RESEARCH

Report on an Educational Program

Department of Research and Accountability

SCIENCE ENGINEERING COMMUNICATION & MATHEMATICS ENHANCEMENT (SECME, INC.) 2001–2002

Houston Independent School District

HOUSTON INDEPENDENT SCHOOL DISTRICT

Board of Education

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Executive Summary

Science Engineering Communication & Mathematics Enhancement (SECME, Inc.) 2001–2002

Program Description

The Science, Engineering, Communication, and Mathematics Enhancement program (SECME, Inc.) was established in 1975 by engineering college deans from seven southeastern universities. SECME, Inc. (formerly known as the Southeastern Consortium for Minorities in Engineering) encourages students in primary and secondary school to become involved in the fields of science, math, engineering, and technology (SMET). Although students from varying backgrounds are encouraged to participate in SECME, Inc., the principal goal of SECME is to increase the number of African American, Hispanic, and Native American students prepared to enter and complete postsecondary studies in SMET. To achieve this goal, SECME has built partnerships with over 40 engineering universities, 70 corporate and/or government beneficiaries, and more than 100 local education agencies in 17 states. With the assistance of these partnerships, SECME offers professional development to teachers of math, science, language arts, and technology.

The purpose of this report was to provide a summative evaluation to determine participants' level of preparation for postsecondary challenges, participants' attitudes toward SECME, and the impact of SECME on the math and science performance of participating HISD students. To that end, the following research questions were addressed:

1. What were the demographic characteristics of HISD students participating in SECME during the 2001–2002 school year?

2. How well did HISD students participating in SECME perform on the SAT compared to non-SECME students with similar demographic characteristics?

3. What were the math and science courses and grades of HISD students who participated in SECME, compared to non-SECME students with similar demographic characteristics?

4. What were the attitudes of HISD SECME students toward the organization, and toward the fields of science, math, engineering, and technology?

Findings

- Data analysis revealed SECME students were no more prepared for college-bound tests than non-SECME students. That is, there was no difference in performance between the two groups on the SAT I. However, SECME students did have a higher participation rate on the SAT than did the control group, which may indicate that SECME teachers encourage their students to take the SAT I.

- An analysis of course enrollment data revealed that approximately one-third of SECME students were enrolled in science AP courses, while 28 percent were enrolled in math AP courses. Furthermore, an analysis of course grades in math and science revealed no statistically significant difference between SECME and non-SECME students.

- Survey results indicated that most participants believed they benefitted from SECME's teachers and the activities and competitions. Furthermore, most SECME participants planned to pursue a career in SMET and to major in SMET when they attend college.

- Lastly, the general attitudes scale revealed that 30% of the participants believed SECME had not helped them prepare for the college application process or for the academic challenges they will face in college.

Recommendations

1. Because of the large minority population in HISD, it is recommended that SECME teachers and coordinators continue to recruit minority students into its organization so that more students can benefit from SECME.

2. An analysis of SAT data revealed SECME students did not perform any better on the SAT than non-SECME students; therefore, it is recommended that SECME teachers encourage SECME students to prepare for college-bound tests such as the SAT I so they can pursue postsecondary endeavors in the fields of science, math, engineering, or technology.

3. Because AP courses and examinations help students prepare for postsecondary studies, it is recommended that SECME teachers continue to encourage participants to enroll in such courses and prepare for corresponding exams.

4. An analysis of course grades in math and science revealed no statistically significant difference between SECME and non-SECME students. Therefore, it is recommended that SECME coordinators encourage professional development for teacher participants in an effort to ameliorate the teaching efficacy of SECME teachers.

5. One of SECME's goals includes preparing HISD participants for postsecondary challenges; therefore, it is recommended that SECME teachers and coordinators attempt to assist their students in the college selection and application process by creating a workshop designed to help juniors and seniors choose and apply to college.

