whole-class discussions during which the teacher talks less than the students?		29.6	70.4
Participate in hands-on activities?		39.3	60.7
Have an opportunity to provide you with feedback?		42.9	57.1
Hear you speak about teaching as a career?		42.9	57.1
Use technology (e.g., computers) in class?	3.7	44.4	51.9
Perform investigative activities that include data collection, analysis, and various types of representation?		50.0	50.0
Have a voice in decisions about course activities?		55.6	44.4
Discuss learning and/or teaching strategies and approaches?		55.6	44.4
Work with other students where the whole group gets one grade?		55.6	42.9
Design and make presentations that help them learn class concepts?		59.3	40.7
Write descriptions of their reasoning?		63.0	37.0
Collaborate with K-12 teachers and/or students?		64.3	35.7
Evaluate the extent of their own learning?		64.3	35.7
Complete assessments or assignments that include problems with complex solutions?		64.3	35.7
Have the opportunity to ask questions in class?		67.9	32.1
Work on problems related to real world or practical issues?		71.4	25.0
Have opportunities to work on long-term projects?		75.0	25.0
Make connections to other science, mathematics, and technology (SMT) fields?		78.6	21.4
Complete assessments or assignments that include multiple choice/short answer items?	22.2	59.3	18.5
Make connections to other non-SMT fields?		82.1	17.9
Complete assessments or assignments that include portfolios?		84.6	15.4
Teach a portion of the course?		85.2	14.8
Complete assessments or assignments that include full-length papers?	3.7	96.3	

Other STEMTEC Activities

STEMTEC faculty were also asked several questions about their STEMTEC activities outside of the classroom. When asked "Would you like to have more opportunities to be involved with STEMTEC during the academic year?" 67% responded "no." Similarly, when asked "Would you like to have more opportunities to be involved with STEMTEC during the summer months?" only 30% answered "yes." These somewhat negative responses probably reflect the hectic schedules of STEMTEC faculty.

Faculty were also asked about their involvement with K-12 educators. First, they were asked "In your STEMTEC courses, about how often per term do you collaborate with K-12 teachers?" Response options were "never," "seldom," "sometimes" and "often." Seventy-five percent responded "seldom" or "never," and only 11% responded "often." Next, they were asked "In your STEMTEC courses, about how often per term do your students collaborate with K-12 teachers?" Using this same scale, 63% responded "seldom" or "never," 26% responded "sometimes" and 11% responded "often." Finally, faculty were asked "In your STEMTEC courses, about how many times per term do you provide students with information about teaching in grades K-12?" Only 4% responded "never," 43% responded "seldom," 32% responded "sometimes" and 21% responded "often." It appears that there is great diversity with respect to the extent to which STEMTEC faculty interact with K-12 classes.

Assessing Student Work

STEMTEC suggested teaching strategies encourage faculty to assess students' work using more performance-based measures such as tests with constructed-response items and portfolios. Faculty were presented with a list of ten assessment strategies and were asked to indicate the percentages of their students' grades that were associated with each type of assessment. The results to this inquiry are presented in Table 3. Although multiple-choice assessments are the most convenient forms of assessment for faculty (e.g., they are easy to score), non-multiple choice exams or quizzes were the most popular form of assessment, accounting for about 20% of students' grade on average. Multiple-choice assessments were the second most common form of assessment, accounting for about 13% of students' final grades. Other performance-based assessment measures are being used by these faculty, including homework assignments (11% of final grade), essays (11%), group projects (10%), lab assignments (10%), class participation (9%), and in-class projects (8%).

When asked directly about the percentages of total points on their examinations that are allocated to multiple-choice and constructed-response items, on average, the respondents indicated 21% were allocated to multiple-choice items and 51% were allocated to constructed-response items. When asked "To what extent are student assessments used to modify what is taught?" the average response on a four-point scae ranging from "not at all" to "a great extent" was "somewhat."

Table 3

Use of Selected Assessment Strategies

Assessment Technique	Average Percent of Final Grade
Non-multiple-choice exams or quizzes	20.56
Multiple-choice exams or quizzes	13.02
Homework assignments	11.11
Essays or other papers	10.75
Group projects	9.91
Laboratory reports	9.87
Class participation	8.79
In-class presentations	8.43
Attendance	5.35
Journals	1.38
Other ___________________	0.83

Analyses of Responses to Open-Ended Questions

To allow faculty to comment on any aspects of the STEMTEC program, seven extended, open-ended questions were included on the survey. These questions inquired about the strengths and weaknesses of STEMTEC, suggestions for improvement, K-12 teaching opportunities provided to students, and non-STEMTEC sources of funding for course redesign. Content analyses were performed on these questions by first reviewing all of the responses to each question, and then deriving themes for each question. Themes were derived by discovering similar comments made by more than one respondent. Once themes were identified, the number of respondents mentioning each theme was calculated. Almost all of the participating faculty responded to at least three of the seven open-ended questions.

Strengths of STEMTEC

The first of the open-ended questions asked "in general, what do you think are the STRENGTHS of STEMTEC?" One major theme and two minor themes emerged from the content analysis of this question (see Table 4). Seventy-five percent of the twenty-eight respondents cited learning new teaching techniques as a strength of STEMTEC. Regarding the two minor themes, approximately half of the respondents indicated that collaboration with K-12 and/or higher education colleagues including positive workshop experiences was a real benefit and a handful of respondents stated financial support for course development or increased scholarship opportunities for students were also strengths of the program.

Table 4. Strengths of STEMTEC

Strengths	% Respondents (n=28)
Learning new teaching techniques	75
K-12 and higher education collaboration	39
Financial support for course development/modification and scholarship opportunities for students	25

Faculty respondents described a wide range of individual teaching techniques that they incorporated into course instruction due to their involvement in the program. Many professors mentioned that the STEMTEC program brought faculty together to discuss teaching strategies and mechanisms for interactive teaching and learning techniques. For instance, one respondent wrote, "…made me think more about how I teach and how students learn." In addition, another survey respondent stated "…an opportunity to hear from instructors who have tried and evaluated different [instructional] approaches." Many other faculty members mentioned specific classroom instructional techniques that improved student motivation and learning; such as in-class problem-solving, class talk, group projects, and the use of assessment as a classroom tool to improve teaching and learning. One instructor wrote "…source of ideas and strategies to support active, motivated students." In other words, the program assisted instructors in thinking about alternate ways of teaching, which often resulted in cross-disciplinary teaching ideas. Another instructor wrote "in summary, STEMTEC has made a major impact on the development of courses, and the way they are taught at [this institution]."

Eleven of the twenty-eight survey respondents indicated that having the opportunity to work with K-12 and/or higher education colleagues was a strength of the STEMTEC program. They reflected on how they benefited from the sharing of ideas with other teachers in their respective fields. The respondents also tended to indicate that the program greatly increased dialogue among faculty members. The program's various workshops were regularly portrayed in a positive light.

A handful of faculty members were grateful for STEMTEC funding, which allowed them to purchase teaching materials supporting course development or course modification, such as computer software. A few respondents also indicated that another strength of the program was its scholarship opportunities offered to students that they felt encouraged students to teach.

Weaknesses of STEMTEC

The second open-ended question inquired about the weaknesses of the STEMTEC program. Although a major theme (i.e., a majority of respondents making the same comment) did not emerge, two minor themes emerged with only five and eight respondents in each of the two categories, respectively, as well as several other comments made by one or two respondents.

Approximately one-quarter of the survey respondents (8) indicated that on going or continued discussions or relationships among participants were difficult. A respondent cited the geographical distance between participants as an issue. A few survey participants indicated that training workshops had too many broad or non-specific topics that were supposed to be applicable to many disciplines. For instance, one faculty member wrote, "too much of what went on was not applicable to mathematics classes." Still another wrote "some of the small-group sessions during the summer workshop…[involved] silly, pointless activities." Regarding ongoing relationships, a few respondents wrote about the time and effort needed to set up partnerships with K-12 teachers. This issue related to the institutionalization of the program at each of the eight campuses. One faculty member wrote, "… this should be a permanent university function."

Slightly less than one-quarter of the respondents indicated that the program's annual evaluation process was a weakness. Lack of feedback and timeliness regarding requests for student or faculty survey participation was an issue. More specifically, a survey respondent indicated "feedback to faculty has been very slow after participation in surveys and/or class evaluations." Another respondent wrote "the frequent requests to participate in survey processes seemed never-ending."

Several respondents also mentioned other aspects of the program that they thought were weaknesses. Two participants mentioned the need for more follow-up workshops during the summer months. Another two faculty members indicated STEMTEC should develop incentives to involve faculty who are not already participants in the program. Two other respondents mentioned available faculty time is unfortunately "a zero-sum game"; one of the two wrote "I do not have the opportunity to take advantage of all that STEMTEC has to offer due to time constraints", while the other wrote "…STEMTEC does not seem to be very sensitive to this fact."

Advice for improving STEMTEC

Sixteen of the twenty-eight participants offered advice about improving the STEMTEC program. Eleven respondents indicated that a continuation or increase in meetings, roundtable discussions, or professional development workshops would be beneficial to program participants. Specific discussion topics were suggested, such as help with new technologies, joint grant writing between participants, and new innovative teaching techniques. Respondents offered many suggestions regarding the setting for these discussions including weekday dinner meetings, Saturday workshops, or professional development workshops at different campuses (with one faculty member stating workshops should be for all faculty, not just those who have been through the program). Three more respondents stated the program could be more organized; one of the three wrote, "this project consumed a huge amount of paper and materials tended to get lost." She went on to suggest using the STEMTEC website for the completion of future surveys, but the website would have to be improved first because it is exceedingly slow.

Approaches used to encourage students to consider teaching as a career

The next two open-ended questions related to the manner in which STEMTEC faculty provide students with information about teaching grades K-12. The first question asked "If you have provided students with information about teaching grades K-12, please describe your approach to encouraging students to consider teaching grades K-12 as a career" and the second question asked "If not, please describe briefly why you chose not to provide information or encourage teaching as a career." Approximately three-quarters of the respondents answered the first question and a quarter of the participants responded to the second.

Fifteen out of the twenty-three respondents mentioned teaching as a career on several occasions during the semester. One respondent wrote, "I mention the career path option, the need for *good* teachers, and I mention STEMTEC as a way to pursue this option." Another faculty member stated, "I mostly talk about how teaching, especially K-12, is so satisfying because it's a chance to interact with kids over intellectual matters and open them to the joys of questioning and learning, in contrast to the joys of making money." In addition, many of the respondents indicated they mentioned specific STEMTEC lectures, scholarship programs, and workshops available to students who are interested in teaching as a career.

A small group of participants (8) developed creative ways to introduce teaching as a potential career. For instance, one instructor required students to teach in a K-12 classroom as part of the course requirements. These students were then required to write about the experience by responding to leading questions about their attitudes towards teaching. Another creative example was offering a one credit independent study to those students who were interested in the opportunity to try teaching. Another faculty member invited K-12 teachers into the classroom during the semester. One professor described how he brought college students into an eighth grade classroom where the Middle School teacher was an outstanding role model for the visiting students. Still others outlined small group discussions, in class debates, academic advising, projects with K-12 teachers, and informal one on one discussion as ways that teaching as a career is mentioned and/or encouraged.

Regarding the seven respondents who indicated they had not mentioned teaching as a potential career, the majority (5) indicated that their students had made it clear they were not interested in teaching as a career. One respondent wrote, "engineering and hi-tech are (or at least were) too enticing." Another wrote, "if I find very few students interested in teaching, then I don't use precious class time." Still one more lamented, "the life of a school teacher continues to be less than desirable!" The remaining two professors responding to this question explained there was no time to devote to such matters due to very full syllabi. For instance, one of the two faculty members indicated, "the dynamics of the class-'field-focused'- (I feel if it is <u>not</u> introduced early in the course, it is too awkward later." In addition, the other respondent citing time as an issue wrote, "very full syllabi, typically due to departmental or service-related departmental constraints. There is not enough time to cover all important topics."

<u>STEMTEC support of making students aware of teaching as a career option</u>

Survey respondents were asked to comment on how the STEMTEC project staff might assist them in making students in their STEMTEC courses more aware of teaching as a career. Half of the respondents (n=14) commented on this issue. One major theme and two minor themes emerged from the content analysis of this open-ended question. A summary of these responses is presented in Table 5.

About half of the faculty who responded to this question indicated a handout on teaching as a career would be useful for this purpose. One professor wrote, "give an info-pack to all students." Another offered, "perhaps 'frequently' circulate fliers or memos that detail the steps an undergraduate can take to prepare for a K-12 teaching career." One more instructor explained, "it might be useful to have a handout (other than the Pre-Ed one). It could highlight the benefits of math/science teaching, etc.." Many of the respondents indicated the pamphlets should describe educational pathways at each of the colleges.

Table 5

Faculty Suggestions on how STEMTEC Can Help Promote Teaching as a Career

Suggestions	% of Respondents (n=14)
Provide handouts outlining benefits of teaching including education/certification requirements and scholarship opportunities	50
Offer support services and staff that will coordinate on-going K-12 collaboration	29
No changes needed	21

Twenty-nine percent of the fourteen respondents indicated that an increase in support services on behalf of STEMTEC project staff would be helpful. More specifically, many stated that they would welcome a STEMTEC representative into their classroom to discuss teaching as a career (e.g., practice teaching, teaching certification requirements). In addition, instructors suggested that STEMTEC staff establish and maintain K-12 collaboration because they cannot devote work-time to this issue. One professor wrote, "STEMTEC itself could organize general science experiences for college and K-12 kids. All would benefit." The idea of assisting in the establishment of a one-credit course that allows students to try teaching at each campus was suggested. Another respondent suggested opening up the STEMTEC scholars gatherings to others interested in math/science teaching. In addition, one professor offered this statement, "tell how pay is rising in K-12 teaching dramatically compared to pay in industry and business." Finally, twenty-one percent stated STEMTEC staff is adequately assisting them. In other words, no change in assistance is needed.

<u>Financial Support from Outside STEMTEC</u>

Eighty-nine percent of the faculty members (25) responded to the question that asked "in the past few years have you received money (or other resources such as released time) for course development or reform from a source other than STEMTEC?" Twelve respondents answered affirmatively with the remaining thirteen responding "no" to this question. Table 6 reflects all of the sources and the corresponding amount of money outlined by the respondents who answered the second part of the question requesting specific information about outside funding.

Table 6

Non-STEMTEC Funding Sources

Funding Source*	Dollar amount
HHML grant	$400/per year for one STEMTEC course
NSF Co-PI on CCLI grant	$300,000
Matching funds from on-campus foundation	$6,000
NSF CCLI Grant	$150,000
PEW Foundation	$200,000
NSF EIA MASS BHE CITI ECE Dept CFI, FGT	$500,000 $15,000 $10,000 $5,000
Hewlett Teaching Fellowship	$2,500
Course Technology Development	$1,200
Sabbatical leave plus a one course release equal to a replacement instructor (GCC Funds)	$15,000
NSF – ILI program with institutional match (dept provided two TA positions to help with development of new experiments) American Chemical Society (with dept match)	$120,000 ($60, 000 each) $40,000 ($20,000 each)
Physics dept Community Service Learning program	$500 $2,000
University Space Research Association (USRA), which is part of their Earth System Science Education (ESSE)	$50,000 over a 2-yr period
Distinguished teaching professorship	$3,000

* Funding source is broken down by participant response (3 participants outlined multiple funding sources).

Discussion

The responses from faculty regarding their impressions of STEMTEC were illuminating regarding the strengths and weaknesses of the program. On the positive side, there was a strong consensus that STEMTEC facilitated course redesign/reform and supported faculty in these endeavors. It also appears that STEMTEC faculty were applying STEMTEC pedagogy in their classes, including more student-active learning and more varied forms of assessment. In general, the faculty were also positive about the K-12 connections made possible through STEMTEC.

Very few negative aspects of the program were mentioned by the respondents. Some faculty commented that more dialogue among colleagues was needed. Others commented about the lack of feedback they received, particularly from prior STEMTEC surveys they completed. In general, however, these respondents seemed pleased with STEMTEC activities and support.

Although the general consensus regarding STEMTEC seemed positive, the respondents had several excellent suggestions for improving STEMTEC. One suggestion was to increase the number of roundtables and other professional development activities. Another suggestion was to reduce the amount of paperwork required of faculty to participate in the program. With respect to improving students' awareness of teaching as a career, several respondents suggested the development of handouts and other material for teachers to distribute in their classes, as well as a visit from STEMTEC staff to their classroom to discuss this topic. It was also mentioned that the K-12 teaching experiences should be coordinated by the STEMTEC central office, since faculty often did not have time for this coordination.

Although the response rate for this survey was lower than desirable, the participating faculty provided important information regarding the functioning of STEMTEC. STEMTEC should follow-up on the suggestions provided by these faculty and be proud of the positive benefits it is having on math and science instruction.

STEMTEC Classroom Observations For Spring 2001

Joseph B. Berger

STEMTEC Classroom Observation For Spring 2001

Introduction

Classroom observations were conducted in 15 postsecondary science and math classes during the 2001 spring semester. The purpose of the classroom observations was to assess and document the extent to which reformed teaching[1] practices are occurring in science and math classes at postsecondary institutions participating in the STEMTEC project. This type of assessment informed the following research questions that are key components of the annual evaluation:

1. What reformed teaching practices and strategies have actually been incorporated into classroom instruction?
2. To what extent are students being engaged in the classroom?
3. How effective is classroom instruction in promoting higher levels of classroom-based cognitive activity?

More specifically, the classroom observations focused on the collection of the following types of information:

- Classroom context and demographics;
- Purpose of classroom lessons and associated pedagogical techniques;
- Documentation of teaching strategies and activities used by the instructor to fulfill the purpose of the lesson.

A slightly modified version of the Classroom Observation Protocol (COP) was used to measure and assess the presence of reformed teaching in STEMTEC courses. The original version of the COP was developed by a team of researchers at the University of Minnesota working for the Core Evaluation of the Collaboratives for Excellence in Teacher Preparation (CETP) program. The research plan for the classroom observation component of the 2000-2001 evaluation of STEMTEC is more thoroughly described in the next section.

Method

Instrument Selection

Previous evaluation efforts of STEMTEC have incorporated classroom observations. However, the degree to which those observations were systematic is unknown. For example, there is no indication that the observation protocols used in those evaluation efforts were explicitly derived from standardized instruments, nor is there evidence that they were appropriately field-tested prior to use. Given the need to use an established observation protocol for this phase of the 2000-2001 STEMTEC evaluation, a number of options were considered.

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[1] Reformed teaching has been defined in accordance to the guidelines established by the Core Evaluation of CETP at the University of Minnesota. As such, reformed teaching includes classroom practices that use active learning techniques and instructional strategies that facilitate high levels of cognitive activity among students as engaged learners.

Three potential observation protocols were considered for use in this evaluation. The research team conducted a review of literature and solicited feedback from numerous sources – including STEMTEC campus coordinators, the CETP Core Evaluation team at the University of Minnesota, and National Visiting Committee members. A variety of classroom observation instruments were identified as a result of these investigations. After considering several options, the Classroom Observation Protocol (COP) was chosen for use in this project over other approaches. Some of the other options considered were (a) the development of our own protocol, (b) the use of protocols used in previous STEMTEC evaluations, (c) the Reformed Teaching Observation Protocol (RTOP) developed by the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT), (d) the Local Systemic Change Revised Classroom Observation Protocol developed by Horizon Research, and (e) the inquiry-oriented classroom observation developed by Neil Stillings and his colleagues at Hampshire College.

The COP was selected for use in this evaluation for a number of reasons. First, it is the classroom observation instrument that has been developed and supported by the CETP Core Evaluation team. By using the CETP Core instruments, STEMTEC may eventually be able to compare results from this evaluation with the results from other CETP programs. Using the core instrument will also enable STEMTEC to provide data to the Core Evaluation team as they work to document the effects of the larger CETP program as a whole. Second, the COP draws heavily from other established classroom observation protocols, which increases the reliability and validity of the instrument in comparison with locally developed protocols. Third, the COP focuses on a wide range of recognized reformed instructional practices and allows for the identification of what is happening in the classroom during specific time intervals – both of these features are preferred by NSF in assessments of classroom observations according to the Core Evaluation team at the University of Minnesota. Finally, excellent training materials for the COP were available from the Core Evaluation team and one of the evaluation team members (Joe Berger) received training at the University of Minnesota in the use of the COP.

The potentially subjective nature of classroom observation makes it imperative that observers are comprehensively trained to consistently and appropriately use the observation protocol in a manner that produces reliable and valid results. Therefore, it is extremely important in any rigorous and methodologically sound classroom observation plan that classroom observations be conducted by qualified and well-trained observers. The training materials available from the CETP Core Evaluators facilitated effective and efficient training of observers for this phase of the STEMTEC evaluation.

During the training period, the evaluation team also worked with and assessed the COP with regards to its appropriateness for its specific use in evaluating STEMTEC courses. During the training and assessment stages it was determined by the research team that a few changes needed to be made to the COP. The changes include:

- First, the classroom checklist form was modified and re-formatted to make it easier to mark classroom activities as they occurred during the observation.

- Second, item 11 in the rating of key indicators section was split into two separate items (one asking if appropriate connections were made to other areas of mathematics/science and/or to other disciplines and a second item asking if appropriate connections were made to real-world contexts, social issues, and global concerns) in order to avoid the double-barrel nature of the original item.