SCIENCE ENGINEERING COMMUNICATION MATHEMATICS ENHANCEMENT (SECME, INC.) 2001–2002

Purpose: *The purpose was to provide a summative evaluation to determine the level of program implementation, and the impact of SECME on the math and science performance of participating HISD students.*

Design: *Quasi-experimental utilizing comparative posttests.*

Population: *High school students participating in SECME during the 2001–2002 school year, and SECME high school seniors who graduated in May 2001. A control group composed of non-SECME high school graduating seniors was also used for statistical comparisons.*

Methods: *Summative evaluation with quantitative and qualitative analyses.*

Findings: *Most SECME students surveyed believed they benefitted from participating in SECME. However, an analysis of SAT scores, science and math course grades, and survey data suggests SECME students were no more prepared for postsecondary studies than a control group.*

Conclusions: *Overall, SECME teachers and students benefited from participating in SECME. However, in light of the primary goal of SECME, which is to prepare students for postsecondary study in science, math, engineering, or technology, consideration should be given to preparing SECME high school students for the college application and selection process.*

Introduction

Program Description

Established in 1975 by engineering college deans from seven southeastern universities, SECME, Inc. (formerly known as the Southeastern Consortium for Minorities in Engineering) encourages students in primary and secondary school to become involved in the fields of science, math, engineering, and technology (SMET). Although students from varying backgrounds are encouraged to participate in SECME, Inc., the principal goal of SECME is to increase the number of African American, Hispanic, and Native American students prepared to enter and complete postsecondary studies in SMET. To achieve this goal, SECME has built partnerships with over 40 engineering universities, 70 corporate and/or government beneficiaries, and more than 100 local education agencies in 17 states. With the assistance of these partnerships, SECME offers professional development to teachers of math, science, language arts, and technology.

Participating SECME schools form "teams" consisting of SMET teachers, the principal, counselor, and a media specialist. During the summers, the SECME teams participate in courses and workshops at member universities. The courses are taught by university faculty, master teachers, SECME staff members, and outside trainers using a graduate-level curriculum. During the professional development courses, teachers learn teaching strategies, methods for integrating technology into the classroom, and how to prepare their students for careers in SMET.

Program Participants

SECME participants include both students and teachers. As previously mentioned, teachers participating in SECME are offered professional development opportunities, and they are also offered annual stipends. Students participating in SECME may al-

ready be motivated to succeed in school, and/or plan to pursue a career in SMET. Under the guidance of their teachers, SECME students participate in competitions designed to teach principles of engineering, physics, and technology (e.g., mousetrap, bottle rocket, egg-drop, etc.). In the Houston Independent School District (HISD) there are six middle schools and seven high schools participating in SECME, with students from various ethnic, social, and economic backgrounds. In 2001–2002, there were 33 high school SECME teachers at DeBakey, Scarborough, Sharpstown, Sterling, Washington, Worthing, and Yates; and there were 141 high school SECME students at the preceding schools (excluding DeBakey and Sterling, whose SECME coordinators did not submit student data).

Program Cost and Funding Source

HISD implemented SECME in six middle schools during the 1996–1997 academic year with $56,000 in initial funding from the engineering firm Montgomery Watson Harza (MWH). MWH also contributed $56,000 during the 1997-1998 school year, but only contributed $25,000 for the 1998-1999 school year. To make up for the decrease in funding, HISD used $35,000 from the Eisenhower Title II Professional Development Grant. This grant is part of Title II of the Elementary and Secondary Education Act (ESEA). Title II authorizes federal funds to be used by local education agencies for professional development activities in an effort to improve the quality of teaching in the schools. During the 1999–2000 academic year, ExxonMobil provided $10,000 in support of the SECME program, which was used for the professional development of SECME teachers and for the purchase of peripheral equipment.

No budget information was provided for the 2000–2001 academic year. For the 2001–2002 school year, the Eisenhower grant provided the HISD Science Department with $39,000 for 13 campuses participating in SECME. The campus coordinator received $1,000, and four teachers, or "team members," at the campus received $500.

HISD sent six teachers to a two-week SECME Summer Institute in Washington, D.C., during the 2001–2002 school year, with funds provided by the Eisenhower grant. The University of Houston, HISD's SECME university partner, provided $12,000 for students and their sponsor to attend a SECME national competition. Overall, SECME's budget included $51,000 for teacher participation, and $400 for food and miscellaneous supplies for the 2001–2002 academic year.

Purpose of the Evaluation Report

The purpose was to provide a summative evaluation to determine the level of program implementation, and the impact of SECME on the math and science performance of participating HISD students. To that end, the following research questions were addressed:

1. What were the demographic characteristics of HISD students participating in SECME during the 2001–2002 school year?
2. How well did HISD students participating in SECME perform on the SAT compared to non-SECME students with similar demographic characteristics?
3. What were the math and science courses and grades of HISD students who participated in SECME, compared to non-SECME students with similar demographic characteristics?
4. What were the attitudes of HISD SECME students toward the organization, and toward the fields of science, math, engineering, and technology?

Literature Review

Need for SMET Workforce

According to the U.S. Department of Labor (2001), engineering employment is expected to increase 10 to 20 percent over the next decade. However, the number of engineering degrees awarded by colleges and universities each year has declined steadily since 1987 (U.S. Department of Labor, 2001). While the demand for engineering personnel will increase over the years, the pool of qualified engineering professionals will decrease. Additionally, data from the Bureau of Labor Statistics (1999) project rapid growth in technological careers such as computer engineering and computer support, and medical careers such as home health aides and physician assistants over the next decade.

Demographics of SMET Workforce

In addition to the projected growth for science, engineering, and technological careers, the composition of the workforce is also projected to change over

the next decade as the population of underrepresented minorities increases; underrepresented minorities refer to African Americans, non-White Hispanics, and American Indians. While White males only make up 42% of the U.S. workforce, and 37% of the entire U.S. population, recent workforce data show that 68% of the science, math, engineering, and technology (SMET) workforce is composed of White males (US Census Bureau, 1998). Similarly, Asians only make up 3% of the U.S. population, but 10% of the U.S. SMET workforce. This evidence suggests White males and Asians are overrepresented in SMET occupations. Moreover, the U.S. Census Bureau (1996) projects that by 2035 minorities will make up more than half of the school age population in the U.S., which means the U.S. must recruit more minorities into the SMET workforce to remain a competitor in the global economy.

Professional Development of SMET Teachers

Researchers examining the professional development (PD) of educators have identified several elements of effective PD, namely university-school collaborations (Darling-Hammond, 1997), teacher networks (Renyi, 1996), supportive school/district environments (Elmore & Burney, 1997), and teacher study groups (Clair, 1998). Professional development of teachers is important for their pedagogical efficacy and their effectiveness in the classroom.

SECME provides PD to teachers of math and science in an effort to attract underrepresented minority students to these fields. A report by the Commission on the Advancement of Women and Minorities in Science (2001) states that "many who teach math and science lack adequate preparation in these subject areas" (p.21). In addition, the report continues, "a large proportion of these poorly prepared teachers can be found in schools with large numbers of underrepresented minority students" (p.21). The result is that many underrepresented minorities do not receive quality teaching in the areas of math and science.

SECME collaborates with local universities to provide workshops for teachers of math and science. In-service workshops have been the traditional method for the professional development of teachers, but other professional development techniques and strategies have been utilized in recent years. For example, Loucks-Horsley, Hewson, Love, and Stiles (1998) identified five categories of strategies used to aid the professional development of math and science teachers:

1. *Immersion*, which involves teachers doing the same math and science projects that their students would do in class;
2. *Curriculum*, which refers to teachers learning how to implement new topics (which in turn can build the teachers' content knowledge in a subject area);
3. *Examining practice*, which involves teachers reflecting on their teaching practices and their own content knowledge;
4. *Collaborative work*, which includes partnerships with other scientists and mathematicians; and, finally,
5. *Vehicles and mechanisms*, which refers to workshops and institutes designed to increase teachers' content knowledge (e.g., SECME).

Methods

Sample

Data for this report was gathered using several sources; namely, HISD SECME high school teachers and students, the HISD Science Curriculum Department, and HISD's Public Education Information Management System (PEIMS) and Schools Administrative Student Information (SASI) databases.

The samples for the t-test on SAT I scores were chosen in two stages. First, data on SECME students who graduated in 2001 was gathered from longitudinal data created and maintained by SECME high school teachers. There were 41 cases in this sample, known as the "experimental group," all of which were used for data analysis. After descriptive statistics were obtained for this experimental group, a control group was obtained using stratified randomization.