- Third, greater specificity was added to the definition of ratings given to items 13-15 in the rating of key indicators section. These three items focus on effectiveness and are rated on a scale of 1 to 5, but no definitions were provided in the COP about what meaning should be attached to each score. Therefore, it was decided that a score of one indicated “no effect”, while a score of five indicated “very effective.”

- Fourth, the evaluation team decided not to use the final section of the COP that focuses on assessing the overall quality of instruction. The decision not to use this section was made because the research team felt that the evaluation teaching quality based on a observation of a single class meeting was inappropriate and beyond the scope of the intended evaluation. The classroom observation component of the 2000-2001 STEMTEC evaluation is meant to provide a descriptive overview of what is occurring in a sample of STEMTEC classrooms; it is not designed to critique and evaluate the instructors.

A copy of the revised version of the COP that was used in this evaluation is included in Appendix E. Briefly, the revised COP consists of five components. The five components include a description of background information about the class and the instructor, a description of the classroom demographics, a description of the physical environment of the class, a description of the purpose of that particular class, and a rating of key indicators of reformed teaching strategies.

Sampling and Collection Procedures

Initially, fifteen classes were selected for observation during the spring semester of the 2000-2001 academic year. Ultimately, eleven of these observations were completed. Observations occurred between the dates of April 26, and May 8, 2001. The observations were completed by three members of the evaluation team, all of whom were trained in advance on use of the (revised) COP. The courses were identified from a list of courses that were certified as STEMTEC courses by the STEMTEC coordinating office. All observations were conducted after an initial contact had been made with the course instructor by the observers and permission had been given by the instructors for their classes to be observed.

Results

Description of the Sample

Data were collected from a total of eleven classrooms. All of the instructors were identified as STEMTEC instructors.[1] Four of the observations took place at the University of Massachusetts Amherst (UMass), two each occurred at Greenfield Community College (GCC)

[1] STEMTEC instructors are defined as anyone who has taken part in one of the conferences and any faculty who have revised a course due to contact with existing STEMTEC faculty (Marie Silver, personal communication).

and Springfield Technical Community College (STCC), and one each at Amherst College, Mount Holyoke College, and Holyoke Community College (HCC). Seven of the courses were biology classes, one was a physics course, one was an astronomy course, one was a chemistry course and the final observation occurred in a geology course. One of the courses was a lab section. The courses ranged in enrollment from 4 students to 314 students with an average enrollment across the eleven classes of 73.91. Six of the courses were primarily intended for students fulfilling liberal arts/general education requirements, four of the classes were targeted to science and math majors, three of the courses focused on prospective teachers, one course was designed for both science/math students and for teacher education students, and one course included students in teacher education and students fulfilling general education/liberal arts requirements. The classes ranged in time from 55 minutes to two hours. Table 1 summarizes the description of the observed classes.

The instructors of the observed classes reflected a wide range of professional diversity. Of the eleven instructors, four of them were full professors, five of them were associate professors, and two of them were assistant professors. The length of the academic careers of the observed instructors (of those who provided such information) ranged from eight to thirty-one years. Four of the instructors had been involved with STEMTEC for two years, four of them had been involved for three years, and the other three had been involved with STEMTEC for four years. There was excellent sex balance in the sample as six of the observed instructors were female and five were male. Table 2 summarizes the relevant demographic characteristics of the observed instructors.

Table 1

Description of Classroom Sample

Campus	Discipline	Type of Student	Enrollment	Time Period	Lab Class (Yes/No)
UMass	Biology	Liberal Arts/General Education	26	1 hr. 15 min.	No
UMass	Biology	Liberal Arts/General Education	301	1 hr. 15 min.	No
UMass	Physics	Math/Science Majors	4	1 hr. 15 min.	No
UMass	Geology	Liberal Arts/General Education	22	50 min.	Yes
GCC	Chemistry	Liberal Arts/General Education	25	50 min.	No
GCC	Biology	Prospective Teachers/ Math/Science Majors	46	1 hr. 15 min.	No
STCC	Biology	Prospective Teachers/ Liberal Arts/General Education	26	1 hr.	No
STCC	Biology	Math/Science Majors	19	50 min.	No
Amherst College	Astronomy	Liberal Arts/General Education	76	50 min.	No
HCC	Biology	Prospective Teachers	10	1 hr. 15 min.	No
Mt. Holyoke College	Biology	Math/Science Majors	64	1 hr. 15 min.	No

Table 2

Demographic Characteristics of Instructors

Sex	Academic Rank	Instructional Experience	STEMTEC Involvement
Female	Professor	??	2 yrs.
Female	Associate Professor	11 yrs.	2 yrs.
Female	Assistant Professor	15 yrs.	3 yrs.
Male	Assistant Professor	8 yrs.	3 yrs.
Male	Professor	31 yrs.	4 yrs.
Male	Professor	20 years	2 yrs.
Female	Associate Professor	20 yrs.	4 yrs.
Female	Associate Professor	??	2 yrs.
Male	Professor	32 yrs.	3 yrs.
Female	Associate Professor	9 yrs.	3 yrs.

Summary of Observed Classroom Activities

A wide range of teaching practices and instructional activities were observed in the eleven classrooms. These activities were recorded in five-minute intervals during the observed classes. Observers focused on the instructional activities that were directed toward the students in the classes or the activities in which the students themselves were engaged during the class period. The version of the COP used in these evaluations included 17 categories of instructional activities and strategies. The list of instructional activities[1] is summarized in Table 3.

[1] Complete definitions of these activities can be found in the COP Training Manual.

Table 3

Categories of Instructional Activities

L	lecture/presentation
LWD	lecture with discussion
CD	class discussion
HOA	hands-on activity/materials
SGD	small group discussion
LC	learning center/station
TIS	teacher/instructor interacting w/ student
CL	coop learning (roles)
WW	writing work (if in groups, add SGD)
RSW	reading seat work (if in groups, add SGD)
PM	problem modeling
D	Demonstration
SP	student presentation
UT	utilizing digital educational media and/or technology
AD	administrative tasks
I	Interruption
A	Assessment
Other	

Table 4 summarizes the frequency with which each of the instructional activities were observed to occur in each of the classes. Thirteen of the 17 activities were observed in at least one of the classes. The most prevalent observed activity was lecturing, which was observed in 10 of the 11 classroom observations and occurred in approximately 48% of the five-minute segments. Lecture with discussion occurred in seven of the classes about 23% of the time. Administrative tasks were also conducted in most classes (8 of 11), but very little total class time was spent on such activities. Small group discussions and teacher interacting with students both occurred in almost half of the observed classes (5 of 11), but slightly more overall time was devoted to small group discussions (18%) than was devoted to teacher interacting with students (16.5%). Technology was utilized as an enhanced classroom activity in four of the classes and was used in almost 13% of the five-minute time segments that served as the unit of analysis for instructional activity within each class. Writing work was observed to occur at a similar rate (12% overall in a total of 3 classes). Assessment also occurred in three classes, taking nine percent of the class time counted in these observations. Hands on activity was also observed nine percent of the time, but was only used in two of the classes. None of the other activities were observed frequently.

Table 4

Summary of Observed Instructional Activities

Activity Code	Activity	Number of Classes in Which Activity was Observed	% of Time in Which Activity was Observed[1]
L	lecture/presentation	10	48.1%
LWD	lecture with discussion	7	23.3%
SGD	small group discussion	5	18.0%
TIS	teacher/instructor interacting w/ student	5	16.5%
UT	utilizing digital educational media and/or technology	4	12.8%
WW	writing work (if in groups, add SGD)	3	12.0%
HOA	hands-on activity/materials	2	9.0%
A	Assessment	3	9.0%
AD	administrative tasks	8	0.8%
LC	learning center/station	1	0.04%
CD	class discussion	1	0.02%
PM	problem modeling	1	0.01%
D	Demonstration	1	0.01%
I	Interruption	1	0.01%
RSW	reading seat work (if in groups, add SGD)	0	0%
CL	coop learning (roles)	0	0%
SP	student presentation	0	0%
Other		0	0%

Summary of Levels of Student Engagement

In addition to documenting the types of activities that were occurring in the classroom, the observers also recorded the levels of student engagement, which are summarized below in Table 5. Levels of engagement are defined by the percentage of students in the classroom who the observers believe are engaged in the task. If more than 80% of the students in the class were engaged in the task at hand during a five minute period, then they were defined as being highly engaged. If less than 20% of the students were engaged in the class during any five minute period, then a mark of low engagement was recorded by the observer. If the percentage of engaged students was between 20% and 80%, then students were coded as having medium levels of engagement. These observations are summarized in Table 5.

The observers found that students were highly engaged over eighty percent of the time. Medium levels of engagement were recorded only 12% of the time and low levels of engagement

[1] Percentages add up to more than 100% because activities could occur concurrently within a five-minute time segment.

were reported not to have occurred at all. It is worth noting that the vast majority of incidences of medium levels of engagement occurred in a large lecture hall with over 300 students in the class.

Table 5

Summary of Student Engagement

Level of Engagement	**% Time**
High	82.0%
Medium	12.0%
Low	0.0%
Don’t Know	6.0%

Summary of Cognitive Activity Levels

Evaluations were also made during the observations about the level of cognitive activity occurring in the classroom. Receipt of knowledge, defined by involvement in the rote reception of information (e.g. lectures, going over worksheets, questions, watching something, or homework), was most prevalent as it was observed to be occurring 81.2% of the time. Application of knowledge (e.g. doing worksheets, homework or practice problems similar to ones modeled in class, skill building, performance) was found to be occurring almost one quarter of the time. Knowledge representation, defined as occurring when students manipulate information (e.g. organizing, trying to make sense out of something, describing, categorizing), was observed just over 10% of the time. Knowledge construction, which occurs when students are creating new meaning (e.g. higher order thinking, generating, inventing, solving problems, revising, etc.), was virtually non-existent during the times these classes were observed. Table 6 summarizes the observations regarding levels of cognitive activity.

Table 6

Summary of Cognitive Activity Levels

Cognitive Activity	**% Time**
Receipt of Knowledge	81.2%
Application of Procedural Knowledge	24.8%
Knowledge Representation	10.5%
Knowledge Construction	0.01%

Summary of Ratings of Key Indicators

After observing what actually happened in the classroom, the observers also reflected upon and assessed how well the classes rated on a number of key indicators related to the broader goals of the CETP initiative. The rating of these indicators is summarized below in Table 7.

In general, key indicators were evaluated quite favorably by the observers. One a scale of one to five (where 1 = not at all and 5 = to a great extent for the first 12 items below; and 1 = no effect and 5 = very effective), all fifteen items had a mean score higher than three and nine of the items had an average score above four. The most highly rated item focused the extent to which the instructors displayed an understanding of the mathematics/science concepts with their students (m = 4.82). It was also encouraging to see that other highly rated indicators included the extent to which instructors were effective in increasing students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation and the extent to which instructors were able to make appropriate connections to real-world contexts, social issues, and global concerns (both items had a mean of 4.27). The lowest ratings, which still averaged in the above average range, focused on the extent to which students were reflective about their learning (m = 3.27) and the extent to which the classroom lesson encouraged students to seek and value alternative modes of investigation or problem solving.

Table 7

Summary of Ratings of Key Indicators

Item	Mean	S.D.	Range
1. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving	3.36	1.12	2-5
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so	3.73	1.19	1-5
3. Students were reflective about their learning	3.27	1.49	1-5
4. The lesson was designed to engage students as members of a learning community	4.00	1.26	2-5
5. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein	4.10	1.20	2-5
6. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/instructor and students	4.00	1.41	2-5
7. Intellectual rigor, constructive criticism, and the challenging of ideas were valued	4.18	0.98	2-5
8. The lesson promoted strongly coherent conceptual understanding	3.91	1.14	1-5
9. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence	3.64	1.21	2-5
10. The teacher/instructor displayed an understanding of mathematics/ science concepts (e.g., in his/her dialogue with students)	4.82	0.40	4-5
11. Appropriate connections were made to other areas of mathematics/ science and/or to other disciplines	3.56	1.51	1-5
12. Appropriate connections were made to real-world contexts, social issues, and global concerns	4.27	1.01	2-5
13. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation	4.27	0.90	3-5
14. Students' understanding of important mathematics/science concepts	4.09	1.04	2-5
15. Students' capacity to carry out their own inquiries	4.20	0.92	2-5

Discussion of Findings

This assessment is a descriptive snapshot of what kinds of instructional activities are being employed in the classrooms of STEMTEC instructors. The sample is small enough that caution should be used regarding the generalization of these findings across the STEMTEC program. However, the diversity of courses, students and instructors in the sample provides a good foundation for concluding with some general observations of the extent to which reformed instructional practices are being incorporated into classrooms by STEMTEC faculty. A descriptive summary of the observed classes shows that courses were covered across a number of science disciplines (although no math classes were observed) and five of the participating postsecondary institutions participating in STEMTEC were represented in the sample. The courses ranged in size from the very small to the quite large and included a variety of students – including science majors, education majors, and other students. Moreover, as demonstrated in Table 2, the instructors represent a diverse group in terms of professional experience and exposure to STEMTEC.

Beyond the basic description of what STEMTEC classes look like, the remainder of the discussion will be organized around addressing the three research questions listed at the beginning of this section.

What reformed teaching practices and strategies have actually been incorporated into classroom instruction?

Lecture, and lecture with discussion to a lesser extent, appears to remain the predominant form of classroom instruction in the STEMTEC courses observed as part of this evaluation. However, a variety of other techniques are being incorporated into many classes. Hands on activities, teacher interaction with students, small group discussions, and writing work were all observed being incorporated into classes in various ways. Some novel and effective means for utilizing educational technology were also observed in some classes.

The higher incidence of pure lecturing may be a function of the sample or it may be even more likely that it is a potential artifact from collecting the data late in the semester when faculty may have tended to revert to lecturing to cover more material as the end of the semester drew near. Future evaluations should incorporate observations throughout the semester to see if different instructional strategies and techniques are used at varying points in the semester.

Despite the high incidence of lecturing, the solid ratings of key indicators suggest that STEMTEC instructors are well prepared, engaging, and able to contextualize knowledge for students. Reform teaching is about more than merely incorporating certain techniques into the classroom, it is also about the attitude instructors bring into the classroom and their abilities to use the tools to engage students in learning. Taken together, the solid ratings among the key indicators suggest that STEMTEC teachers, even when relying somewhat heavily on lecture techniques, are engaged to some extent in reform teaching.

To what extent are students being engaged in the classroom?

Further evidence that STEMTEC courses are engaging in some level of reform teaching can be found in the high levels of student engagement that were observed in these classes. Overall, students were observed to be highly engaged over 80% of the time. This is surprising given that instructors were lecturing over eighty percent of the time. Additionally, medium levels of engagement were reported 12% of the time, and more importantly, there was no evidence of low engagement. Clearly, these STEMTEC courses and instructors are having success in engaging students with teaching and learning as it occurs in the classroom.

The high levels of engagement are encouraging and suggest that the actual counting of time spent on particular kinds of instructional activities (e.g., lecturing) may be less important than the ways in which instructors conduct such activities. It may also be that lecturing was less common earlier in the semester and the students have already been socialized to be highly engaged in these classes, even when the instructor utilizes traditional lecture methods. Again, additional observations at various points in a semester would be helpful in providing more insight on this important issue.

How effective is classroom instruction in promoting higher levels of classroom-based cognitive activity?

These observations suggest that students are largely receiving knowledge in these STEMTEC classes, rather than having opportunities engage in higher-level cognitive activities. It is likely that the heavy emphasis on lecturing contributes to the high frequency of time spent receiving knowledge by students rather than on applying, representing and creating knowledge. It is encouraging that students spent almost one quarter of their time applying knowledge. It is less encouraging that they spent only about one tenth of their class time engaged with knowledge representation and it is somewhat alarming that there was virtually no evidence of knowledge creation as a cognitive activity in these classes.

Conclusions

In sum, these classroom observations provide a good initial picture of what is happening inside STEMTEC classrooms. These observations are even more valuable when considered in light of other evidence collected in other parts of the STEMTEC evaluation. Additionally, a larger number of observations over different points in time as part of future evaluation activities should provide additional insights about the extent to which reform teaching is being effectively practiced in STEMTEC courses. It is unfortunate that classroom observations were not conducted at the beginning of the STEMTEC initiative as a baseline for determining how much instructional practices have changed over time. However, additional observations in the future may be helpful in detecting emerging trends toward greater use of reform teaching techniques in science and math courses.

The bottom line is that there appears to be too much emphasis on traditional lecturing and receipt of knowledge by students. On the other hand, students are highly engaged and instructors appear to be working hard to develop teaching styles that are more interactive and engaging for students.

Evaluation of the Teaching Scholars Program

Sharon Cadman Slater

Results of the Teaching Scholar Survey Administered May 2001

In each year of the STEMTEC project, the Student Program awards NSF scholarships to students interested in exploring the prospect of becoming a science and/or math teacher. These students, called Teaching Scholars, must be enrolled at one of the eight institutions associated with the STEMTEC Collaborative: Amherst College, Greenfield Community College, Hampshire College, Holyoke Community College, Mount Holyoke College, Smith College, Springfield Technical Community College, or the University of Massachusetts Amherst. Further, scholarship recipients agree to attend at least three events organized by STEMTEC, arrange to participate in a teaching experience, and submit a final report at the end of the academic year. The results presented in this paper summarize the information reported by students in the 2000-2001 Teaching Scholar Mandatory Final Report and Survey.

Method

In May 2001, a survey was mailed to fifty-nine of the 2000-2001 NSF Teaching Scholars. The goal of the survey was to gather information from the Teaching Scholars about their learning and teaching experiences over the academic year. The participants and the survey are described in more detail in the following sections.

Participants

Fifty-four of the 59 (92%) Teaching Scholars completed and returned surveys. The survey was conducted through the mail, and various follow-ups with the Teaching Scholars were made through email. Although the final report and survey are mandatory requirements of the scholarship, there are no repercussions for failing to complete the form, except perhaps to be denied renewal of the scholarship. Nonetheless, the majority of students did respond. The Teaching Scholars that responded to the survey represented all eight institutions involved in the Collaborative. However, nearly half of the participants were students from the University of Massachusetts Amherst. The participants were predominantly female and white, with only eight describing themselves as African American or Black, Asian, Hispanic or Latino/a, Multiracial, or Other. (More detailed demographics of the participants are presented in the Results section below.)

Description of Survey

The 2000-2001 Teaching Scholar Mandatory Final Report and Survey is presented in Appendix F. On the survey, Teaching Scholars supplied their names, permanent addresses and telephone numbers, and email addresses. Respondents were asked to indicate their ethnicity, their campus, expected graduation date, and teaching level interests. Questions on the survey were designed to gain information about the Teaching Scholars' interests in teaching and how they perceive their teaching skills. Of particular interest was how STEMTEC may have influenced their attitudes about teaching and their teaching skills.

Results

The results section first describes the demographics of the participants. Second, Teaching Scholar attitudes about teaching are discussed, including student interest in teaching and how they perceive their skills. Next the teaching experiences of the Scholars are described. Finally, the Scholars' impressions of the STEMTEC program are presented.

Demographics

As mentioned earlier, a total of 54 of the 59 Teaching Scholars responded to the survey, yielding a response rate of 92%. Non-participating Scholars came only from the University of Massachusetts (7) and Mount Holyoke College (1). The sample of students was predominantly female (72%) and Caucasian (83%). Ethnicity/Race information is presented in Table 1.

Table 1. Ethnicity/Race Categorization of the Teaching Scholars

Ethnicity or Race	Number of Respondents	Percent
Caucasian or White	45	83.3
Multiracial or Other	3	5.6
African American or Black	2	3.7
Hispanic or Latino/a	2	3.7
Asian	1	1.9
No Response	1	1.9

Nearly half of the students were enrolled at the University of Massachusetts Amherst (44%), but each of the eight institutions involved with the Collaborative was represented by at least one Teaching Scholar. There was also a mix of expected graduation dates, with the majority of students expecting to graduate in 2001 or 2002 (81%). Keep in mind that graduation dates could be for associate's, bachelor's, or master's degrees. Breakdowns of campus and graduation information are presented in Tables 2 and 3, respectively.

Table 2. Campus Affiliation of the Teaching Scholars

Campus	Total Number of Scholars	Number of Respondents	Percent
University of Massachusetts Amherst	31*	24	44.4
Hampshire College	7	7	13.0
Mount Holyoke College	8	7	13.0
Smith College	7	7	13.0
Holyoke Community College	5	5	9.3
Springfield Technical Community College	2	2	3.7
Amherst College	1	1	1.9
Greenfield Community College	1	1	1.9

*Three of these students were not included in the survey because they withdrew from the University during the academic year.

Table 3. Expected Graduation Dates of Teaching Scholars

Expected Graduation Date*	Number of Respondents	Percent
2001	22	40.7
2002	22	40.7
2003	8	14.8
2004	1	1.9
No Response	1	1.9

* Dates include May, August, and December graduations

Students graduating in May 2001 were asked to briefly describe their future plans, and in particular their plans related to teaching. Six of the students (11%) reported that they are planning on attending graduate school. The fields of study they will be pursuing include biology, environmental engineering, nutrition, physics education, special education, and law. Many of the students (14 or 26%) plan to teach at some point. Three (6%) specifically stated that they have secured teaching jobs, while eight (15%) are actively looking for teaching positions. Subject levels these graduating seniors would be interested in teaching were elementary teaching (5), biology (3), math (2), general science (2), chemistry (1), and physics (1).