According to Babbie (1998), "[s]tratified sampling is a method for obtaining a greater degree of representativeness – decreasing the probable sampling error" (p. 216). The experimental group was composed primarily of gifted/talented, African American, "at-risk" students who received free or reduced lunch (see **Table 1** for a more detailed description of the experimental and control groups). In an effort to make valid comparisons, the control group had to be comparable to the experimental group. As explained by Babbie, "the cardinal rule of subject selection concerns the comparability of experimental and con-

Table 1: Comparison of SECME and Non-SECME Students on Various Demographic Variables

Variable	SECME[1]		Non-SECME[2]	
	N	%	N	%
Program				
At Risk	19	46	35	49
Economically Disadvantaged	18	44	27	38
Special Education	3	7	1	1
Gifted and Talented	22	54	38	53
Immigrant	1	2	1	1
Migrant	0	0	0	0
LEP	0	0	0	0
Bilingual	0	0	0	0
ESL	0	0	0	0
Title 1	0	0	0	0
Gender				
Male	25	61	37	51
Female	16	39	35	49
Ethnicity				
African American	20	49	34	47
Hispanic[3]	15	36	19	26
White	2	5	14	19
Other[4]	4	10	5	7

[1] N = 41
[2] N = 72
[3] Includes Latin Americans, Cuban Americans, and Puerto Ricans
[4] Includes Asians and Middle Easterners

trol groups" (1998, p. 237). Therefore, through careful selection and randomization, the control group was chosen based on appropriate numbers of elements found in the experimental group (i.e., ethnicity, gifted/talented, at-risk, etc.).

The sample for the student survey was chosen in three stages and included HISD high school students participating in SECME. First, a memorandum requesting student data for the evaluation was sent to all participating SECME HISD high schools, which included DeBakey, Scarborough, Sharpstown, Sterling, Washington, Worthing, and Yates. Of those high schools, only DeBakey and Sterling failed to send student data, which excluded their students from survey participation. Once the student data was compiled into a database, a random sample was conducted using SPSS, which yielded 108 out of 141 SECME students.

Finally, a general attitudes scale was sent to all 108 students from five high schools: Scarborough, Sharpstown, Washington, Worthing, and Yates. All but one high school, Worthing, remitted the student surveys to the Research and Accountability Department for data analysis. As such, only students from Scarborough, Sharpstown, Washington, and Yates were included in the analysis. From these schools, a total of 56 surveys were returned, yielding an overall response rate of 52% (see **Table 2**).

Measurement Indicators

Achievement indicators used included a college bound test, the Scholastic Aptitude Test (SAT I), and

Table 2: SECME High School Student Response Rate

School	Surveys Sent	Surveys Returned	Response Rate (%)
DeBakey	0*	–	–
Scarborough	8	8	100
Sharpstown	8	8	100
Sterling	0*	–	–
Washington	54	33	61
Worthing	25	0	0
Yates	13	7	54
Total	108	56	52

**Note*. No surveys were sent to DeBakey or Sterling because the schools elected not to submit student data.

course grades for SECME students graduating in 2001.

Developed by the College Board, the SAT I is a three hour exam that measures verbal and mathematical reasoning skills. According to the College Board, approximately two million students, mostly juniors and seniors, take the SAT I annually during one or more of the seven administration dates. College admission committees use SAT I scores, in addition to transcripts, extracurricular activities, etc., to help them determine the future academic performance of applicants. Some researchers have found that SAT scores and high school grades combined tend to overpredict African American and Hispanic students' postsecondary academic performance (Young, 2001). In other words, the research college bound students suggests that African American and Hispanic students who do well on the SAT and have a favorable high school transcript, may not do well in college. Across all ethnic groups, the SAT explains about 22% of the variance in first year college grades (The College Board, 2001).

Each SAT section, verbal and math, is scored on a range from 200 to 800, with a score of 1600 being perfect. Only test-takers in the top 1% earn a score of 1600. Test-takers who score a 520 on the math section and a 510 on the verbal section fall into the 50th percentile (The College Board, 2002).

High school students' math and science courses for 2001–2002 and their corresponding grades were obtained using HISD's SASI database system. Ostensibly, math and science grades are an indicator of academic performance in those areas. For example, a high grade in Biology would indicate proficiency in that area of science; similarly, a low grade would indicate poor performance in that particular subject area.

Lastly, to determine participating high school students' general attitudes toward SECME, and their education/career aspirations, a survey was developed and administered in the spring of 2002 (see **Appendix A**). The survey participants were chosen randomly in an effort to eliminate bias caused by teacher selection.

Qualitative Data Collection

Informal discussions (face-to-face interaction and e-mail) with staff members in HISD's Science Curriculum Department, and with SECME high school teachers were conducted to gather information on program goals and objectives. Documents related to program goals and outcomes were also collected and analyzed for the current evaluation report.