Future Teaching Plans

All Teaching Scholars were asked to indicate the levels and subjects they were interested in teaching. High School teaching was the most popular choice, with 41 of the 54 (76%) students indicating an interest in teaching that level. Math was the most popular subject choice (21 or 39%). Tables 4 and 5 contain the information on interests in teaching level and subject, respectively.

Table 4. Teaching Levels of Interest to Teaching Scholars

Teaching Level	Number of Respondents	Percent*
High School	41	75.9
College	24	44.4
Middle School	20	37.0
Elementary	17	31.5
Other	8	14.8

* Respondents could select more than one level, therefore the percent column does not sum to 100.

Table 5. Subjects of Interest to Teaching Scholars

Subject	Number of Respondents	Percent*
Math	21	38.8
Biology	10	18.5
All Science	9	16.7
Earth Science / Geology	8	14.8
Elementary	5	9.3
Environmental Science	5	9.3
Computer Science	4	7.4
Physics	4	7.4
Chemistry	3	5.6
Health / Life Science	3	5.6
Other	1	1.9

* Respondents could select more than one subject, therefore the percent column does not sum to 100.

Of the fifty-four respondents, nine (17%) were currently enrolled in certification programs when they completed the survey. Six of those students were enrolled for high school (grades 9-12) certification, two were for elementary (grades K-6), and one was for grade levels 5-12. Certification subject areas were: math (5), biology (2), and elementary (2).

Twelve of the fifty-four Teaching Scholars (22%) completed certification programs in the 2000-2001 academic year. Five of those students completed certification for the elementary level, four for the high school level, two for grade levels 5-12, and one for the middle school level. Certification subject areas for this group were: elementary (5), earth science (2), general science (2), physics (2), and chemistry (1). Of the remaining Teaching Scholars not enrolled in certification programs, sixteen (30%) were planning to enroll in a certification program someday, eight (15%) were not planning to enroll, and six (11%) were unsure.

Attitudes Toward Teaching

The Teaching Scholars were asked to rate the attractiveness of a career in teaching and the likelihood that they would someday teach a course in math or science. Ratings for these two questions were on a 6-point scale, with one meaning "not at all attractive or likely" and six meaning "very attractive or likely." The mean response to the question, "How attractive does a career in teaching science or math sound to you?" was 4.9 (standard deviation = 0.86) and the median was 5.0, indicating a positive response. Only three of the respondents (6%) chose a response less than 3. The mean response to the question, "How likely is it that you will someday teach a math or science course?" was 5.3 (standard deviation = 1.02). Again, only 6% selected a response less than 3 on this six-point scale.

The Teaching Scholars were also asked to rate their degree of agreement with eight statements about teaching interest and skills on a five-point scale (strongly disagree, disagree, neutral, agree, strongly agree). Six of the eight responses were positive (i.e., median response was "agree"), while the other two were neutral. These results are summarized in Table 6 where the medians, means, and standard deviations of responses are listed by statement. As the summary presented in Table 6 indicates, the Scholars tended to agree that the STEMTEC experiences and activities were rewarding. However, the responses to the last two questions suggest that many of the teachers would have become math or science teachers irrespective of STEMTEC. However, the responses to the other questions suggest that STEMTEC has helped them become better teachers.

Table 6. Means, Medians, and Standard Deviations of Responses to Statements About Teaching

Statement	Median Response	Mean[1] (Standard Deviation)
My STEMTEC teaching experience (the teaching activity I participated in during the award period) increased my interest in teaching math or science.	Agree	4.2 (0.73)
My STEMTEC teaching experience provided me with knowledge or skills that will make me a more effective math or science teacher.	Agree	4.2 (0.63)
The STEMTEC Teaching Scholar activities (e.g., workshops, talks) provided me with skills or knowledge that will make me a more effective math or science teacher.	Agree	4.2 (0.64)
The STEMTEC Teaching Scholar workshops were a good use of my time.	Agree	4.1 (0.78)
The STEMTEC Teaching Scholar activities increased my interest in teaching math or science.	Agree	4.0 (0.88)
I was very committed to becoming a teacher *before* I participated in the Teaching Scholars Program.	Agree	3.8 (1.01)
I am more likely to become a teacher now, than I was at the beginning of this school year.	Neutral	3.4 (0.96)
One or more STEMTEC faculty members helped me to reach my teaching goals.	Neutral	3.4 (1.16)

[1]Means and standard deviations were calculated by using 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree.

Teaching Experience

As described in the beginning of the paper, one of the requirements of the NSF Teaching Scholarship was to complete a teaching experience, defined as "a formal or informal teaching activity on your own campus, another campus, or a K-12 classroom." On the survey, students were asked to indicate, among other things, the number of hours spent on the teaching experience, the grade level, the subject area or topic, and the kinds of activities that were involved in their experience.

Teaching Scholars varied a great deal in the amount of time spent on the teaching experience, with some students reporting to have spent two to five hours total, and others reporting having spent 550, 850, even 1200 hours total (which is the equivalent of 40 hours a week during both semesters). The majority of students (38 or 70%) appear to have had some sort of weekly commitment associated with their teaching experience. Teaching experiences were primarily in K-12 settings, with 44 (81%) of the Teaching Scholars working in K-12 classrooms. Regardless of where the teaching experience occurred, or how much time was invested, the results were predominantly positive.

Each Teaching Scholar was asked to write a brief description of their teaching experience. To give some direction to these descriptions, students were asked two specific questions: "What were your responsibilities?" and "How did this experience affect your attitude / commitment towards teaching?" The types of experiences varied, with sixteen students (30%) describing situations where they were responsible for "everything a real teacher does," seven students (13%) who prepared a single topic to present to a group, six (11%) working as teaching assistants at the college level, six (11%) primarily tutoring one-on-one, and five (9%) assisting or observing K-12 classrooms. Table 7 contains information on how many students participated in specific activities as part of their teaching experience.

Table 7. Teaching Activities Experienced by Teaching Scholars

Teaching Activity	Number of Respondents	Percent
Small Group Work	42	77.8
Hands-on Activities	35	64.8
Preplanning	35	64.8
Observation	31	57.4
Tutoring	26	48.1
Lecturing	25	46.3
Teaching Assistantship	16	29.6
Other Teaching Experience	16	29.6

Regardless of the type of experience, the summaries written by the students were overwhelmingly positive. Five Scholars specifically mentioned the reward of seeing students learn. As one student wrote,

> "I was thrilled to see the excitement and ownership visible in their faces. Facilitating learning is an amazing and rewarding feeling that surprises me again and again."

A few students mentioned that their teaching experience gave them an "eye-opener to the realities of teaching." Examples of realities that were named were dealing with co-workers and parents, classroom management issues, the tremendous amount of work, and political aspects of education. Despite learning about these challenges involved with teaching, the single most common comment made by the Teaching Scholars was that the teaching experience solidified their interest to teach. Twenty-one of the fifty-four students (39%) specifically stated that being in the classroom either increased their interest and motivation to teach or confirmed their decision to become a teacher.

Evaluation of the STEMTEC Program

Included on the survey were questions designed to collect information about the STEMTEC program, including questions about STEMTEC courses, activities, and the strengths and weaknesses of the program. One surprising result has to do with what the Teaching Scholars had to say about STEMTEC courses. Nearly half 26 (48%) of the respondents claim to have never taken a STEMTEC course. Further, when asked how important it was for them to take STEMTEC courses, the majority of the Teaching Scholars answered, "not at all important." (See Tables 8 and 9 for more information about STEMTEC courses.) Were the STEMTEC courses not advertised completely enough among the group of Teaching Scholars? If not, how likely is it that the students at large are selecting courses because the courses are affiliated with STEMTEC? These results suggest that dissemination of information about STEMTEC courses on the eight campuses, or even just among the Teaching Scholars, may not have been very successful.

Table 8. Number of STEMTEC Courses Taken by Teaching Scholars

Number of STEMTEC Courses	Number of Respondents	Percent
0	26	48.1
1	6	11.1
2	4	7.4
3	4	7.4
4	2	3.7
5	0	0.0
6	2	3.7
7	1	1.9
No Response	9	16.7

Table 9. "How important was it for you to take STEMTEC courses?"

Response	Number of Respondents	Percent
Not at all important	22	40.7
Somewhat important	12	22.2
Very important	10	18.5
No response	10	18.5

Teaching Scholars were also asked to rate the various activities and events offered by STEMTEC throughout the year. Table 10 includes a summary of what was reported by the students. Very few students completed the information for any given activity, therefore it is difficult to evaluate the individual events. Overall, for those that did attend the activities, reactions were positive. For each activity, the majority of respondents found that it both helped them become better teachers and increased their interest in teaching. This was particularly true for the K-12 classroom experiences, Science Through Multiple Intelligences, Science as Inquiry, and Project Wet and Wild.

Table 10. Summary of Responses to Various Teaching Scholar Activities

Activity	Location	Number Who Responded	(a) Helped Me Become a Better Teacher*			(b) Increased My Interest in Teaching*		
			Yes	No	Not Sure	Yes	No	Not Sure
K-12 classroom experience	Various	38	95%	--	--	89%	8%	3%
Science Through the Multiple Intelligences: Patterns That Inspire Inquiry	Smith College	12	92%	--	8%	67%	--	33%
The teaching that was modeled in STEMTEC courses	Various	10	90%	--	10%	80%	--	20%
When You Are the Teacher (Part II)	Hampshire College	8	88%	12%	--	63%	12%	25%
Project Wild and Wet (Parts I & II)	UMass Amherst	15	87%	--	--	93%	7%	--
Full Court Press	Basketball Hall of Fame	7	86%	--	14%	71%	14%	14%
Science as Inquiry	Hitchcock Center, Amherst, MA	17	83%	6%	--	88%	6%	6%
Various STEM Institute talks	UMass Amherst	15	80%	--	20%	87%	--	13%
Patterns and Relationships: Algebra and Real World Examples	Mount Holyoke College	10	80%	10%	10%	50%	20%	30%
The Teaching Experience	Mount Holyoke College	14	71%	14%	14%	50%	29%	21%
When You Are the Teacher (Part I)	Bridge St. School, Northampton	10	70%	10%	20%	80%	10%	10%
Workshop on Astronomy Resources	Amherst College	8	63%	13%	25%	75%	--	25%
Environmental Education Society Annual Conference	Worcester, MA	5	60%	--	40%	80%	20%	--
Certification Information Session	UMass Amherst	6	--	17%	50%	67%	--	33%

* Percentages were calculated based on the number of students who responded.

The Teaching Scholars were also asked a series of questions about the STEMTEC program itself. When asked how they found out about STEMTEC and the Teaching Scholars program, 29 (54%) listed Professors or staff, 9 (17%) said friends, 6 (11%) found out about STEMTEC from flyers, 4 (7%) found out from the website, and 2 (4%) reported that they learned about STEMTEC from other sources. When asked if the STEMTEC Teaching Scholarship allowed them to do anything that they would not have been able to do otherwise, 49 (91%) answered "yes." Of those 49, twenty-eight students (57%) reported that the money enabled them to spend less time working to pay for school. Eleven (22%) said that the scholarship allowed them to be involved with STEMTEC events, and ten (20%) listed experience teaching as the thing that the scholarship enabled them to do. Twenty-five (46%) said that they would reapply for the Teaching Scholarship next year; twenty-seven (50%) said they would not. Of those not reapplying, most are completing their degree requirements this year and therefore are not eligible to reapply. Other reasons stated for not reapplying include: not sure about teaching (4), missed the application deadline (2), poor grades (1), can't comply with the scholarship requirements (1).

Teaching Scholars were asked to describe the strengths and weaknesses of the STEMTEC program. Among the most frequently stated strengths were, the STEMTEC events and activities (39 / 72%) and networking with other students interested in teaching (20 / 37%). Other strengths mentioned were the faculty and staff (4 / 7%), the scholarship money (4 / 7%), STEM talks (3 / 6%), support (3 / 6%), teaching experience (3 / 6%), certification information (1 / 2%), and resources (1 / 2%). Weaknesses perceived by the students include the need for more networking (8 / 15%), inconvenient times of events (8 / 15%), and the events themselves (5 / 9%). For example, all of the STEM talks were scheduled on Tuesdays. Finally, students were asked, "If there were only one activity that the STEMTEC Student Services Program could continue providing in the future, what should it be?" The most common response to this question was some sort of event (32 / 59%). Eleven students (20%) mentioned the events in general, the rest specifically noted which event they would like to see continue: Project Wet and Wild (8), certification session (3), Science as Inquiry (3), panel discussions with teachers (3), When You Are the Teacher (2), MEES conference (2). In addition to the STEMTEC sponsored events, students mentioned networking (5), teaching experience (5), STEM talks (5), and STEMTEC courses (2) as the one thing they would like to see the Student Services Program continue.

Discussion

Much can be learned from the Teaching Scholars' responses to the final survey and report. The aspects of the Teaching Scholar Program that students found the most beneficial were the teaching experience, the events and activities, and the opportunity to network with other students interested in teaching. This suggests that in the coming year, more networking opportunities should be scheduled for students. Also, students reported that the Teaching Scholar Activities increased both their interest in becoming a teacher and their teaching skills. This particular group of Teaching Scholars had many students interested in teaching at the high school level. For this group, more activities geared toward high school level teaching or with mathematics topics would have been beneficial. It would be useful to collect this kind of information at the beginning of the academic year so activities could be planned to match the interests of the particular group of Teaching Scholars as much as possible.

Further, the importance of the teaching experience cannot be emphasized enough. Even though nearly all students reported positive teaching experiences, regardless of the setting or time commitment, students should be encouraged to seek out teaching opportunities at the K-12 level, preferably those that involve weekly commitments.

The lack of knowledge about and interest in STEMTEC courses from this population of students that is so closely in contact with STEMTEC staff was troubling. More obviously needs to be done to advertise what these courses have to offer. So much time and effort has been expended on improving the STEMTEC courses, it seems a shame not to heavily publicize them. Faculty and staff were named most often as the way that Teaching Scholars found out about the program. This would be one avenue for informing students about STEMTEC courses. Perhaps complete lists and descriptions of recommended STEMTEC courses could be provided for the STEMTEC Teaching Scholars as soon as their awards are offered to them. If one of the premises of the STEMTEC program is that college students will learn reformed teaching practices by modeling the teaching that they observe in STEMTEC classes, getting Teaching Scholars to take more STEMTEC courses should be a priority of the program.

Overall, the responses to the 2000-2001 Teaching Scholar Mandatory Final Report and Survey were very positive. Obviously, the Student Services Program is doing an outstanding job of organizing activities and events for students interested in teaching and in providing them with the opportunity to experience teaching in the K-12 setting. Due in large part to their participation in the scholarship program, the Teaching Scholars are motivated, excited, and committed to try teaching as a career.

Student Surveys: Fall 2000 and Spring 2001

Sharon Cadman Slater and Mary L. Zanetti

Report on the Teaching Interest Surveys: Fall 2000 & Spring 2001

One of the goals of STEMTEC is to "recruit and retain promising students into the teaching profession, with special attention to underrepresented groups." Three strategies were implemented by the Collaborative to increase student interest in teaching mathematics and science: (a) modeling different reformed teaching styles in STEMTEC courses, (b) providing opportunities for students to participate in teaching activities, and (c) engaging students in events sponsored by the STEMTEC Student Services program.

To determine if STEMTEC is having an effect on student attitudes toward teaching, it is important to identify the career interests of students early in their undergraduate education. Later in the students' undergraduate education and even after graduation, career interests of the students can be obtained again and compared to their earlier career interests to examine how these interests have changed. In cases where a change occurs, students can be questioned about what they believe influenced their shift in career goals. Namely, students can be asked what, if any, influence the STEMTEC program had on their career decisions.

Method

Two surveys were developed and administered to evaluate the STEMTEC program's effect on student teaching interests and the role reformed teaching styles plays in STEMTEC classes. The participants and the two surveys will be described separately in the next section.

Participants

During the 2000-2001 academic school year, students enrolled in various STEMTEC and Non-Stemtec courses at all eight colleges were asked to complete a survey inquiring about the STEMTEC program. The selected courses were in the science and mathematics subject areas at the eight campuses involved in the collaborative project. Two different surveys were administered to a total of 1,513 students. Sex, ethnicity and race information can be found in the results section.

Description of Surveys

Survey administered in the fall

At the beginning of the Fall 2000 semester, a brief survey was administered to undergraduates in a sample of both STEMTEC and Non-Stemtec courses at the eight postsecondary institutions that comprise the STEMTEC Collaborative. (See Table 1 for a listing of courses surveyed.) Introductory level mathematics and science courses were selected for survey administration in hopes of reaching students early in their undergraduate careers.

Table 1. Courses Included in the Teaching Interest Survey, Fall 2000

Institution	Course Title	# of STEMTEC Students	# of Non-Stemtec Students	Percent of Students
Amherst College	Introduction to Chemistry	64		6.7
	Molecules, Genes, and Cells		41	4.3
Greenfield Community College	Physical Geology	27		2.8
	Ecology		15	1.6
	College Algebra		47	4.9
Hampshire College	Teaching Science in Middle School	8		0.8
	Human Biology	18		1.9
Holyoke Community College	Topics in Science	36		3.8
Mount Holyoke College	Organic Chemistry II	15		1.6
Smith College	Geology in the Field	13		1.4
	General Chemistry I	66		6.9
Springfield Technical Community College	Pre-Algebra	30		3.2
	University Physics		23	2.4
University of Massachusetts Amherst	Introduction to Oceanography	88		9.3
	Introduction to Physics I	157		16.5
	Society and the Environment		111	11.7
	EDUC 524		70	7.4
	Mathematics 113		121	12.7
Total		522	428	100.0

The purpose of the teaching interest survey was to identify the level of interest in teaching held by students early in the semester. The survey contained 15 selected-response questions. Questions on the survey asked students to identify their major, and the areas in which they were considering a career. Students were also asked to rate the attractiveness of a career in teaching and the likelihood that they would someday teach a mathematics or science course. A copy of the survey is presented in Appendix G. In addition, students were asked to provide their names and student identification numbers to provide STEMTEC with the opportunity to gather longitudinal data on these same students at different points in the future. The baseline data gathered by this survey will enable the program to track students to determine if STEMTEC did indeed have the effect of increasing interest in teaching science and mathematics.

Survey administered in the spring

At the end of the spring 2001 semester, a brief survey was administered to undergraduates in a sample of STEMTEC mathematics and sciences courses at the eight institutions involved with the STEMTEC Collaborative Program (See Table 2 for a listing of courses surveyed). The purpose of this survey was to determine the degree to which STEMTEC courses represent reformed teaching styles and support the recruitment and retention of future mathematics and science teachers, including future teachers from underrepresented minority groups. In developing this survey, members of the evaluation team reviewed previous questionnaires used in the STEMTEC evaluation as well as the student questionnaires developed by the Core Evaluation team in Minnesota. Several questions were borrowed from Core surveys. The final version of the survey used in this study contained 34 selected-response questions. A copy of the survey is presented in Appendix H. The survey gathered demographic information about the students (e.g., school, sex, race/ethnicity), inquired about their familiarity with STEMTEC, and asked about the teaching and assessment methods they experienced in the class.

Table 2. Courses Included in the Learning Experience Survey, Spring 2001

Institution**	Course Title	Number of STEMTEC Students	Percent of Students
Amherst College	Introduction to Modern Astronomy	43	7.7
Greenfield Community College	Introduction to Oceanography	24	4.3
	Introduction to Algebra	14	2.5
Hampshire College	Local and Global Climate Change	3*	0.5
	Computers in Science Education	3*	0.5
	Food, Nutrition & Health	13*	2.3
Holyoke Community College	Human Biology	12	2.1
	Organic Chemistry II	15	2.7
Smith College	The Environment	42	7.5
	Petrology	12	2.1
Springfield Technical Community College	Microbiology	43	7.7
	Principles of Biology II	28*	5.0
	Sectional Anatomy	19	3.4
	Linear Algebra II	26	4.6
	Statistics	36	6.4
University of Massachusetts Amherst	Analytical Chemistry for Non-majors	20*	3.6
	Principles and Methods of Teaching Science in Elementary School	25*	4.5
	Insects in the Classroom	23*	4.1
	Global Environment Change	85*	15.0
	Introduction to Oceanography	54*	9.6
	Plant Diseases: Feast or Famine	22	3.9
Total		562	100.0

*Number includes students enrolled through the 5-College Admissions Agreement
**Mt. Holyoke is not represented in the results of this survey

In the next section, results from both surveys were aggregated when it was appropriate to do so. In other words, when the same or similar question was asked on both surveys, student responses were described together. When unique information was gathered on only one survey it was described separately. For instance, the learning and assessment selected-response questions, which were included on the spring survey only, were described separately.

Results

The primary goal of the survey administered in the fall, hereinafter referred to as the Teaching Interest Survey (TIS), was to identify a group of students, by name and social security number, for the purposes of tracking their interests in teaching mathematics and science during their undergraduate studies and beyond. A high percentage (81%) of respondents provided the necessary identification information. These 772 people, from here referred to as the TIS Cohort, will be contacted again to reexamine their interest level in teaching as a profession.

The primary goal of the survey administered in the spring, hereinafter referred to as the Learning Experience Survey (LES), was to determine the types of learning activities students experienced in a sample of STEMTEC classes.

Demographics

A total of 1513 students responded to the TIS and LES surveys, which were handed out by the instructors of the courses listed in Table 1 and Table 2. The sample of students was predominantly Caucasian and female (TIS: Caucasian/white 80%, females 63%; LES: Caucasian/white 81%, females 66%). Ethnicity/race information for the TIS and LES surveys are presented in Table 3 and Table 4, respectively.

Table 3. Ethnicity and Race Information of the TIS Survey Respondents

Ethnicity or Race	Number of Respondents		Percent
	Female	Male	
Caucasian or White	468	285	79.6
Asian	49	21	7.5
Hispanic or Latino/a	28	21	5.2
African American or Black	31	12	4.5
Multiracial	10	7	1.8
Native American or Alaska Native	3	4	0.7
Native Hawaiian or Pacific Islander	3	0	0.3
No Response	51		5.4

Table 4. Ethnicity and Race Information of the LES Survey Respondents

Ethnicity or Race	Number of Respondents		Percent
	Females	Males	
Caucasian or White	300	154	80.8
African American or Black	20	15	6.2
Hispanic or Latino/a	18	12	5.3
Asian	18	4	3.9
Native American or Alaska Native	10	4	2.5
Other	8	6	2.5
Native Hawaiian or Pacific Islander	0	2	0.4

Introductory level courses were selected for the TIS survey in order to reach students early in their undergraduate careers. The TIS Cohort included 307 Freshman, 337 Sophomores, 174 Juniors, and 63 Seniors. Sixty-nine percent of these students were in their first or second year of college. Given that the majority of TIS respondents were in their first two years of college, it is not surprising that one of the most popular academic majors among this cohort was "Undecided" (13%). Two other choices for academic major that were selected by many TIS respondents were "Biology" (15%) and "Education" (14%).

The composition of the LES survey respondents was similar. Sixty–five percent of these students were in the first or second year of college. LES student respondents included 191 Freshman, 172 Sophomores, 106 Juniors, 63 Seniors and 27 “other”. Sixty-one percent of the LES respondents were earning a bachelor’s degree with thirty-four percent earning an associate’s degree. In addition, approximately sixty-percent of the students completing the LES survey indicated that they enrolled in the course because it was required for their major or was a general graduation requirement.

This group of survey respondents was offered nine options when asked about their declared or intended majors. The nine choices were business, computer science/technology, education, engineering, humanities/art/music, mathematics/statistics, natural sciences, social sciences, and “other”. These categories differ slightly from the response options for declared or intended majors on the TIS survey. For instance, natural sciences was offered as a choice on the LES survey rather than the following six individual majors offered on the TIS survey: biology, natural resources/food services, chemistry, geology/geosciences, physics, and astronomy. Two of the most popular academic majors selected by the LES students were natural sciences and “other.” The number and percentage of TIS and LES students choosing each academic major is reflected in Table 5.

Table 5. Academic Majors of TIS & LES Survey Respondents

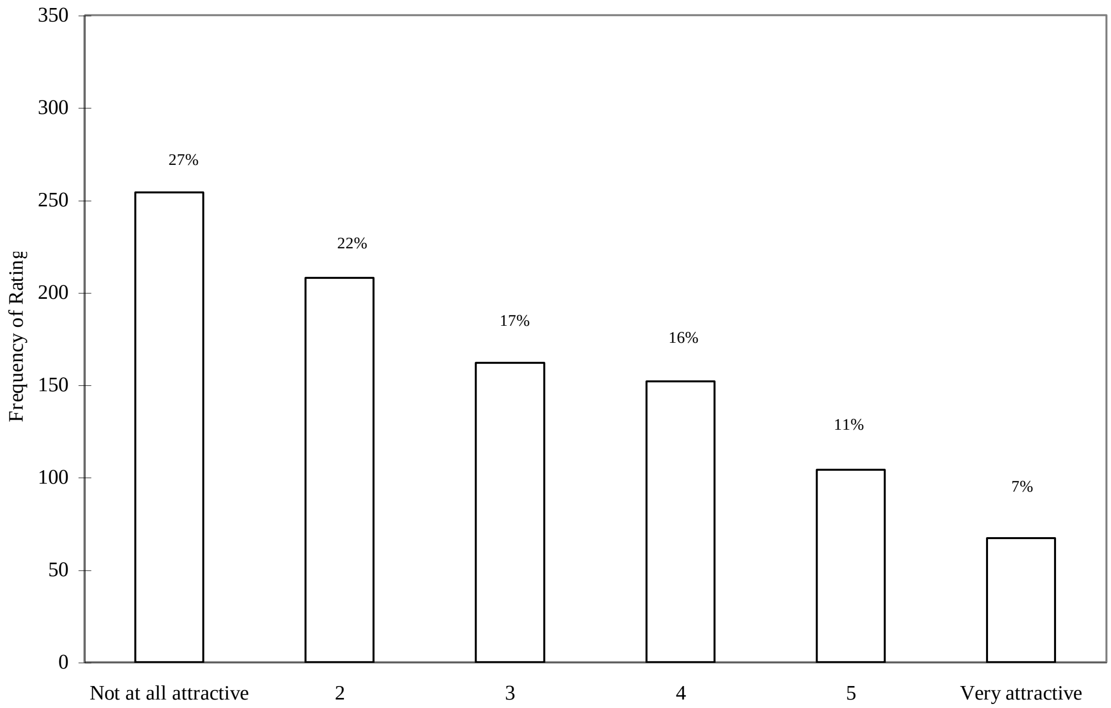
Academic Major	Number of TIS Students*	Number of LES Students*	Total Number of Students	Percent
Business/Economics	52 (5.5)	51 (9.0)	103	6.8
Comp Science/ InfoTechnology	16 (1.7)	16 (2.8)	32	2.1
Education	129 (13.6)	70 (12.4)	199	13.2
Engineering	22 (2.3)	7 (1.2)	29	1.9
Humanities/Art/Music	74 (7.8) *English/Comm:* 49 (5.2) *History:* 25 (2.6)	59 (10.5)	133	8.8
Mathematics/Statistics	11 (1.2)	11 (2.0)	22	1.4
Natural Sciences	243 (25.6) *Astronomy: 2 (0.2)* Biology: 146 (15.4) *Chemistry: 26 (2.7)* *Geology/Geosciences: 9(0.9)* *Nat Res/Food Serv: 54 (5.7)* *Physics: 6 (0.6)*	111 (19.7)	354	23.4
Other	187 (19.7)	143 (25.4)	330	21.8
Social Sciences	83 (8.7) *Law: 14 (1.5)* *Psychology: 55 (5.8)* *Sociology: 14 (1.5)*	73 (13.0)	156	10.3
Undecided	119 (12.5)		119	7.9
Missing		22 (3.9)	22	2.4
Total	950	563	1513	100

*Number in parenthesis represents % of individuals declaring that major in that particular group of survey respondents

TIS Respondents' Opinions on Teaching as a Career

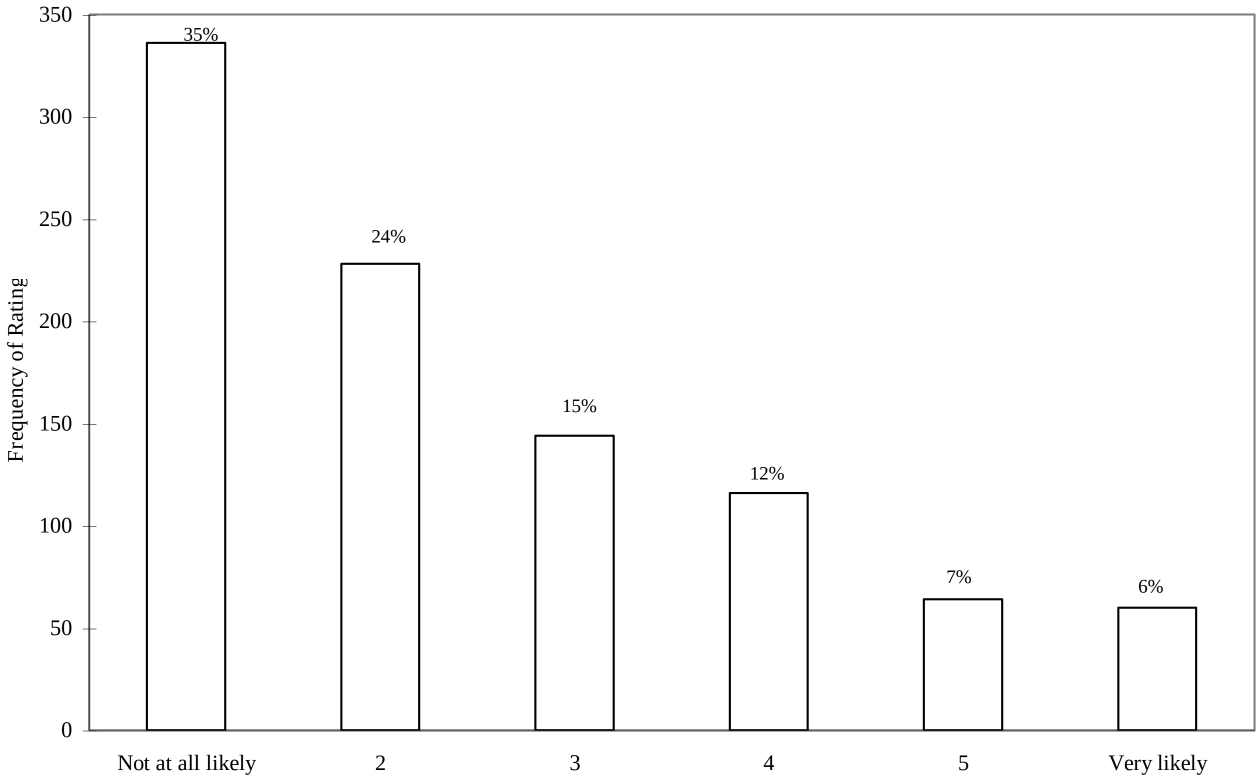
Overall, ratings of the attractiveness of a career in teaching mathematics or science and ratings of the likelihood of teaching a mathematics or science course someday were negative. The TIS students were asked to "indicate how attractive a career in teaching mathematics or science is to you" and were then given a six-point rating scale where 1="not at all attractive" and 6="very attractive." These data are summarized in Figure 1. The mean attractiveness rating was 2.8. Almost two-thirds of the TIS students responded 3 or below, indicating that teaching mathematics or science was not attractive.

Figure 1. TIS Student Ratings of Attractiveness of a Career in Teaching Math or Science (n=947)



The students who completed the TIS survey were also asked to "indicate how likely it is that you will someday teach a mathematics or science course." A six-point scale was also used for this question ranging from 1= "not at all likely" to 6="very likely." These data are summarized in Figure 2. The mean likelihood rating was 2.5. Three-quarters of the students responded 3 or less, suggesting that it was not likely that they would teach a mathematics or science course someday. Although it is disheartening to see such low ratings of the attractiveness and likelihood of teaching mathematics or science, the low ratings do allow for quite a bit of improvement in attitudes toward teaching.

Figure 2. TIS Student Ratings of Likelihood of Teaching a Math or Science Course Someday (n=948)



When TIS students were asked to comment hypothetically ("if you think you may become a mathematics or science teacher someday") on which subjects and levels they would like to teach. Virtually all students completing the TIS survey responded to this question. It is interesting to note that there were students who selected teaching mathematics and science at all levels from preschool through college. More students indicated that they were more interested in teaching science than mathematics. More TIS students also listed teaching at the high school and elementary levels than at the preschool, middle school, or college levels (see Table 6).

Table 6. Number (and Percent) of TIS Students Indicating Particular Subjects and Levels They Would Like to Teach

Teaching Option	Number of Students Considering	Percent
Science	309	32.5
Mathematics	161	16.9
High School	245	25.8
Elementary School	228	24.0
College	174	18.3
Middle School	135	14.2
Preschool	77	8.1

LES Respondents' Opinions on Teaching as a Career

Approximately twenty-five percent of the LES respondents (142 respondents) indicated they were considering a career in education/teaching. These students were then asked about the particular level and/or subject they were interested in teaching. Teaching at the elementary (55.6%) and high school (38.0%) levels was most popular with this specific group of students. While twenty-three percent of these students indicated science was the subject they were interested in teaching, six percent preferred to teach mathematics (see Table 7). In addition, eighty-four percent of all LES students indicated they were not planning on enrolling in a teacher certification program.

Table 7. Number (and Percent) of LES Students Indicating Particular Subjects and Levels They Would Like to Teach (n=142)

Teaching Option	Number of Students Considering	Percent
Science	33	23.2
Mathematics	9	6.3
Preschool	15	10.6
Elementary School	79	55.6
Middle School	32	22.5
High School	54	38.0
College School	33	23.2
Not interested in teaching	3	2.1

Careers Being Considered by TIS & LES Respondents

Despite the negative attitudes regarding the attractiveness of a career in teaching and the likelihood of teaching a mathematics or science course someday, a third of the TIS students indicated that they were considering a career in Education or Teaching. A quarter of the LES students indicated that they were considering a career in the education profession. Table 8 shows the percentages of TIS and LES students considering various career options.

Table 8. Percent of TIS & LES Students
Considering Careers in Various Fields

Career Option	% of Students Considering	
	TIS (n=950)	LES (n=563)
Biology/Medicine Career	36.0	22.4
Education/Teaching Career	34.3	25.2
Art/Music/Humanities Career	14.5	13.5
Psychology Career	11.7	8.9
Business/Economics Career	10.8	17.4
Social Services Career	6.4	8.5
Law Career	6.3	11.9
Computer Science Career	5.4	6.0
Chemistry Career	4.6	1.8
Engineering Career	4.1	2.5
Geology Career	3.1	5.0
Physics Career	1.7	1.2
Other Careers	17.8	20.8

TIS Student Responses: STEMTEC vs. Non-Stemtec Comparisons

An attempt was made to survey an equal number of students in the STEMTEC and Non-Stemtec courses. In the end, 522 students were surveyed in STEMTEC courses and 428 students surveyed were in Non-Stemtec courses. Results were compared for STEMTEC and Non-Stemtec courses and very few differences were identified between the groups. This finding is expected, for near the beginning of the semester, the groups of students should be somewhat similar. In other words, STEMTEC has not yet had an influence on interests and attitudes. If anything, the students surveyed in STEMTEC courses were slightly more negative in their attitudes about teaching. There was essentially no difference between the groups in average rating of attractiveness of a career in teaching (2.8 in the STEMTEC courses and 2.9 in the Non-Stemtec courses; ($t_{(945)}=1.19$, p=.231). There was a greater difference in the average ratings of the likelihood of teaching a course in mathematics or science someday. The average likelihood within the STEMTEC courses was 2.3; the average likelihood for the Non-Stemtec courses was 2.7 indicating students in Non-Stemtec courses were more likely to teach a course in mathematics or science in the future. This difference was statistically significant ($t_{(946)}=3.60$, p<.000), and the effect size (.24) was moderate.

When comparing the STEMTEC and Non-Stemtec courses there were differences in the number of students considering careers in various fields (see Table 9). For example, more students in the STEMTEC courses indicated considering careers in Biology and Medicine, where in the Non-Stemtec courses, more students indicated considering careers in Education and Teaching in general. This highlights a limitation of basing results on a sampling of courses. The results were influenced by the particular courses selected for the survey. In this case, there were a large number of students in a Non-Stemtec course in the Department of Education, which explains the larger percentage of students in this group selecting "Education/Teaching" as a career they were considering. Likewise, many of the STEMTEC courses selected are prerequisites for a pre-medicine academic track, explaining why there is a higher percentage in this group that selected "Biology/Medicine" as a career they were considering.

Table 9. STEMTEC and Non-Stemtec Comparison of Percent of TIS Students Considering Careers in Various Fields

Career Option	STEMTEC (%) (n=522)	Non-Stemtec (%) (n=428)
Biology/Medicine Career	51.9	16.6
Education/Teaching Career	18.8	53.3
Art/Music/Humanities Career	14.4	14.7
Business/Economics Career	12.8	8.4
Psychology Career	12.6	10.5
Law Career	8.0	4.2
Social Services Career	7.5	5.1
Chemistry Career	6.3	2.6
Computer Science Career	5.9	4.7
Geology Career	3.1	3.0
Engineering Career	2.9	5.6
Physics Career	1.5	1.9
Other Careers	15.3	20.8

When TIS students were asked to comment hypothetically ("if you think you may become a mathematics or science teacher someday") on which subjects and levels they would like to teach, there were students who selected teaching mathematics and science, and at all levels from preschool through college. However, as with the careers being considered, there were some differences between the STEMTEC and Non-Stemtec groups of students. In both samples of students, more are considering teaching science than mathematics. Again, the sampling of courses selected to participate in this survey could have confounded these results. More STEMTEC students are considering teaching at the high school and college levels than the Non-Stemtec students. More Non-Stemtec students are considering teaching at the preschool and elementary levels. See Table 10 for percentages of students choosing particular subjects and the levels they would like to teach.

Table 10. STEMTEC and Non-Stemtec Comparison of Percent of TIS Students Indicating Particular Subjects and Levels They Would Like to Teach

Teaching Option	STEMTEC (n=522)	Non-Stemtec (n=428)
Science	34.3	30.4
Mathematics	14.5	19.9
High School	28.2	22.9
College	21.3	14.7
Elementary School	16.7	32.9
Middle School	14.4	14.0
Preschool	6.5	10.0

LES Student Responses Regarding Classroom Activities

The LES students were asked to rate how often a classroom activity occurred during the semester using a five-point rating scale where "1" equaled "never" and "5" equaled "every class." The responses to the fifteen statements inquiring about classroom activities were mixed (see Table 11). Fifty-six percent of the LES students indicated they had listened to a lecture every class with another twenty-three percent indicating that lectures occurred almost every class. This finding was further expanded upon when seventy-one percent of the students indicated that their teacher rarely or never talked less than the students enrolled in the course.

Table 11. Mean Ratings of LES Student Responses to Frequency of Classroom Activities

In this course, how often did you:	Mean*
listen to lecture?	4.26
feel encouraged to ask questions in class?	3.69
work on in-class problem solving and/or open-needed questions?	3.33
have opportunities to give feedback to the instructor?	3.25
work on problems related to real-world or practical issues?	3.25
work in small groups?	2.94
see the teacher use educational technology (e.g., computers, VCRs)?	2.89
make connections to other fields or disciplines?	2.82
participate in hands-on activities?	2.70
have opportunities to work on long-term projects?	2.30
discuss learning and/or teaching strategies?	2.17
have discussions in which the teacher talked less than the students?	2.11
hear the instructor speak about teaching as a career?	1.74
see other students teach a portion of this class?	1.46
collaborate with K-12 teachers and/or students?	1.44

*The scale ranged from 1 (never) to 5 (every class).

When students were asked how often they worked in small groups, three-quarters of the students responded with a rating of 3 or more, suggesting that this occurred quite often. Regarding work on problems that related to real-world or practical issues and in-class problem solving and/or open-ended questions, approximately sixty-five percent of the respondents indicated this type of work occurred often by rating this statement 3 or 4, ("3"=often; "4"="almost every class"). The mean ratings for the statements "work on problems that relate to real-world issues" and "in-class problem solving" were 3.25 and 3.33, respectively. Approximately forty-percent of the LES students indicated they often participated in hands-on activities and connections to other fields or disciplines were often made during classroom activities. In addition, students were asked to rate how often they had opportunities to work on long-term projects, fifty-six percent indicated that they never or rarely participated in this type of activity.

A total of eighty-five percent of the respondents often felt encouraged to ask questions in class (mean=3.69, see figure 3). Of those students, thirty-four percent indicated they felt that way during every class. When asked about having opportunities to give feedback to the instructor, seventy-five of the students responded 3 or more, suggesting this was a common occurrence in the classrooms surveyed in the spring (mean=3.25, see figure 4).

Figure 3. LES Student Ratings of Feeling Encouraged to Ask Questions in Class

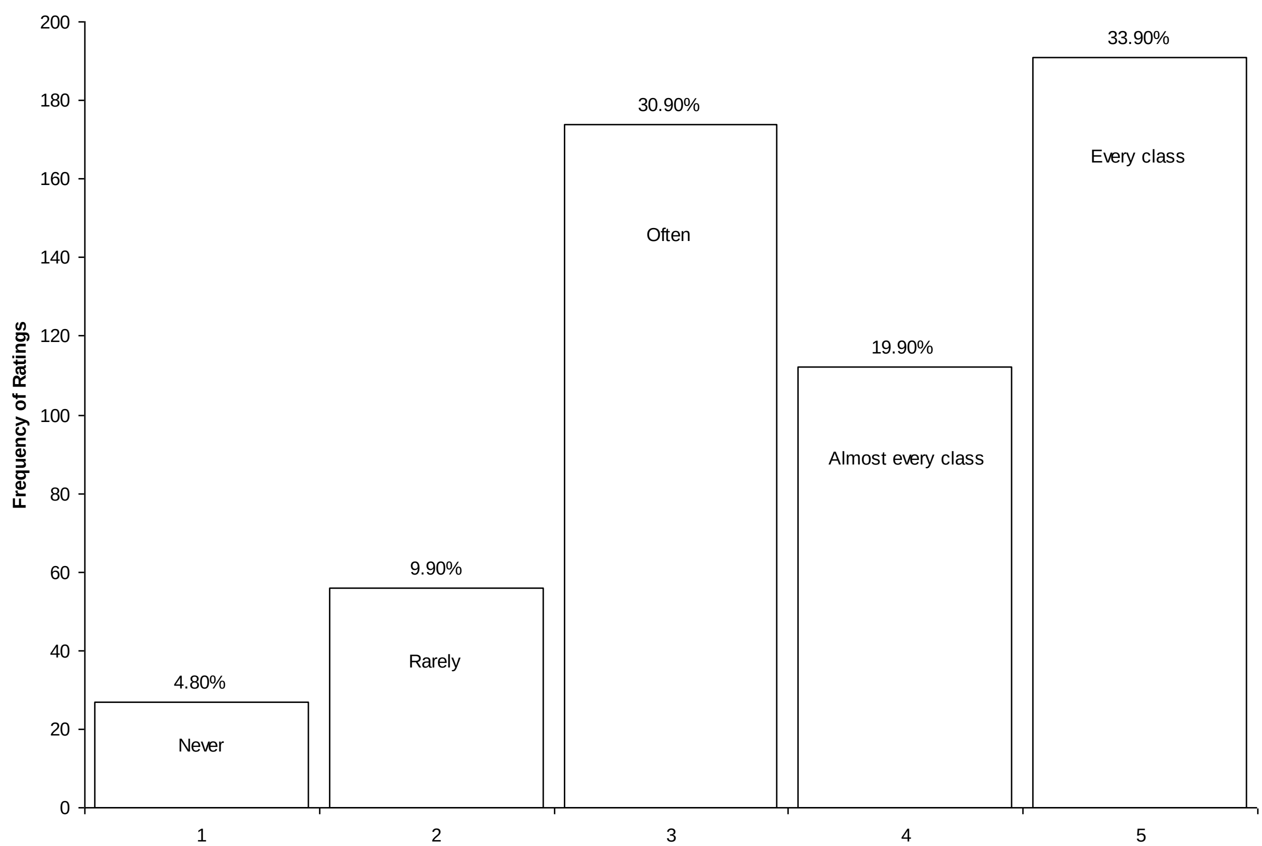
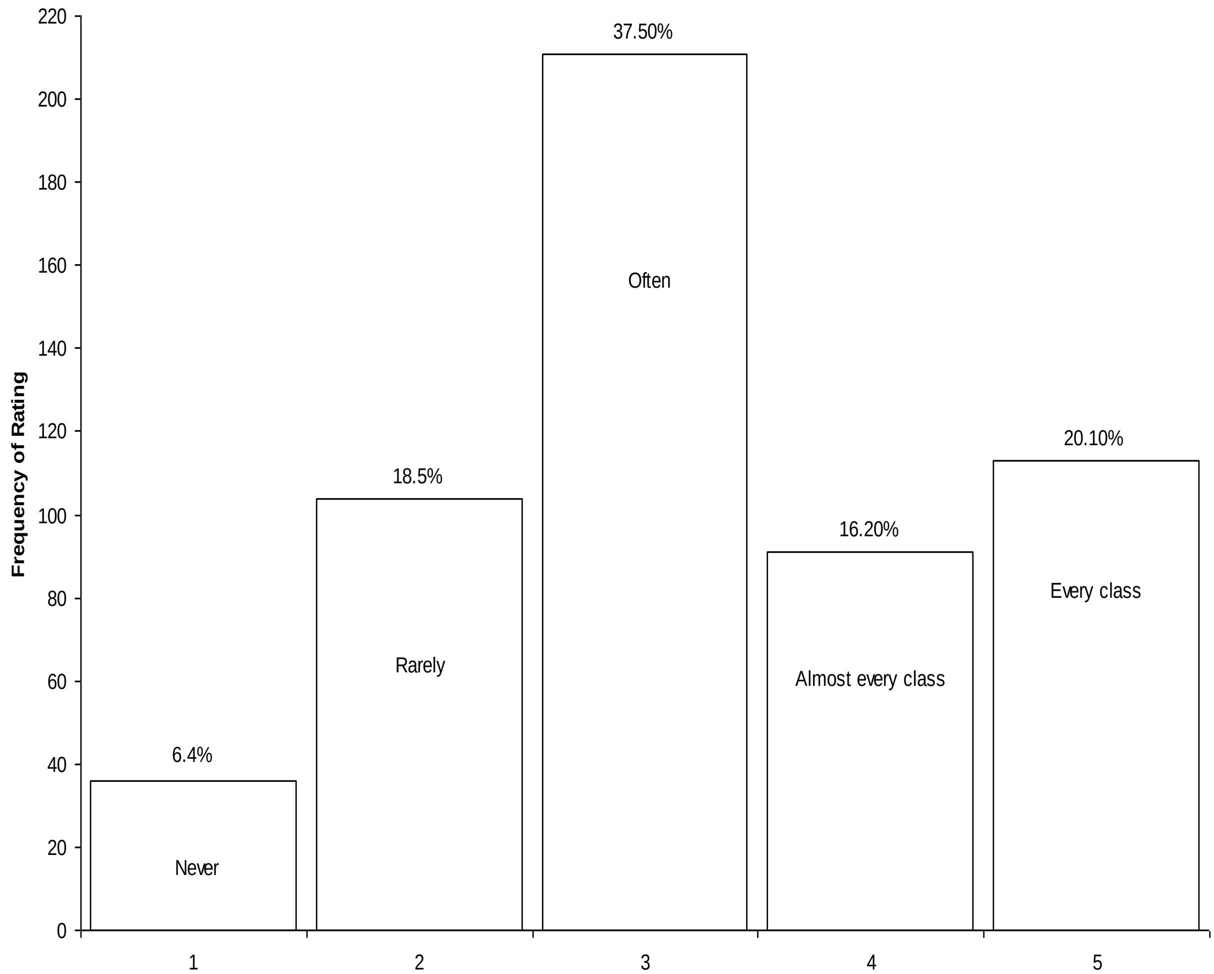


Figure 4. LES Student Ratings of Opportunities to Give Feedback to the Instructor



Classroom activities related to teaching as a career

While the responses to classroom activities related to teaching as a career were quite negative, highlighting student responses is an important component in the evaluation of the STEMTEC program's effect on attracting and recruiting qualified teachers. Eighty-four percent of those surveyed in the spring indicated that their instructor rarely or never mentioned teaching as a career (mean=1.74), where "1" equaled "never" and "5" equaled "every class, and a similar proportion of students indicated other students rarely or never taught a portion of the class (mean=1.46). While three-quarters of the respondents indicated that they never collaborated with K-12 teachers and/or students (mean=1.44), sixty-six percent indicated they rarely or never discussed learning and/or teaching strategies.

LES Student Responses to Interest in Subject/Content Area

Students were asked to rate seven statements pertaining to the manner in which course material was presented in class and whether or not completing the course increased their interest in the subject area. A five-point scale ranging from "1," strongly disagree, to "5," strongly agree, was used to rate each statement. Approximately eighty-two percent of the LES students agreed or strongly agreed that the course helped them learn the course material (mean=4.08), the course encouraged discussion among students and teacher (mean=3.87), and there was sufficient time for them to respond to questions in class (mean=4.05). These findings mirror the overall ratings of similar "classroom activities" statements described in a previous section. In addition, approximately half of the LES survey respondents agreed or strongly agreed (mean=3.55) that the course encouraged them to think about their own learning, while sixty-three percent agreed that the course increased their interest in the subject. When students were asked to rate their agreement with the statement "this course increased my interest in becoming a teacher", about half of the survey respondents disagreed (rating of 1 or 2) with this statement and another thirty-percent remained neutral (rating of 3). The mean rating for this statement was 2.45. See Table 12 for mean ratings with corresponding survey statements.

Table 12. Mean Ratings of LES Student Responses to Interest in Subject/Content Area

Statements about the course:	Mean*
This course helped me learn the course material.	4.08
There was sufficient time for me to respond to questions in class.	4.05
This course encouraged discussion among students and teacher.	3.87
This course increased my interest in this subject.	3.76
This course encouraged me to think about my own learning.	3.55
I look forward to taking more courses in this subject area.	3.19
This course increased my interest in becoming a teacher.	2.45

*The scale ranged from "1" (strongly disagree) to "5" (strongly agree).

LES Students' Familiarity with STEMTEC program

The survey administered in the spring, known as the Learning Experience Survey, asked about students' familiarity with the STEMTEC program. Seventy-eight percent of these students were not familiar with STEMTEC. Students were then asked if they are familiar with STEMTEC, how important is it for them to choose a STEMTEC course over an equivalent Non-Stemtec course. Of the students (n=122) who answered this question, fifty percent indicated choosing a STEMTEC course as opposed to a Non-Stemtec course was moderately or very important to them. These findings are will be further touched upon in the discussion section.

Discussion

The information gathered from the two student surveys provides meaningful evaluative indicators of STEMTEC's impact on a sample of college students enrolled at the eight higher education institutions involved in the project. These survey analyses highlighted some very positive aspects of the program's effect on student learning, which reflects well upon some of the STEMTEC goals and objectives.

Evidence from the TIS survey indicated that the TIS cohort were generally not interested in teaching as a career early in their college experience, which leaves plenty of room for improvement on behalf of STEMTEC participants. Obtaining longitudinal data on this group of students will allow members of the STEMTEC program to determine its success in increasing interest in teaching science and mathematics among this sample of college students.

Information gathered from the survey administered in the spring, the LES survey, indicated that some very positive activities were occurring in STEMTEC classrooms. Working in small groups, working on problems that related to the real-world, and in-class problem solving was very popular among students who completed surveys in the STEMTEC classes. Students, for the most part, received instruction that connected classroom activities to other fields or disciplines. Students were very comfortable asking questions in class. This was true of both groups, TIS and LES, of survey participants. Both groups agreed they were encouraged to ask questions and they had been given sufficient opportunities to give feedback to instructors and/or respond to questions in class. These findings are positive indicators of STEMTEC's effect on revising pedagogy and improving student learning.

The LES survey results that were a bit more disheartening related to the low frequency in which teaching as a career was mentioned in the STEMTEC classes. STEMTEC instructors very rarely mentioned teaching as a career. In addition, K-12 collaboration was rarely happening. Finally, the majority of the LES students indicated that their coursework did not include a teaching component. Therefore, it is not surprising that completion of the STEMTEC course did not increased their interest in teaching.

The LES survey finding relating to the lack of familiarity with the STEMTEC program on behalf of the students enrolled in the STEMTEC courses can be easily remedied by ensuring that instructors discuss this important topic with students in the future. At that time, STEMTEC initiatives can be outlined verbally and in writing throughout the semester. Students should be fully aware of how STEMTEC affects course instruction and student learning. In addition, students should be made aware of the teaching scholarships and the support system available through the STEMTEC program. This should be viewed as a major issue within the collaborative project.

Future Plan for Tracking Students

Follow-up surveys will be conducted including each of the students who provided their name and student identification number (also known as the TIS Cohort) on the first administration of the Teaching Interest Survey. In addition to asking the questions from the original survey again, new items will be included that specifically address STEMTEC courses. Students will be asked to indicate if they have taken any of the specific STEMTEC courses offered after the fall semester, 2000. They will also be asked if any of the STEMTEC courses had a particular influence on their career goals, and whether or not their experience in the course encouraged them to consider teaching as a profession. Further, students will be asked if any of their STEMTEC courses included opportunities to gain K-12 classroom experience, and if that experience had a positive impact on their attitudes toward teaching as a career. A similar follow-up survey could be sent to the TIS cohort after they graduate. Additional questions about the careers the graduates entered could be asked at that time.

Until one or both of these follow-up measures are taken, the degree to which STEMTEC is meeting its goal to "recruit and retain promising students into the teaching profession" is unknown. However, administration of the Teaching Interest Survey, which was administered in the fall, was an important first step toward establishing a database of students whose interests can be studied and tracked over time. In addition, the Learning Experience Survey, which was administered in the spring, was an important step in obtaining students' perspectives on the effect STEMTEC had on classroom activities and its success in offering students the opportunity to consider teaching as a career and/or participate in teaching activities while enrolled in STEMTEC courses.

Conclusion

In conclusion, the survey analyses of the participants' responses that were enrolled in a total of thirty-nine courses indicated that the STEMTEC program has had, and continues to have, a positive impact on learning at the college level. The findings discussed in this paper have important implications for higher education students and faculty. These implications are important to the long-term success of the STEMTEC program as well as its effect on recruiting and retaining qualified science and mathematics professionals.

Content Analysis of 1999 STEMTEC Faculty Interviews

Mary L. Zanetti

Content Analysis of 1999 STEMTEC Faculty Interviews

In the Spring and Fall semesters of 1999, an external evaluation team interviewed fourteen STEMTEC faculty. These interviews were previously summarized by Champagne and O'Connor (2000) in the STEMTEC Evaluation Report 2000. The STEMTEC Principal Investigators were not satisfied with the previous summary and requested that we reanalyze these data.

In response to this request, we asked the previous evaluation team to forward all interview transcripts to us. To preserve the anonymity of the respondents, we asked that all names be removed from the transcript data. The previous evaluation team decided to request informed consent from the interviewees before forwarding their transcripts to us. As described below, we received transcripts for only five of the original faculty members. This report summarizes these transcripts as well as two others that were not included in the original report.

Method

Participants

During the spring and fall semesters of 1999, members of the previous evaluation team interviewed fourteen faculty members. All of the faculty members who were interviewed specialized in the sciences. Of those fourteen interviews, we received the transcripts from five of them, as well as transcripts from follow-up interviews for three of these faculty members. In addition, we received two additional interviews that did not appear in the STEMTEC Evaluation Report 2000. All seven faculty members were science teachers. Four of the participants were women; three were men. Three of the participants were from a university, two were from community colleges, and two were from private colleges. Champagne and O'Connor (2000) indicated that faculty members were chosen based on their survey responses reflecting a particular course focus and their availability to be interviewed.

Interview Method

As mentioned above, the interviews were conducted by a third party (i.e., Champagne & O'Connor, 2000). The specific interview methodology used is unclear; however, the protocol appears to be similar to the confirmation survey interview technique (Gall, Borg & Gall, 1996), which is designed to supplement data that have been collected by other methods. The interviews were very loosely structured. The order and wording of the questions were not predetermined. In fact, questions were not standardized across interviews and the interviews contained a great deal of informal conversation. This improvisational structure made summarizing the transcripts a formidable task. However, for many of the interviews, the interviewer asked about common issues, such as classroom teaching and assessment.

Data Analyses

To summarize the information obtained in these interviews, content analyses were conducted on the transcripts by first reviewing the content of each interview, and then deriving themes from those responses. The analyses were guided by two research questions. Had STEMTEC facilitated change? If so, what types of change occurred? These questions correspond with some of STEMTEC's goals and objectives. Themes were developed by grouping similar comments made by different respondents into a the same category. Once the themes were identified, the number of responses contributing to each theme was calculated.

All key phrases and comments were coded during the content analyses of the first transcript. Subsequent transcripts were coded by comparing them to the transcripts that were previously coded. This process was developed to promote consistency in coding and to add depth to the information gleaned from the interviews.

Results

A complete list of the themes with corresponding codes and frequencies is contained in Table 1. The results portion of the study has been divided into two sections. The first section addresses STEMTEC's ability to facilitate change and the second section addresses specific types of change facilitated by STEMTEC.

STEMTEC's Ability to Facilitate Change

Regarding the program's ability to facilitate change, three themes emerged. Two of the themes related to the positive impact the program has had on faculty instruction, relationships and perceptions and ultimately student learning; and challenges that developed during the faculty members' involvement in STEMTEC. Negative issues concerning program implementation and its impact on some faculty members was another theme that emerged.

Positive Impact Program had on Faculty

Six of the seven faculty members clearly indicated that they learned a lot about their own teaching style and how their instruction affected their students. Several professors indicated that re-designing lectures and laboratory activities in a more student-centered way seemed to be an important positive change. In other words, more group work and more reflection on the students' part was considered to be an important by-product of STEMTEC initiatives. Two participants commented that changing the perceptions or eliminating the fear some students had of science was affected by these instructional changes because the science courses were presented in a less traditional manner, perhaps more user-friendly or hands-on.

Table 1

Content Themes Derived from Faculty Interviews

Content Themes	Frequency
STEMTEC's Ability to Facilitate Change:	
Positive impact program had on faculty	6
Negative issues concerning program	3
Challenges due to STEMTEC involvement	4
Types of Change Facilitated by STEMTEC:	
Instructional Methods:	
Group Work	6
Use of Technology	1
Project-based/Inquiry-based Learning	5
Methods of Assessment	6
Facilitation of Faculty Discourse/Collaboration	5
Investigation of New Pedagogies	7
Involvement of K-12 teachers & students	5

One professor commented that their students' "perception of a science course and of what biology was about….was where we got many rewards and sort of positive benefits." This same faculty member found that the distinction between lectures and labs became blurred once they initiated "STEMTEC" changes into their courses. Another faculty member indicated that the basis of a project must benefit either the class itself or people outside of the class. It can't just be a "do this, write it up and turn it in." There has to be some fundamental benefit. She consistently explained why they're doing something or why they're working in groups; explained that companies now want teamwork and the only way you're going to learn teamwork is by doing it.

Many of the seven professors indicated that STEMTEC impacts more than their official STEMTEC class(es) because it is impossible to separate their new teaching strategies from one class to another. In other words, STEMTEC has a positive effect on all of their courses not just the one labeled as an official "STEMTEC" course. The following quote reflects the sentiment of what many STEMTEC faculty members considered to be a benefit of their participation in the program, "STEMTEC helped me analyze that a little better by giving me some of the theory behind some of these techniques, and it also gave me a whole lot of new techniques or just variations on things I'd been doing but variations that worked better than what I'd been doing."

Challenges Due to STEMTEC Involvement

Four of the seven faculty members talked about challenges they faced due to their STEMTEC involvement. For instance, one faculty member mentioned that integrating all of the new teaching strategies/changes was overwhelming. He went on to say, "research labs, grants and graduate students must be juggled along with the STEMTEC initiatives." He further stated, "the university is not always willing to recognize STEMTEC activities and programs as important, especially for non-tenured faculty members." Another professor believed it would be important to include administrators from education and the sciences when discussing STEMTEC innovations and initiatives in the future. Finally, that same faculty member believed many higher education faculty members could learn a lot by going into K-12 classrooms.

Regarding future workshops, one professor reflected about the desire to have more outside speakers, very focused discussion topics, and the chance to learn about and practice new teaching techniques, rather than lengthy whole group discussions about last semester's STEMTEC activities. Also, a different professor would like to see instruction and activities in laboratories given more attention and discussion at future workshops.

Finally, a professor noted, "I think the big issue that the more traditional faculty have with STEMTEC approaches is that content versus process-type thing…you know, do you water down your content by doing interactive stuff?" The professor believed this concern should be addressed in order to support those embracing or about to embrace STEMTEC initiatives.

Negative Issues Concerning Program

Three of the seven faculty members made negative comments about a particular STEMTEC experience or event. For example, one faculty member indicated that faculty who specialized in technology were not well integrated into the summer workshops offered by STEMTEC. They met as an individual group rather than mixing with the biology, chemistry or other subject teachers (workshop participants). It was recommended that this issue be addressed when coordinating future workshops.

A professor indicated satisfaction with the whole STEMTEC experience with one exception. She stated, "The only cost benefit quarrels I've had with STEMTEC are when we've been asked to do something that hasn't been followed up on. Like last summer we were asked to do a portfolio and no one ever collected it or looked at it and remember asking us to do a portfolio again and this time you really need to do it. Well, all right, I suppose I believe that but…" While the lack of follow-up regarding the requests for portfolios bothered this professor, there was a more common concern that relates to this issue and that is the lack of feedback provided to the STEMTEC professors after classroom observations and/or surveys were completed. There seemed to be an uneasiness associated with the lack of results shared from those evaluation tools. In addition, it was mentioned that the timing of most evaluation requests was a bit overwhelming.

Types of Change Facilitated by STEMTEC

Five themes related to types of change facilitated by STEMTEC emerged from the content analyses. The themes are as follows: instructional methods, facilitation of faculty discourse/collaboration, investigation of new pedagogies, methods of assessment and the involvement of K-12 teachers and/or students.

Instructional Methods

Three sub-themes emerged within the theme of instructional methods: group work, use of technology, project-based and inquiry-based learning.

Group work

Group work, defined here as randomly numbering people in a group and assigning roles to each member, appears to have impacted instruction within official STEMTEC courses. Six of the seven professors indicated that group work was occurring at some level due to STEMTEC's initiatives and strategies. The technique of reporting back and discussing topics as a whole class after working in small groups has been an instructional tool introduced as a result of STEMTEC. Several interviewees reported that many adaptations of group work have occurred, including the length of time spent on group work and depth of feedback at the classroom level.

Regarding randomized groups, many professors mentioned that in theory this strategy makes sense, but occasionally in practice the fact that there are a lot of bodies crammed into a small room makes it difficult for students to move around; therefore, sometimes it is quicker to have people turn to those closest to them when forming groups.

Use of technology

One professor mentioned the use of technology both in and outside of the classroom during his interview. He introduced various types of multimedia, such as: videos, campus-housing network, computers, CD-ROMs, and teleconferencing. He indicated students are expected to become familiar with and use the required technology when enrolled in STEMTEC courses.

Project-based and inquiry-based learning

Five of the seven faculty members discussed how group work fit into the classroom instruction. Keep in mind, the distinction between group work and project-based or inquiry-based learning was sometimes blurred during the interviews. Oftentimes, a class was broken into groups and then a short-term or long-term project was chosen. A few professors had students choose different topics of interest or assigned a different topic to each group, while others offered a range of topics in which to choose. One professor required each group to interact with K-12 educators and/or students in some manner as a component of their project.

Methods of Assessment

Many issues and concerns pertaining to assessment were discussed during all of the faculty interviews. Many professors were not always comfortable with their ability to fairly and adequately evaluate their student's progress, especially in the area of group participation and the completion of group projects.

Evaluating a student's participation in a group project was considered difficult. The quality of the end product was mentioned to be one useful measurement tool and a professor's observations of a group in action during class time was another useful tool. However, many faculty members mentioned that more training was needed in the area of assessment. In particular, they were often unclear if the individuals in a group were listening to one another and whether they were they on task.

One professor believed his monitoring of group activities during class time was a real weakness. This same professor indicated that students' group work was graded on completion of the assignment alone, not on the content or quality of the work. In other words, if a student handed in her/his assignment, then she/he would receive credit.

Quizzes, tests, and research papers were typical forms of assessment routinely mentioned in the interviews. The completion of a wide range of tasks in order to finish a project or presentation was another assessment tool. This was a dichotomous issue; either the students completed the tasks or they did not.

A few professors indicated their students received either a "check" or a zero for participating in class. For example, a professor stated: "I decided if I really wanted to get them involved without fear and get them to be a little daring; I should just give them credit for being involved. And that's a new thing for me that I got through STEMTEC, too."

Another professor reflected, "now the emphasis sort of shifted to finding out what they really did learn and even then it's complicated." This statement reflects a general concern emanating from the interviews: How do you assess a student's learning? In other words, a STEMTEC classroom promotes lots of interaction and thought on the students' part. Assessment of true learning in this environment is more complex. All of the professors indicated or implied that they had slowly adapted many methods of assessment based on prior classroom experiences and new STEMTEC knowledge. For example, a professor indicated that the second time group work was assessed, each student was asked to identify the part she/he completed, and then her/his grade was based in part on her/his specific work. This feedback helped stop some of the resentment observed in previous group work where some students did not contribute to a group project, but still received credit for the project.

Another professor developed many forms of assessment, such as: narrative rather than multiple-choice tests, writing reflective essays, portfolios and self-evaluations. This same professor indicated that it may take longer to assess high-level thinking, but the end product is well worth it. In a slightly different situation, a professor, who was initially concerned that a recently transformed STEMTEC course resulted in lower overall student scores on a particular exam, concluded after some reflection "a slightly weaker class has performed as well under the new regimen. So maybe I should be more encouraged, too."

In one STEMTEC course, students evaluated themselves in their group – their contribution to the group, how well the group was working, and then they were assigned a group problem, which the group had to complete together and the professor graded.

Many professors indicated a desire for more training in the area of student assessment. Student portfolios and other similar assessment tools require a lot of time to coordinate, time some faculty members indicated they did not have. Assessing non-traditional things, such as: small group work and service learning, is a concern for some faculty members. One professor found building just one teaching experience, which was assessed, into a STEMTEC course helped promote and/or identify those students who might have otherwise overlooked teaching as a possible career.

Facilitation of Faculty Discourse/Collaboration

The interview dialogues reinforced the fact that STEMTEC has facilitated improved communication between K-12 and/or higher education professionals. Six of the seven faculty members mentioned improved communication between and among other STEMTEC members. In addition, higher education faculty members indicated an increase in peer interaction due to STEMTEC. One professor reflected upon STEMTEC's ability to improve K-16 faculty collaboration, "the other really enriching thing for me with STEMTEC was just the chance to talk to other teachers. I mean, that was so valuable and especially in K-12 biology we had some excellent high school teachers who are far ahead of college in terms of interactive stuff. I learned a lot from them." Another example of successful collaboration came from a community college faculty member who stated that a STEMTEC group had done workshops during a few of their professional development days and this along with in-house word of mouth was very effective in promoting collaboration and STEMTEC itself.

This same community college professor also commented "it's valuable for us to hear the theory behind it [instructional practices] and some new ways of applying theories that we've never thought of on our own. What I've enjoyed most about STEMTEC is all the ideas that get spread around." While this professor indicated that the sharing of ideas had often occurred, a specific example was offered where the sharing of a grading rubric among STEMTEC and NON-STEMTEC professionals ultimately created many positive dialogues and the eventual inclusion of this grading rubric in many faculty repertoires.

A university professor stated, "I think STEMTEC was phenomenally successful at getting the different faculties to talk to one another." In other words, he added, "It was the one place where scientists could gather together to talk about teaching issues." The same professor thought some of the common writing problems students were having could be addressed by a crosssection of department personnel (e.g., chemistry, biology, physics). One general meeting had already been convened to discuss this matter.

Another university professor outlined one benefit of participating in STEMTEC, "it brought me face to face with other teachers of chemistry who were wrestling with the same problems that I'm wrestling with, and who tried some of these things and have got success and other stories to tell."

Investigation of New Pedagogies

Another theme that emerged was the investigation of new pedagogies. Five of the seven professors indicated that the discussion of new instructional strategies and the implementation of some of those STEMTEC strategies was welcomed and found to be useful. For example, students "taking charge of their learning" was one important instructional goal commonly discussed during the interviews. One professor mentioned that the incorporation of many STEMTEC teaching strategies was helpful in meeting this goal. A variety of instructional tools made it possible to choose a technique that would be more successful in a given classroom situation. The faculty members interviewed did not always give specific examples of the pedagogies used; however, they admitted to using new pedagogies that had been learned and implemented due to their involvement with STEMTEC. Most of the examples cited by faculty members have been mentioned in previous sections of this report, such as: group work, project-based or inquiry-based learning.

One community college professor indicated, "STEMTEC fostered a change in expected learning outcomes. Content knowledge is one part of the picture, but students' ability to evaluate and process the skills is important or more important in some cases."

One professor from a private college indicated that obtaining student feedback was a tool that prompted the investigation of and changes to classroom instruction. This faculty member found involving students in the process of learning had a twofold effect. First, students took ownership of their learning; and second, the instructor was able to adapt certain aspects of classroom instruction to better meet the needs of the students.

Involvement of K-12 Teachers and/or Students

Many examples of faculty and student involvement of K-12 teachers and/or students were presented during the interviews. Keep in mind, five of the seven faculty members mentioned their involvement and/or their students involvement with K-12 teachers and students. One example of K-12 teacher involvement was already mentioned in the *Facilitation of Faculty Collaboration* section where high school teachers interacted with college and university professors on a regular basis. Another example involved a community college professor who required students to connect with a K-12 teacher and her/his classroom in order to complete a service-learning project.

There were two different examples where elementary school children were brought to a higher education institution to learn about science; however, it was not clear whether or not these two events were driven by STEMTEC initiatives and/or funds.

A community college faculty member indicated that STEMTEC should take the K-12 connection to the next level. She stated, "the K-12 connections that have been developed should be institutionalized so teachers do not have to individually make the connection year after year." This professor believed the institutions, with STEMTEC's help, should find some way to support these relationships.

Discussion

The information developed from the seven faculty interviews represent meaningful evaluative indicators of STEMTEC's impact on a particular group of professors, and ultimately, their students. This qualitative analysis highlighted some very positive aspects of the program's activities, which reflects well upon some of the STEMTEC goals and objectives.

Evidence from the faculty interviews indicated that college and university faculty members are learning and adopting new pedagogic approaches to some extent. Further research needs to occur in order to determine to what degree new pedagogical techniques have been implemented. Quantifying the extent to which faculty have learned and implemented new teaching approaches will require specific classroom observation techniques along with additional student and faculty surveys. The interview questions included in these analyses did not yield specific, detailed information regarding pedagogy; however, the majority of faculty members made reference to the use of new teaching techniques during the interviews. The problem is that these comments were made oftentimes without providing concrete examples.

In addition, several faculty members expressed the desire for an increase in pedagogical/instructional support. Perhaps "instructional" workshops at future STEMTEC events could address this issue. While it may be difficult to implement, creating more informal support and dialogue among faculty members might also be helpful to members who are developing and implementing STEMTEC instructional techniques.

The use of technology appears to be an area in which more workshop time may be well received and may benefit those faculty members involved with STEMTEC. It is possible that the role technology plays in a course is dependent upon the subject matter, the instructor's preference and level of her/his knowledge of technology. While technology usage was mentioned by one professor during the faculty interviews, the low frequency of this discussion topic supports the idea that more time could be spent in better preparing STEMTEC faculty members in using various types of multi-media during classroom instruction.

Another theme that reflected a need for further attention is *methods of assessment.* Faculty members indicated a real need and desire to receive further training on assessment of students. Future workshop time might be utilized for this purpose.

One issue involving the institutionalization of STEMTEC deserves further attention. It involves institutionalizing the K-12 relationships that are formed with higher education faculty on an annual basis rather than having individual college and university faculty members and/or K-12 educators making new connections on an ad hoc basis. Perhaps a more widely recognized and accepted connection can be constructed, so that institutional relationships remain intact from year to year. In some cases, this is already happening at the level of individual faculty and K-12 educators. The connection to K-12 public education should be maintained at the college/university level so future teachers learn in a higher education environment that reflects STEMTEC initiatives and realistic K-12 experiences, which could potentially produce more effective K-12 science and mathematics teachers.

The concerns regarding the timing and feedback of various evaluative tools can be easily corrected in the future. Well-developed evaluation tools as well as well-timed distribution of these tools will foster a more cooperative atmosphere. An equally important issue revolves around providing all STEMTEC faculty members with feedback on their participation in any and all evaluation processes.

Table 2 summarizes the positive and negative findings discussed in this report. It is important to remember that much time has passed since the actual interviews were conducted; therefore, perhaps many of the recommendations outlined in the discussion section have already been considered and/or implemented.

Table 2

Summary of Positive and Negative Interview Findings

Positives	**Negatives**
Increased awareness of teaching styles	Unstructured interview methodology
Impact on STEMTEC and NON-STEMTEC courses	Difficulty in integrating new teaching strategies
Facilitation of faculty collaboration	Lack of follow-up with evaluation tools
Increased involvement of K-12 students and teachers	Need for increased knowledge regarding assessment methods
Investigation of new pedagogical techniques	Technology

Limitations of the Study

A significant limitation of this study relates to the interview technique used. The interview format was unstructured and standardized questions were not used throughout the interviews. If the interview instrument had been pilot-tested, perhaps many of the “bugs” could have been worked out before the actual interviews took place. These issues adversely affected the evaluation team’s ability to compare the content of each interview. In addition, the interview questions did not elicit specific enough information regarding many important STEMTEC initiatives, particularly in the areas of improved or different instructional techniques, and in the recruitment of underrepresented minority teachers.

A second significant limitation of this study is that only a small number of STEMTEC faculty were interviewed. The original sample of 14 teachers was small, and we received transcripts from only half of them.

Conclusion

In conclusion, the content analyses of the seven faculty who were interviewed indicated that the STEMTEC program has had, and continues to have, a positive impact on K-16 education professionals. The findings discussed in this paper have important implications for students, K-12 teachers and higher education faculty. These implications are important to the long-term success of the STEMTEC program as well as its affect on K-16 science and mathematics instruction.

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Analysis of Course Evaluation Data at UMASS

Stephen G. Sireci

Analysis of Course Evaluation Data at UMASS

Collecting feedback from students about their experiences in the classroom is an important component of the educational evaluation process. At the University of Massachusetts Amherst, the Office of Academic Planning and Assessment (OAPA) developed the Student Response to Instruction (SRTI) form for this purpose. This course evaluation survey is used by about 60% of the courses at UMASS. According to guidelines for interpreting SRTI results, it is designed to be “appropriate for the wide variety of instructional styles and courses taught at UMASS Amherst” (OAPA, 2000).

There are several reasons why the SRTI has utility for evaluating the benefits of STEMTEC instruction. First, a mechanism is already in place for administering and scoring these surveys. Second, many courses are already using this form, which avoids the added burden of administering an additional survey to students. Third, these surveys are used in both STEMTEC and non-STEMTEC courses. A difficult part of evaluating STEMTEC is gathering comparison data from non-STEMTEC courses. There are no incentives for non-STEMTEC instructors to administer a form. The SRTI represents a standardized metric on which STEMTEC and non-STEMTEC courses could be compared.

This report summarizes a comparison of students’ responses to SRTI items across STEMTEC and non-STEMTEC courses. From the outset, it should be noted that this comparison is non-experimental. The data from only some STEMTEC instructors were available and some departments, such as physics, were excluded from analysis for logistical reasons. Nevertheless, as is evident from the SRTI items, these comparisons should be useful for evaluating the degree to which STEMTEC has influenced the redesign of science and math curricula to promote student active learning at UMASS.

The SRTI is presented in Appendix I. It contains twelve selected response items and three open-ended questions. Only the selected response data were available for analysis. The first nine of these items are considered “core items.” These items “reflect six teaching constructs important to facilitating student learning and achievement: skill and clarity, course structure, teacher availability and rapport with students, feedback to students, classroom interaction, and stimulation of student interest” (OAPA, 2000). The three remaining items are “global” items that “ask students about their *overall* evaluations of how much they have learned in the course, the effectiveness of the instruction, and rating of the course as a whole” (OAPA, 2000).

Although the data on all items are of interest to the STEMTEC evaluation, we are particularly interested in comparing STEMTEC and non-STEMTEC classes on the following questions:

The instructor used class time well.

The instructor inspired interest in the subject matter of this course.

The instructor provided useful feedback on your performance.

The methods of evaluating your work were fair.

The instructor stimulated useful class participation.

Overall, how much do you feel you have learned in this course?

Method

Participants

Informed consent was solicited from all department chairs in which STEMTEC courses were taught and from all STEMTEC faculty. The initial intent was to compare the SRTI data for STEMTEC and non-STEMTEC faculty within each department. Unfortunately, only 17 STEMTEC faculty returned the informed consent forms, which made within-department comparisons infeasible. Therefore, the SRTI responses for these 17 faculty were compared with the SRTI responses from the remaining faculty for which data were available. SRTI responses from the Physics department were not included due to the fact that those data are scored separately and were not acquired in time for this report. Therefore, the analyses reported here are based on a comparison of the responses from students of these17 STEMTEC faculty to the responses of all other students in the SRTI database for the Fall 2000 and spring 2001 semesters. Although this analysis is not a pure comparison of STEMTEC vs. non-STEMTEC instruction, it provides some external analysis of students' perceptions of STEMTEC instruction vis-à-vis a nonequivalent, but relevant, comparison group.

It should be noted that the average class sizes for the STEMTEC and other groups were comparable. For the fall data the mean enrollment for the 17 STEMTEC professors' courses was 133.22 and the mean enrollment for the other courses was 107.56. For the spring data, the mean enrollments were 112.88 and 110.36 for the STEMTEC and other courses, respectively.

Analyses

Independent samples t-tests were conducted for each SRTI item. Data from the fall 2000 and spring 2001 semesters were analyzed separately. The unit of analysis was individual students' SRTI responses. The grouping variable for the analysis was STEMTEC (i.e., one of the 17 STEMTEC professors who gave informed consent) vs. other instructors; the dependent variable was SRTI item response. In addition to statistical significance, effect sizes were calculated for each item. The effect sizes reported here are delta effect size indices, which express the mean difference between groups in terms of standard deviation units. Effect sizes of .20 or greater (i.e., two-tenths of a standard deviation unit) are generally considered to indicate a small effect, with moderate effects signified by deltas of .30 or larger. Effect sizes of .40 and above signify a large effect. Given the large sample sizes involved in these analyses, statistical significance is less substantive than large effect sizes. Therefore, only those items that exhibited effect sizes larger than .20 were considered to represent meaningful differences across groups.

To serve as a validity check for our effect size criterion and to help gauge *meaningful* differences across STEMTEC and non-STEMTEC data, independent t-tests were conducted on all SRTI items using two *randomly* sampled (without replacement) groups of students. These analyses are reported in Table 1. Given that these comparisons are based on random samples, it is no surprise that all effect sizes are zero. Thus, the effect size criterion seems reasonable for the identification of substantive differences on SRTI items across STEMTEC and non-STEMTEC groups. A statistically significant mean difference at $p < .05$ was observed for the item “Overall, how much do you feel you have learned in this course?”, which shows that statistical significance is not an appropriate criterion for flagging meaningful differences between the STEMTEC and non-STEMTEC groups. Nevertheless, items that achieved a Bonferroni-corrected level of statistical significance (i.e., $p<.004$) were flagged in the analyses.

Table 1

Comparison of Two Random Samples of UMASS Students’ Course Evaluation Data (n_1=29,199, n_2=29,555)

SRTI Item[a]	**Sample A**		**Sample B**		**Mean Difference**	**Effect Size**[b]
	Mean	St. Dev.	Mean	St. Dev.		
The instructor was well prepared for class.	4.67	.64	4.67	.63	0.00	.00
The instructor used class time well.	4.40	.85	4.39	.85	0.01	.00
The methods of evaluating your work were fair.	4.29	.93	4.28	.93	0.01	.00
The instructor explained course material clearly.	4.27	.90	4.28	.90	-0.01	.00
What is your overall rating of this instructor’s teaching?	4.19	.96	4.19	.96	0.00	.00
The instructor showed a personal interest in helping you learn.	4.17	1.04	4.16	1.04	0.01	.00
The instructor cleared up points of confusion for you.	4.17	.96	4.17	.96	0.00	.00
The instructor inspired interest in the subject matter of this course.	4.05	1.07	4.05	1.07	0.00	.00
The instructor stimulated useful class participation.	3.95	1.11	3.94	1.12	0.01	.00
The instructor provided useful feedback on your performance.	3.81	1.18	3.80	1.20	0.01	.00
What is your overall rating of this course?	3.79	1.03	3.78	1.03	0.01	.00
Overall, how much do you feel you have learned in this course? **c**	3.75	1.02	3.73	1.03	0.02	.00

Notes: [a]All items were answered on a six-point scale, with 6 representing the most favorable response (see Appendix I). [b]Effect size is the delta index (mean difference/standard deviation).None of the items were statistically significant at $p\leq .01$. [c]The mean difference on this item was statistically significant at $p\leq.05$.

Results

The results of the t-test analyses for Fall 2000 and Spring 2001 are presented in Tables 2 and 3, respectively. In each table, the items are presented in descending order according to the mean difference between groups. For the fall data, the mean scores on all 12 items were higher for the 17 STEMTEC professors than for the other professors. The effect sizes associated with these differences were greater than .20 for five of these items: *The instructor stimulated useful class participation*, *The instructor showed a personal interest in helping you learn*, *The instructor used class time well*, *The methods of evaluating your work were fair,* and *What is your overall rating of this instructor's effectiveness?*

Table 2

Comparison of SRTI Responses of UMASS Students From Selected STEMTEC Courses (n=526) and Other Courses (n=32,088) For Fall 2000

SRTI Item[a]	**STEMTEC**		**Other**		**Mean Difference**	**Effect Size**[b]
	Mean	St. Dev.	Mean	St. Dev.		
The instructor stimulated useful class participation.	4.25	0.92	3.92	1.13	0.33[c]	0.29
The instructor showed a personal interest in helping you learn.	4.46	0.82	4.18	1.03	0.28[c]	0.27
The instructor used class time well.	4.63	0.61	4.40	0.85	0.23[c]	0.27
The methods of evaluating your work were fair.	4.50	0.77	4.28	0.93	0.22[c]	0.23
What is your overall rating of this instructor's teaching?	4.41	0.78	4.19	0.96	0.22[c]	0.23
The instructor inspired interest in the subject matter of this course.	4.27	0.91	4.08	1.07	0.19[c]	0.18
The instructor explained course material clearly.	4.43	0.78	4.27	0.91	0.16[c]	0.17
The instructor provided useful feedback on your performance.	3.98	1.13	3.83	1.18	0.15[c]	0.13
The instructor cleared up points of confusion for you.	4.30	0.86	4.16	0.97	0.14[c]	0.14
The instructor was well prepared for class.	4.80	0.45	4.68	0.62	0.12[c]	0.19
What is your overall rating of this course?	3.89	0.93	3.81	1.04	0.08	0.07
Overall, how much do you feel you have learned in this course?	3.78	0.99	3.77	1.02	0.01	0.00

Notes: [a]All items were answered on a six-point scale, with 6 representing the most favorable response (see Appendix I). [b]Effect size is the delta index (mean difference/standard deviation). [c]Statistically significant at $p<.004$.

It should also be noted that the mean ratings for the selected STEMTEC professors were generally high. Nine of the 12 items had means greater than 4.0 on the six-point scale. The comparison group had means greater than 4.0 on eight of the items.

Unfortunately, these positive results did not hold up for the spring 2001 data. For 10 of he 12 SRTI items, the data from the 17 STEMTEC instructors' students had *lower* means than the other group. Although five of these differences were statistically significant at p < .004, none of them reached the .20 effect size criterion for a meaningful difference across groups. Nevertheless, it was disappointing that the positive effects observed in the fall 2000 data were not replicated for the spring 2001 data.

Table 3

Comparison of SRTI Responses of UMASS Students From Selected STEMTEC Courses (n=526) and Other Courses (n=32,088) For Spring 2001

SRTI Item[a]	**STEMTEC**		**Other**		**Mean Difference**	**Effect Size**[b]
	Mean	St. Dev.	Mean	St. Dev.		
The instructor stimulated useful class participation.	3.79	1.10	3.98	1.10	-0.19[c]	0.17
The instructor provided useful feedback on your performance.	3.67	1.21	3.85	1.17	-0.18[c]	0.16
The instructor showed a personal interest in helping you learn.	4.04	1.13	4.18	1.03	-0.14[c]	0.14
The instructor inspired interest in the subject matter of this course.	3.95	1.10	4.09	1.06	-0.14[c]	0.13
Overall, how much do you feel you have learned in this course?	3.64	1.03	3.78	1.02	-0.14[c]	0.14
The instructor cleared up points of confusion for you.	4.15	0.99	4.21	0.94	-0.06	0.07
What is your overall rating of this instructor's teaching?	4.17	0.98	4.22	0.94	-0.05	0.06
The instructor explained course material clearly.	4.28	0.90	4.32	0.88	-0.04	0.05
The instructor used class time well.	4.42	0.83	4.43	0.83	-0.01	0.11
The instructor was well prepared for class.	4.72	0.57	4.69	0.60	0.03	0.00
The methods of evaluating your work were fair.	4.34	0.92	4.30	0.93	0.04	0.05
What is your overall rating of this course?	3.73	1.06	3.83	1.02	0.10	0.10

Notes: [a]All items were answered on a six-point scale, with 6 representing the most favorable response (see Appendix H). [b]Effect size is the delta index (mean difference/standard deviation). [c]Statistically significant at p<.004.

It is interesting to note that the STEMTEC group obtained lower means on all 12 SRTI items in spring 2001 than in fall 2000, while the other group obtained slightly higher means on 11 items and the same mean on the twelfth item. These two differences explain the juxtaposition of the fall and spring findings. Differences between the courses taught in the fall and spring semesters should be explored to help explain these findings.

Discussion

The results of this study indicate that the participating UMASS STEMTEC faculty were rated very favorably by their students during the fall 2000 semester. Relative to a nonequivalent comparison group, they earned significantly higher ratings on five course evaluation items. The results also indicate that these faculty were rated less favorably in the spring 2001 semester, relative to their own fall 2000 data and to the comparison group. A detailed analysis of the courses taught during these semesters should be conducted to help explain why there was such a difference between the fall and spring semesters. Interviews with STEMTEC faculty may also be helpful in this regard. If it can be determined that the courses taught in the fall followed the STEMTEC teaching philosophy while those taught in the spring did not, then some evidence that students regarded STEMTEC-influenced courses more favorably will be obtained.

The SRTI course evaluation data seem useful for comparing students' impression of instructional quality across STEMTEC and non-STEMTEC courses. A serious limitation of the present study is that only a small sample of STEMTEC professors was included in the STEMTEC group. A further limitation is that only course evaluation data at UMASS were gathered. We recommend that this study be repeated on STEMTEC and non-STEMTEC courses that are matched on relevant variables such as course content and the student composition of the class.

Reference

Office of Academic Planning and Assessment. (2000). Student Response to Instruction (SRTI): Interpreting your results. Retrieved November 29, 2000, from the World Wide Web: http://www.umass.edu/oapa/SRTI/results.html.

Summary and Recommendations

STEMTEC Year 4 Evaluation Summary and Recommendations

The Year 4 evaluation of STEMTEC was extremely comprehensive, involving surveys of students and faculty, interviews with faculty and campus coordinators, analysis of course evaluation data, and classroom observations. In general, the program appears to be achieving many of its goals. Strengths of the program became evident, as did some limitations. In addition, suggestions for improvement were obtained.

With respect to its strengths, the results conclusively indicate that STEMTEC has had a positive effect on getting math and science teachers to reform their teaching to facilitate student-active learning. The faculty survey, the student surveys, the campus coordinator interviews, and the classroom observations all provided data that the STEMTEC teaching philosophy is being successfully applied in STEMTEC classrooms.

The results also suggest that STEMTEC is providing rewarding teaching experiences for many math and science students. The teaching scholars rated their teaching experiences highly, and the campus coordinators thought this was one of the most positive aspects of the program. In addition, many of the faculty incorporated teaching experiences into their classes or invited K-12 teachers into their classes. Other faculty reported that more needs to be done in this area and requested help from STEMTEC to coordinate K-12 connections.

With respect to areas of weakness, STEMTEC does not appear to be achieving success in recruiting underrepresented minorities into the math and science teaching profession. This finding was particularly evident from the campus coordinator interviews. Although the difficulty of this task is acknowledged, there are virtually no activities specifically targeted to this project goal.

Another area in need of improvement is bringing faculty of the same discipline from different campuses together for professional development and collegial sharing of ideas and practices. The campus coordinator interviews and the faculty surveys both indicated a desire for more inter-campus sharing among faculty.

To summarize our findings, we revisit the evaluation questions around which the evaluation was organized. Subsequently, we provide recommendations for improving STEMTEC during its fifth year of operation.

(a) <u>Has STEMTEC facilitated redesign of the science and math curricula on the campuses?</u>
(b) <u>Has STEMTEC facilitated the incorporation of new pedagogies on the campuses?</u>
(c) <u>Has STEMTEC established mechanisms for supporting faculty in their course redesign?</u>

As stated in the previous section, the evaluation results suggest affirmative answers to these questions. All sources of evaluation data that addressed these questions (i.e., faculty surveys, student surveys, classroom observations, campus coordinator interviews, faculty interviews) resoundingly supported the conclusion that STEMTEC has invigorated teaching within science and math classrooms and has resulted in more student-active learning.

(d) Has STEMTEC improved the preparation of K-12 math and science teachers?

This evaluation question is more difficult to answer and it was difficult to gather evaluation data to answer it directly. Some results support an affirmative answer. For example, STEMTEC is providing teaching experiences for prospective math and science teachers and is discussing such career options in some classes. However, the student learning experiences survey suggests that more teaching experiences should be provided. Although it is somewhat of an intellectual leap, the fact that reformed teaching practices are being implemented in STEMTEC classes suggests that improved learning is taking place in those classes and better teaching is being modeled. Thus, the evaluation results provide some preliminary evidence to suggest that STEMTEC is accomplishing this goal.

(e) Has STEMTEC recruited new math or science teachers?
(f) Has STEMTEC improved the retention of math or science teachers?
(g) Has STEMTEC recruited under-represented minorities into the math/science teaching profession?
(e) Has STEMTEC improved the retention rates among under-represented minority math/science teachers?

It is also difficult to provide unequivocal answers to these evaluation questions since baseline data regarding the production of math and science teachers by the STEMTEC campuses are unavailable. Given the evaluation data, our impressions are that STEMTEC is recruiting more math and science teachers (e.g., evaluation of teaching scholars program), but it is not succeeding in recruiting underrepresented minorities into the math and science teaching professions.

With respect to retention of math and science teachers, no data exist to answer this question. It may take several years after the STEMTEC project ends to evaluate its longer-term effects regarding retention of math and science teachers.

(f) Has STEMTEC effectively supported K-12 math and science teachers?

More data needs to be gathered to address this question and we suggest that this be a focus of the Year 5 evaluation. Given the data gathered from the faculty and campus coordinators, it appears that STEMTEC has provided some support for these teachers, but more can be done in this area.

(g) Are there important elements of STEMTEC that would benefit other K-12 and postsecondary institutions?

Given the high praise that STEMTEC workshops and other professional development activities obtained, it seems clear that its principles and practices would generalize to and benefit other K-12 and postsecondary institutions. We encourage STEMTEC to package its instructional materials for wider dissemination.

(h) Is the collaborative fully implemented?
(i) Is the collaborative running efficiently?

The Collaborative is operating on all eight campuses and is achieving some level of participation on all campuses. However, at this juncture, it appears that the program is running well on each individual campus, but the inter-campus aspects of the program could be improved. Both the campus coordinators and STEMTEC faculty called for more inter-campus dialogue and professional development activities.

(j) What are the strengths and weaknesses of the STEMTEC program?

Many of the strengths and weakness of the program are evident from the answers to the previous questions. In general, the strengths of STEMTEC include its effect on the teaching of science and math, its connections between K-12 and college classrooms, and providing financial support and teaching experiences for college students interested in teaching math or science. Its weaknesses include inability to recruit underrepresented minorities and building more collegiality among faculty from different campuses.

(k) What improvements can be made?

The evaluation data provided several suggestions to be considered for improving STEMTEC. These suggestions include

- Develop program initiatives to recruit underrepresented minorities into the math and science teaching professions. Hire staff whose specific responsibilities are to implement and coordinate these recruitment efforts.
- Use the STEMTEC administration to coordinate connections between STEMTEC and K-12 classes.
- Provide more K-12 teaching opportunities for students in STEMTEC classes.
- Conducting more multi-campus professional development activities.
- Integrate the Teaching Scholars Program with the other STEMTEC activities. A relationship should be initiated between the Campus Coordinators and the teaching scholars on their campuses. The teaching scholars should be made more aware of STEMTEC course offerings.
- Provide more feedback to STEMTEC faculty regarding the success of their reformed teaching practices.
- Recruit new faculty into the STEMTEC program.
- Come up with a systematic procedure for identifying STEMTEC courses on campus and for advertising these courses to students.

- Develop handouts on teaching careers for STEMTEC instructors to disseminate in their classrooms.

- Provide STEMTEC faculty with training on the assessment of student work.

- Develop mechanisms for broad dissemination of STEMTEC instructional material.

We hope these suggestions are helpful for improving STEMTEC during its fifth and perhaps final year of funding.

Appendix A

STEMTEC 2000/2001 Evaluation Plan Matrix

STEMTEC 2000/2001 Evaluation Plan Matrix

Project Goal	Evaluation Questions	Data Collection Techniques					
		Survey Students[1]	Survey Faculty	Interview Key Person[2]	Class Observ.	Analyze External Data[3]	Document Analysis
Redesign science and math curricula …to incorporate new pedagogies and establish mechanisms for supporting faculty in course redesign	(a) Has STEMTEC facilitated redesign of the science curricula on the campuses? (b) Has STEMTEC facilitated redesign of the math curricula on the campuses? (c) Has STEMTEC facilitated the incorporation of new pedagogies on the campuses? (d) Has STEMTEC established mechanisms for supporting faculty in their course redesign?	4	4	4	4	4	4
Improve preparation of future K-12 teachers of mathematics and science	(a) Has STEMTEC improved the preparation of K-12 math and science teachers?	4	4	4	4	4	4
Recruit and retain promising students into the math and science teaching profession, with special attention to underrepresented groups	(a) Has STEMTEC recruited new math or science teachers? (b) Has STEMTEC improved the retention of math or science teachers? (c) Has STEMTEC recruited under-represented minorities into the math/science teaching profession? (d) Has STEMTEC improved the retention rates among under-represented minority math/science teachers?	4		4			4

[1] Includes surveys of students in STEMTEC and non-STEMTEC classes as well as the Teaching Scholar Survey.
[2] Includes interviews of STEMTEC faculty, campus coordinators, and administrators.
[3] Includes analysis of campus-wide and departmental course evaluation data (e.g., SRTI at UMASS).

Project Goal	**Evaluation Questions**	**Data Collection Techniques**					
		Survey Students[1]	Survey Faculty	Interview Key Person[2]	Class Observ.	Analyze External Data[3]	Document Analysis
Develop a program to support new science and math teachers in their first year in the classroom	(a) Has STEMTEC effectively supported K-12 math and science teachers?	4	4	4			
Establish dissemination mechanisms	(a) Are there important elements of STEMTEC that would benefit other K-12 and postsecondary institutions? (b) Are the successes of STEMTEC known at the local, regional, national, and international levels?			4			4
Establish a functional educational collaborative	(a) Is the collaborative fully implemented? (b) Is the collaborative running efficiently?		4	4			4
Conduct strong programs of evaluation and assessment	(a) What are the strengths and weaknesses of the STEMTEC program? (b) What improvements can be made?	4	4	4	4	4	4

[1] Includes surveys of students in STEMTEC and non-STEMTEC classes as well as the Teaching Scholar Survey.
[2] Includes interviews of faculty, campus coordinators, and administrators.
[3] Includes analysis of campus wide and departmental course evaluation data (e.g., SRTI at UMASS).

Appendix B

STEMTEC Evaluation Time Line

APPENDIX B

STEMTEC EVALUATION PROJECT: Time Line for Specific Tasks 2000-2001

Evaluation Activity	**Goals**	**2000**				**2001**							
		Sept.	Oct	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.
Develop *Teaching Interest Survey*	4, 7	X											
Administer *Teaching Interest Survey*	4, 7	X	X										
Develop database of STEMTEC courses	2, 7		X	X	X	X	X	X					
Develop database of STEMTEC faculty	2, 7		X	X	X	X	X	X					
Develop database of STEMTEC students	2-4, 7		X	X	X	X	X	X	X	X	X	X	
Review prior & core evaluation instruments	1-7		X	X	X	X							
Review prior, unreported evaluation data	1-7		X	X	X	X	X	X					
Obtain faculty interview transcripts	2, 7		X	X									
Document program activities	1-7		X	X	X	X	X	X	X	X	X	X	X
Develop *Teaching Practices Survey*	2, 7					X	X	X					
Develop *Faculty Evaluation Survey*	2-5, 7					X	X	X					
Develop *Student Evaluation Survey*	2-5, 7					X	X	X					
Document STEMTEC's recruitment/retention activities	4, 7			X	X	X	X	X	X	X	X	X	
Administer *Teaching Practices Survey*	2, 3, 7									X			
Administer *Faculty Evaluation Survey*	2-5, 7									X			
Administer *Student Evaluation Survey*	2-5, 7									X			
Analyze survey data	2-5, 7									X	X	X	
Select classroom observation protocol	2				X	X	X						
Train observers to use classroom observation protocol	2							X	X				
Conduct classroom observations	2								X	X			
Produce report on classroom observations	2										X	X	X
Conduct campus coordinator interviews	2-5, 7									X	X		
Produce recommendations regarding dissemination activities	6											X	X
Produce 2000/2001 evaluation report	1-7												X

Appendix C

Description of STEMTEC Databases

Development of STEMTEC Databases

The STEMTEC Evaluation team obtained information from many sources to create four different databases[1]. One of the newly formed databases used faculty and course information obtained from an Access database created by STEMTEC personnel. A second database, "Official Courses from STEMTEC Web Page," contains all of the "officially approved" courses taught by STEMTEC professors. This information was copied from the STEMTEC web page. The STEMTEC evaluation team used various lists that were given to them to create a third database, the "Teaching Scholar Award Recipients" database. A fourth database was created from the Teaching Interest Survey that was conducted on all eight STEMTEC campuses during Fall 2000. Brief descriptions of the four databases are provided in this Appendix.

STEMTEC Faculty Database

The STEMTEC Faculty Database contains relevant information concerning STEMTEC faculty members. There are 277 cases in this file with seven variables for each case. The first variable is the "School Name." The second and third variables contain the last name and first name of each STEMTEC faculty member, respectively. The fourth variable is social security number, "SSNum." The fifth and sixth variables are school telephone number, "SchPhone" and school extension, "SchExt," respectively. The seventh and final variable is "E-mail Address."

Official STEMTEC Courses Database

This database contains the most up-to-date listing of official STEMTEC courses. This information was obtained from the STEMTEC web page. This is considered to be the most accurate list of approved STEMTEC courses. Courses from each of the eight institutions involved in the STEMTEC collaborative are included. The database contains four variables. The first variable is "Institution". The second variable is "Sem. Offered," which represents the semester the course is taught. The third variable is "Course Num and Title" representing the STEMTEC course number and course title. The last variable is the "Instructor."

In addition, each of the 107 cases is linked to an individual institution's web page, which allows an interested person to obtain more detailed information about each particular STEMTEC course. For instance, double clicking on "CHEM 10 Energy and Entropy" will bring you to a course description on the Amherst College web page.

A summary of the cases in the database is presented in Table C-1. The number of STEMTEC courses conducted on each campus for each semester is provided.

Table C-1

Official STEMTEC Courses by Institution
(From STEMTEC Course Database)

[1] We extend our thanks to Valerie Huey and Adrienne Gauthier for their help and guidance in collecting and understanding these data. Both individuals are students employed by the STEMTEC, who gathered and entered much of the data contained in the first three databases described here.

	Fall 2000	Spring 2001	Semester Not Identified
Amherst		3	5
GCC		5	10
Hampshire		4	11
HCC	6		7
MHC		3	8
Smith		2	2
STCC		6	4
UMass		10	22

Teaching Scholar Award Recipients Database

The Teaching Scholar Award Recipients database contains identifying information about Teaching Scholar award recipients involved in the STEMTEC program. There are 135 cases in this database. The first variable is "Name," which includes last name, then first name as one variable. The second, fourth and sixth variables represent the following academic school years, "1998-99," "1999-00" and "2000-01," respectively. If a "1" is placed in one of these variable columns, then the person listed in that row was a Teaching Scholar award recipient during that specific school year. For example, one would know that John Smith received a Teaching Scholar award during the 1998-99 and 1999-00 school years because there is a "1" in the corresponding variable columns.

The third, fifth and seventh variables are "Institution." These variables indicate the institution in which the Teaching Scholar student was enrolled during a specific academic year. An "Institution" variable is placed after each academic year variable (i.e., 1998-1999, 1999-00).

The eighth variable is social security number, "SSNum." The ninth variable is "Street Address." The tenth, eleventh and twelfth variables are "City," "State" and "Zip Code," respectively. The last variable is "E-mail Address."

Table C-2 presents a summary of the information contained in the Teaching Scholars database. This table lists the number of Teaching Scholars at each institution for each year.

Table C-2

STEMTEC Teaching Scholar Award Recipients by Institution
(From Teaching Scholar Award Recipients Database)

	Amherst	GCC	Hampshire	HCC	MHC	Smith	STCC	UMass	Total
1998-99	4	7	3	4	12	3	2	16	51
1999-00	3	4	10	5	12	3	5	32	75
2000-01	1	1	7	5	8	2	7	31	62

Teaching Interest Database

In early October 2000, selected classes at all eight STEMTEC institutions were surveyed to acquire baseline data for tracking students' interest in teaching math and science. A total of 950 students were surveyed and student ID numbers were obtained for 772 (81%) for the purpose of conducting follow-up surveys. This database and the results of this survey are described in a separate chapter of this report

Summary

The four databases outlined in this report will play an instrumental role in the current evaluation of the STEMTEC program. Each file will assist the evaluation team in determining who will be surveyed, interviewed and/or where we will conduct a classroom observation. In addition, the databases will help us quantify important statistics concerning the STEMTEC program's success.

Appendix D

Faculty Survey Spring 2001

STEMTEC Faculty Survey -- Spring 2001

Dear Colleague: The purposes of this survey are:

(1) to evaluate the strengths and weaknesses of the STEMTEC program, and
(2) to determine the effects of STEMTEC on classroom instructional practices.

We would greatly appreciate it if you could take a few minutes to complete this questionnaire and return it in the enclosed envelope. Your responses will be kept completely confidential. Thank you very much for your time and consideration.

Background Information

1. What is your position at your institution?

☐ Teaching Assistant
☐ Instructor
☐ Assistant Professor
☐ Associate Professor
☐ Professor
☐ Lecturer
☐ Other: ____________________

2. What is your sex? ☐ Female ☐ Male

3. Please rate the following aspects of the STEMTEC Project using the rating scale provided.

How do you rate the:	Very Good	Good	Acceptable	Poor	Very Poor
support offered by STEMTEC for course redesign and development.	☐	☐	☐	☐	☐
the ongoing course support offered by STEMTEC.	☐	☐	☐	☐	☐
STEMTEC's mechanisms for networking with colleagues.	☐	☐	☐	☐	☐
the Roundtable Talks organized by the STEMTEC staff.	☐	☐	☐	☐	☐
mechanism for information dissemination established by the STEMTEC program.	☐	☐	☐	☐	☐
evaluative feedback you have received from STEMTEC.	☐	☐	☐	☐	☐

4. To what extent do you apply teaching and assessment practices advocated by STEMTEC **in your STEMTEC-affiliated classes**?

☐ To a great extent ☐ Somewhat ☐ Very little ☐ Not at all

5. To what extent do you apply teaching and assessment practices advocated by STEMTEC **in your other classes that are not affiliated with STEMTEC**?

☐ To a great extent ☐ Somewhat ☐ Very little ☐ Not at all

6. In addition to the courses for which you have received STEMTEC support for development or revision, in how many **other** courses are you applying the teaching or assessment practices advocated by the STEMTEC program?

____

7. In your opinion, to what extent have STEMTEC practices had an effect on the teaching methods used by **other faculty in your department** that are not affiliated with STEMTEC?

☐ To a great extent ☐ Somewhat ☐ Very little ☐ Not at all

8. Would you like to have more opportunities to be involved with STEMTEC during the academic year? ☐ Yes ☐ No

9. Would you like to have more opportunities to be involved with STEMTEC during the summer months? ☐ Yes ☐ No

10. In your STEMTEC courses, about how often per term do you collaborate with K-12 teachers?

☐ Often ☐ Sometimes ☐ Seldom ☐ Never

11. In your STEMTEC courses, about how often per term do your students collaborate with K-12 teachers?

☐ Often ☐ Sometimes ☐ Seldom ☐ Never

12. In your STEMTEC courses, about how many times per term do you provide students with information about teaching in grades K-12?

☐ Often ☐ Sometimes ☐ Seldom ☐ Never

13. Listed below are various teaching strategies. For each strategy, consider how often you used it both BEFORE and AFTER becoming involved with STEMTEC. For each strategy, choose the one response that best indicates the degree to which your use of the teaching strategy has changed over this period.

How often did/do students:	Used More Before STEMTEC	No Difference	Use More After STEMTEC
Work with other students where the whole group gets one grade?	☐	☐	☐
Participate in whole-class discussions during which the teacher talks less than the students?	☐	☐	☐
Write descriptions of their reasoning?	☐	☐	☐
Work on problems related to real world or practical issues?	☐	☐	☐
Perform investigative activities that include data collection, analysis, and various types of representation?	☐	☐	☐
Make connections to other science, mathematics, and technology (SMT) fields?	☐	☐	☐
Make connections to other non-SMT fields?	☐	☐	☐
Design and make presentations that help them learn class concepts?	☐	☐	☐
Evaluate the extent of their own learning?	☐	☐	☐
Complete assessments or assignments that include:			
a. problems with complex solutions?	☐	☐	☐
b. portfolios?	☐	☐	☐
c. multiple choice/short answer items?	☐	☐	☐
d. full-length papers?	☐	☐	☐
Use technology (e.g., computers) in class?	☐	☐	☐
Have a voice in decisions about course activities?	☐	☐	☐
Work in pairs or small groups?	☐	☐	☐
Work on in-class problem solving?	☐	☐	☐
Participate in hands-on activities?	☐	☐	☐
Have an opportunity to provide you with feedback?	☐	☐	☐
Have the opportunity to ask questions in class?	☐	☐	☐
Discuss learning and/or teaching strategies and approaches?	☐	☐	☐
Have opportunities to work on long-term projects?	☐	☐	☐
Collaborate with K-12 teachers and/or students?	☐	☐	☐
Teach a portion of the course?	☐	☐	☐
Hear you speak about teaching as a career?	☐	☐	☐

14. Typically, what percent of a student's final grade in your STEMTEC courses is based on the following categories?

	0%	Less than 25%	25 to 49%	50 to 75%	More than 75%
Multiple-choice exams or quizzes	☐	☐	☐	☐	☐
Non-multiple-choice exams or quizzes	☐	☐	☐	☐	☐
Laboratory reports	☐	☐	☐	☐	☐
Essays or other papers	☐	☐	☐	☐	☐
In-class presentations	☐	☐	☐	☐	☐
Homework assignments	☐	☐	☐	☐	☐
Attendance	☐	☐	☐	☐	☐
Class participation	☐	☐	☐	☐	☐
Group projects	☐	☐	☐	☐	☐
Journals	☐	☐	☐	☐	☐
Other ________________	☐	☐	☐	☐	☐
Other ________________	☐	☐	☐	☐	☐
Other ________________	☐	☐	☐	☐	☐

15. About what percent of the total points on your examinations are allocated to multiple-choice type questions?

____

16. About what percent of the total points on your examinations are allocated to constructed response type (e.g., short answer, essay) questions? ________________________________

17. To what extent are student assessment results used to modify what is taught and how?

☐ To a great extent ☐ Somewhat ☐ Very little ☐ Not at all

18. In general, what do you think are the **STRENGTHS** of STEMTEC?

____

____

____

____

19. In general, what do you think are the **WEAKNESSES** of STEMTEC?

____

____

____

____

20. What advice do you have for improving STEMTEC?

____

____

____

21. If you have provided students with information about teaching grades K-12, please describe your approach to encouraging students to consider teaching grades K-12 as a career?

22. If not, please describe briefly why you chose not to provide information or encourage teaching as a career.

23. Please comment on how the STEMTEC project staff might assist you in making students in your STEMTEC courses more aware of teaching as a career.

24. In the past few years have you received money (or other resources such as released time) for course development or reform from a source other than STEMTEC? ○ Yes ○ No

- If yes, what were the sources and the amount of money or other support provided?

Thank you very much for your cooperation.
Please return the survey in the enclosed envelope or fax it to:
Sharon Slater, STEMTEC Evaluation Team
413-545-4181.

APPENDIX E:

Classroom Observation Protocol

CLASSROOM CHECKLIST		**Time in Minutes**								
Type of Instruction		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40
L	lecture/presentation									
LWD	lecture with discussion									
CD	class discussion									
HOA	hands-on activity/materials									
SGD	small group discussion									
LC	learning center/station									
TIS	teacher/instructor interacting w/ student									
CL	coop learning (roles)									
WW	writing work (if in groups, add SGD)									
RSW	reading seat work (if in groups, add SGD)									
PM	problem modeling									
D	demonstration									
SP	student presentation									
UT	utilizing digital educational media and/or technology									
AD	administrative tasks									
I	Interruption									
A	Assessment									
Other										
STUDENT ROLE										
HE	High engagement, 80%									
ME	mixed engagement									
LE	low engagement, 20%									
COGNITIVE ACTIVITY										
1	receipt of knowledge									
2	application of procedural knowledge									
3	knowledge representation									
4	Knowledge construction									

Appendix F

Teaching Scholars Survey

2000/2001 STEMTEC Teaching Scholar

Mandatory Final Report and Survey
Please return in the enclosed envelope by April 27, 2001

Please take a few minutes to provide your **CONFIDENTIAL** responses to the questions below. Your answers will help us to evaluate the strengths and weaknesses of the STEMTEC Teaching Scholars Program. Please contact Bill Tyler at 545-0626 if you have any questions regarding this report.

1. Name: ____

2. Permanent Address: ____________________________________

   ____

3. Permanent Telephone #: ____________________________________

4. Email Address: ____________________________________

5. What is your race / ethnicity? (Please select **ALL** that apply.)

   9 African American or Black
   9 Asian
   9 Caucasian or White
   9 Hispanic or Latino/a
   9 Native American or Alaskan Native
   9 Native Hawaiian or Other Pacific Islander
   9 Other ______________________

6. Expected Graduation Date (month/year): __________________________

7. If you are graduating this semester, briefly describe what your future plans are at this time. In particular, please indicate if you plan to teach. If you have a teaching job, please indicate the location, subject, and grade level.

____

8. What level(s) are you interested in teaching? (Please select **all** that apply.)

9 Elementary 9 Middle School 9 High School 9 College 9 Other/Not Sure

9. What subject(s) are you interested in teaching? ______________________________

____

10. Campus: 9 Amherst College 9 Greenfield CC 9 Hampshire College 9 Holyoke CC 9 Mt. Holyoke 9 Smith College 9 STCC 9 UMASS

11. The statements below reflect different opinions some students have had about their experience in the Teaching Scholars Program. Please circle the response that best matches your level of agreement with each statement.

Statement	Strongly Disagree	Disagree	Neutral/ No Opinion	Agree	Strongly Agree
I was very committed to becoming a teacher **before** I participated in the Teaching Scholars Program.	SD	D	N	A	SA
I am more likely to become a teacher now, than I was at the beginning of this school year.	SD	D	N	A	SA
My **STEMTEC teaching experience** (the teaching activity I participated in during the award period) increased my interest in teaching math or science.	SD	D	N	A	SA
The **STEMTEC Teaching Scholar activities** (i.e., workshops, talks) increased my interest in teaching math or science.	SD	D	N	A	SA
My **STEMTEC teaching experience** provided me with knowledge or skills that will make me a more effective math or science teacher.	SD	D	N	A	SA
The **STEMTEC Teaching Scholar activities** provided me with skills or knowledge that will make me a more effective math or science teacher	SD	D	N	A	SA
One or more STEMTEC faculty members helped me to reach my teaching goals.	SD	D	N	A	SA
The STEMTEC Teaching Scholar workshops were a good use of my time.	SD	D	N	A	SA

12. Using the scale below, please indicate how attractive a career in teaching science or math sounds to you.

1	2	3	4	5	6
Not at all attractive					Very Attractive

13. Using the scale below, please indicate likely it is that you will someday teach a math or science course.

1	2	3	4	5	6
Not at all likely					Very Likely

14. How many STEMTEC courses have you taken? ___________ courses

15. How important was it for you to take STEMTEC affiliated courses?

9 Not at all important 9 Somewhat important 9 Very Important

16. Some STEMTEC teaching scholar activities that occurred during the past year are listed below. For each activity that you attended, please provide your opinion regarding (a) whether it helped you become a better teacher, and (b) whether it increased your interest in teaching by circling the response that best matches your opinion. **Be sure to circle an (a) response and a (b) response for each activity**.

Activity	**Location**	**Did Not Attend**	**(a) Helped Me Become A Better Teacher**			**(b) Increased My Interest in Teaching**		
			Yes	No	Not Sure	Yes	No	Not Sure
Patterns and Relationships: Algebra and Real World Examples	Mount Holyoke College		Y	N	NS	Y	N	NS
Science as Inquiry	Hitchcock Center, Amherst, MA		Y	N	NS	Y	N	NS
Certification Information Session	UMass Amherst		Y	N	NS	Y	N	NS
Science Through the Multiple Intelligences: Patterns That Inspire Inquiry	Smith College		Y	N	NS	Y	N	NS
When *You* Are the Teacher (Part I)	Bridge St. School, Northampton		Y	N	NS	Y	N	NS
When *You* Are the Teacher (Part II)	Hampshire College		Y	N	NS	Y	N	NS
Environmental Education Society Annual Conference	Worcester, MA		Y	N	NS	Y	N	NS
Project Wild and Aquatic (Part I)	UMass Amherst		Y	N	NS	Y	N	NS
Full Court Press	Basketball Hall of Fame		Y	N	NS	Y	N	NS
The Teaching Experience	Mount Holyoke College		Y	N	NS	Y	N	NS
Workshop on Astronomy Resources	Amherst College		Y	N	NS	Y	N	NS
Various STEM Institute talks	UMass Amherst		Y	N	NS	Y	N	NS
The teaching that was modeled in STEMTEC courses	Various		Y	N	NS	Y	N	NS
K-12 classroom experience	Various		Y	N	NS	Y	N	NS

17. Are you currently enrolled in a certification program? 9 yes 9 no

If yes, please indicate Level(s): ______________________ Subject area(s): _____________________

18. Did you complete a certification program in 2000/2001? 9 yes 9 no

If yes, please indicate Level(s): ______________________ Subject area(s): _____________________

19. If you have not completed a certification program, or if you are not currently enrolled in one, are you planning to enroll in one? 9 yes 9 no

20. Did you reapply for a STEMTEC Teaching Scholarship for next year? 9 yes 9 no

If no, please indicate the reason(s) why: 9 will complete degree/certification requirements this year

9 not eligible 9 not interested in teaching 9 transferring to a non-STEMTEC school

9 other (please specify)____

____

21. Did the STEMTEC Teaching Scholarship allow you to do anything that you would not have been able to do otherwise? 9 yes 9 no If yes, please describe. ______________________________

____

____

22. How did you find out about STEMTEC and the Teaching Scholars Program? _________________

____

23. What do you think are the **STRENGTHS** of the STEMTEC Teaching Scholars program?

____

____

____

24. What do you think are the **WEAKNESSES** of the STEMTEC Teaching Scholars program?

____

____

____

25. If there were only **one** activity that the STEMTEC Student Services Program could continue providing in the future, what should it be? ____

____

____

26. Did you complete a teaching experience (i.e., a formal or informal teaching activity on your own campus, another campus, or a K-12 classroom)? 9 Yes 9 No

If yes, answer a-g. If no, answer h only.

a. Location (school name, town): ______________________________

b. Estimate the total hours involved: ______________________________

c. Grade level: ______________________________

d. Subject area/topic: ______________________________

e. Contact person name: ______________________________

f. Contact person phone number or email: ______________________________

g. What kinds of activities were involved with your teaching experience? (Select **all** that apply.)

9 Lecturing
9 Tutoring
9 Preplanning
9 Observation
9 Small group work
9 Hands-on activities
9 Teaching assistantship
9 Other ______________________________

h. If you did not complete a teaching experience, briefly explain why. (Attach additional sheet if necessary)

____

____

27. Please provide a brief description of your teaching experience. (If necessary, use the back of this sheet, or attach an additional sheet.) In your description, please address the questions listed below. In addition, indicate whether or not you would allow us to use excerpts from this written description of your teaching experience in STEMTEC publications, such as brochures or newsletters.

- What were your responsibilities?
- How did this experience affect your attitude / commitment towards teaching?

THANK YOU FOR COMPLETING THIS SURVEY!!!

Please return this survey in the envelope provided or mail to:
Bill Tyler, STEMTEC Student Services, 217 Hasbrouck Lab, UMass, Amherst, MA 01003

Appendix G

Teaching Interest Survey

Career Interest Survey

Please take a moment to complete the following questions. Your responses will help us to determine student interest in particular majors and career paths. All answers will be kept confidential. Thank you for your time.

What is your name? (Last, First)

What is your student ID number?

What is your sex?
- Female
- Male

What is your ethnicity?
- Hispanic or Latino/a
- Not Hispanic or Latino/a

What is your race? (Please select ALL that apply.)
- African American or Black
- Asian
- Caucasian or White
- Native American or Alaskan Native
- Native Hawaiian or Other Pacific Islander

At which school are you enrolled?
- Amherst
- Greenfield CC
- Hampshire
- Holyoke CC
- Mount Holyoke
- Smith
- STCC
- UMass Amherst

Course Code
- 1
- 2
- 3
- 4
- 5

What year are you?
- Freshman
- Sophomore
- Junior
- Senior
- Other ____________________

What type of degree are you earning?
- Associate's
- Bachelor's
- Other ____________________

Please indicate your declared or intended major. (Select ONE response.)
- Astronomy
- Biology
- Business/Economics
- Chemistry
- Computer Science/Technology
- Education
- Engineering
- English/Communications
- Geology/Geosciences
- History
- Law
- Mathematics/Statistics
- Natural Resources/Food Science
- Physics
- Psychology
- Sociology
- Undecided
- Other

In which of the following areas are you considering a career? (Please select ALL that apply.)
- Art/Music/Humanities
- Biology/Medicine
- Business/Economics
- Chemistry
- Computer Science/Technology
- Education/Teaching
- Engineering
- Geology
- Law
- Physics
- Psychology/Counseling
- Social Services
- Other ____________________

Using the scale below, please indicate how attractive a career in teaching science or math sounds to you.

Not at all attractive ○ ○ ○ ○ ○ ○ Very attractive

Using the scale below, please indicate how likely it is that you will someday teach a math or science course.

Not at all likely ○ ○ ○ ○ ○ ○ Very likely

If you think you may become a math or science teacher someday, please indicate the particular subjects and settings in which you would like to teach. (Please select ALL that apply.)
- Math
- Science
- Preschool
- Elementary School
- Middle School
- High School
- College

Teaching Interest Survey

APPENDIX H

Student Learning Experience Survey

Survey of STEMTEC Students -- Spring 2001

This survey is designed to discover your opinions of how well this course engaged you in the learning experience. In addition, we want to discover your career interests and plans. Your responses will be completely ANONYMOUS and will have absolutely no bearing on your performance in this course. Thank you for taking the time to complete this survey.

1. Course Title and Number: ____

2. At which school are you enrolled?

O Amherst College
O Greenfield Community College
O Hampshire College
O Holyoke Community College
O Mount Holyoke College
O Smith College
O Springfield Technical Community College
O University of Massachusetts Amherst

3. Please select the reason that best describes why you are taking this course?

O I am interested in this subject.
O It is a requirement for my major.
O It is a prerequisite for another course.
O It is required for teaching certification.
O It fulfills a general graduation requirement.
O It was recommended by a faculty member.
O It was recommended by a friend.
O Other

4. In what year of school are you currently enrolled?

O First year O Second year O Third year O Fourth year O Other

5. What type of degree are you earning? O Associate's O Bachelor's O Other

6. Please read the following statements and rate the how often the activity occurred during the course of this semester.

In this course, how often did:	**Never**	**Rarely**	**Often**	**Almost Every Class**	**Every Class**
you work in small groups and/or pairs?	O	O	O	O	O
you listen to lecture and take notes?	O	O	O	O	O
you participate in class discussions where the instructor talked less than the students?	O	O	O	O	O
you work on problems related to real world or practical issues?	O	O	O	O	O
your instructor use educational technology (computers, videodisks, VCR's, etc.)?	O	O	O	O	O
The class work on in-class problem solving and/or open-ended questions?	O	O	O	O	O
you participate in hands-on activities?	O	O	O	O	O
you make connections to other fields or disciplines?	O	O	O	O	O
you have opportunities to give feedback to the instructor?	O	O	O	O	O
you feel encouraged to ask questions in class?	O	O	O	O	O
you have opportunities to work on long-term projects?	O	O	O	O	O
The class discuss learning and/or teaching strategies and approaches?	O	O	O	O	O
you collaborate with K-12 teachers and/or students?	O	O	O	O	O
students teach a portion of this class?	O	O	O	O	O
Did the instructor speak to you or the class about teaching as a career?	O	O	O	O	O

7. Listed below are some statements about this class. Please indicate your agreement with each statement using the rating scale provided.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
There is sufficient time for me to respond to questions in class.	O	O	O	O	O
This course encourages discussion among students and between students and the teacher.	O	O	O	O	O
This class helped me to learn the course material.	O	O	O	O	O
This course has increased my interest in this subject.	O	O	O	O	O
I look forward to taking more courses in this subject area.	O	O	O	O	O
This course encouraged me to think about my own learning.	O	O	O	O	O
This course increased my interest in becoming a teacher.	O	O	O	O	O

8. To the best of your knowledge, approximately what percent of your final grade in the course is based on the following categories?

	0%	**Less than 25%**	**25 to 49%**	**50 to 75%**	**More than 75%**
Multiple-choice exams or quizzes	O	O	O	O	O
Non-multiple-choice exams or quizzes	O	O	O	O	O
Pyramid exams	O	O	O	O	O
Reports on projects	O	O	O	O	O
Laboratory reports	O	O	O	O	O
Essays or other papers	O	O	O	O	O
In-class presentations	O	O	O	O	O
Journals	O	O	O	O	O
Portfolios	O	O	O	O	O
Homework	O	O	O	O	O
In-class assignments	O	O	O	O	O
Class participation	O	O	O	O	O
Community-based projects	O	O	O	O	O
Teaching experiences	O	O	O	O	O
Ability to work effectively in groups	O	O	O	O	O

9. What is your sex? O Female O Male

10. What is your race/ethnicity? (Please select **ALL** that apply.)
O African American or Black
O Asian
O Caucasian or White
O Hispanic or Latino/a
O Native American or Alaskan Native
O Native Hawaiian or Other Pacific Islander

11. Please indicate your declared or intended major. (Select only **ONE** response.)
O Business
O Computer Science / Technology
O Math / Statistics
O Natural Sciences
O Other
O Engineering
O Social Sciences
O Humanities / Art / Music
O Education

12. In which of the following areas are you considering a career? (Select ALL that apply.)

O Art/Music/Humanities	O Education/Teaching	O Psychology
O Biology/Medicine	O Engineering	O Social Services
O Business/Economics	O Geology	O Other
O Chemistry	O Law	
O Computer Science/Technology	O Physics	

13. If you selected Education/Teaching in the previous question, is there a particular level or subject you are interested in teaching? (Select ALL that apply):

O Math O Science O Preschool O Middle School O High School O College O Elementary School

14. Are you planning to enroll in a teacher certification program? O Yes O No

15. Are you familiar with the STEMTEC (Science, Technology, Engineering, and Math Teacher Education Collaborative) program? O Yes O No

16. If you are familiar with STEMTEC, how important is it to you to choose a STEMTEC course over an equivalent Non-STEMTEC course offering?
O Very Important
O Important
O Moderately Important
O Of Little Importance
O Unimportant

Thank you for taking the time to respond to this survey.

Appendix I: SRTI Course Evaluation Form

Appendix

University of Massachusetts
Student Response to Instruction (SRTI)

PLEASE mark the bubble this way… ●

… not this way ⊘ ⊗ ◒ ⊙

Use No. 2 pencil only.

This questionnaire gives you the opportunity to comment anonymously about this course and the way it was taught. Please reflect on your experiences in this course and answer each item below honestly and thoughtfully, filling in the circle for the response that most accurately reflects your experience. No results will be released until after grades have been filed.

Instructor's Name (please print)

1. The instructor was well prepared for class.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

2. The instructor explained course material clearly.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

3. The instructor cleared up points of confusion for you.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

4. The instructor used class time well.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

5. The instructor inspired interest in the subject matter of this course.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

6. The instructor showed a personal interest in helping you learn.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

7. The instructor provided useful feedback on your performance.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

8. The methods of evaluating your work were fair.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

9. The instructor stimulated useful class participation.
- ⑤ Almost always
- ④ Frequently
- ③ Sometimes
- ② Rarely
- ① Almost never

10. Overall, how much do you feel you have learned in this course?
- ⑤ **Much more** than most courses
- ④ **More** than most courses
- ③ About the **same** as others
- ② **Less** than most courses
- ① **Much less** than most courses

11. What is your overall rating of this instructor's teaching?
- ⑤ Almost always effective
- ④ Usually effective
- ③ Sometimes effective
- ② Rarely effective
- ① Almost never effective

12. What is your overall rating of this course?
- ⑤ One of the best
- ④ Better than average
- ③ About average
- ② Worse than average
- ① One of the worst

13. ⑤④③②①	18. ⑤④③②①	23. ⑤④③②①
14. ⑤④③②①	19. ⑤④③②①	24. ⑤④③②①
15. ⑤④③②①	20. ⑤④③②①	25. ⑤④③②①
16. ⑤④③②①	21. ⑤④③②①	26. ⑤④③②①
17. ⑤④③②①	22. ⑤④③②①	27. ⑤④③②①

COURSE SCHEDULE NUMBER

⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①
②	②	②	②	②	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

This course is:
- ○ Required
- ○ Elective

What grade do you expect to receive in this class?
- ○ A
- ○ AB
- ○ B
- ○ BC
- ○ C
- ○ CD
- ○ D or lower
- ○ Other (e.g., taking the course Pass/Fail, auditing course)

What is your class level?
- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Graduate
- ○ Other

Written comments about this course or your instructor are welcome. Please use the back of this form.