Quantitative Data Analysis

An independent samples *t*-test was used to compare SECME and non-SECME student performance on the verbal and math section of the SAT I. The *t*-test procedure is used to compare means for two groups of cases. Although it is ideal for subjects to be randomly assigned to the experimental and control groups, students could not be randomly assigned to SECME and non-SECME groups. Instead, a stratified random sample was drawn for the non-SECME group to control for extraneous variables such as ethnicity, gifted/talented classification, at-risk classification, etc.

Statistical analysis of the student attitudes survey included Cronbach's coefficient alpha and exploratory factor analysis. Cronbach's coefficient alpha value provides an indication of the homogeneity of survey items. Because Cronbach's coefficient alpha reflects the internal consistency of a scale, a high alpha is more desirable than a low alpha. Alpha values range from 0 to 1, with one indicating perfect collinearity among items. DeVellis (1991) describes an alpha value between .70 and .80 as "good," while anything over .80 is "very good."

Factor analysis groups items that are correlated with one another into a "factor." Items that are highly correlated with one another (i.e., greater than .50) are presumed to measure the same underlying factor. Researchers use exploratory factor analysis to determine the number or the nature of factors that account for the covariation between variables. Due to its a priori approach, exploratory factor analysis is generally thought of as a theory-generating procedure, as opposed to confirmatory factor analysis, which is considered a theory-testing procedure (Stevens, 1996). The current evaluation used exploratory factor analysis.

Results

What were the demographic characteristics of HISD students participating in SECME during the 2001–2002 school year?

Almost half (N = 69) of all HISD high school students participating in SECME were students at Washington High School, which has an engineering magnet program (see **Table 3**). Worthing High

Table 3: SECME Student Demographics, 2001–2002

School	N	%
Scarborough	14	10
Sharpstown	12	9
Washington	69	49
Worthing	31	22
Yates	15	11
Grade		
9th	19	14
10th	25	18
11th	68	48
12th	29	21
Ethnicity		
African American	82	58
Hispanic[1]	13	9
Mexican American	15	11
White	21	15
Other[2]	10	7

[1]Note: Includes Latin Americans, Cuban Americans, and Puerto Ricans
[2]Note: Includes Asians and Middle Easterners

School has the next highest population of SECME students, with 31 students participating. Yates, Scarborough, and Sharpstown High Schools each have around 10 percent of HISD's SECME high school students. Most SECME high school students, around 69 percent, were juniors and seniors.

Regarding ethnicity, over half of HISD's high school students (58%) participating in SECME were identified as African American. Approximately 20 percent were identified as Mexican American or Hispanic, which includes Latin Americans, Cuban Americans, and Puerto Ricans. The remaining 22 percent of the SECME high school students were identified as White, Asian, or Middle Easterners. With respect to gender identification, there were 74 males participating in SECME, and 67 females.

How well did HISD students participating in SECME perform on the SAT compared to non-SECME students with similar demographic characteristics?

One of the goals of SECME is to prepare students for postsecondary academic challenges; as such, it is essential that students be prepared to take college-bound tests such as the SAT I or ACT. Because most students take the SAT I, this test was used to assess preparation for college. That is, the number of students taking the SAT I and the mean verbal and math score, can give a fair indication of interest in and readiness for postsecondary academic challenges (Young, 2001).

After two samples were drawn, one composed of SECME students and a non-SECME control group, *t*-tests were computed using SPSS to determine if there was a significant difference between the two groups' performance on the SAT I. The results in **Table 4** show the SECME group had higher verbal (M = 528.53, SD = 122.25) and math (M = 550.29, SD = 110.05) SAT I scores than the control group's verbal (M = 518.65, SD = 125.15) and math (M = 537.12, SD = 139.54) scores, but there were no significant differences between the two groups' scores ($p > .05$). Therefore, the null hypothesis that there was no difference between the two groups' (i.e., SECME, and non-SECME) performance on the SAT I was retained. In light of this finding, it is worth noting that SECME high school seniors had a higher participation rate on the SAT I in 2001 than did the control group (83% and 72%, respectively).

What were the math and science courses and grades of students who participated in SECME, compared to non-SECME students with similar demographic characteristics?

A frequency count was performed to assess the number and percent of SECME and non-SECME students taking math and science advanced placement (AP) courses. The data in **Table 5** show that about one-third of SECME students in the sample partici-

Table 4: Independent Samples T-tests for SECME and Non-SECME SAT I Verbal and Math Scores, 2001

		N	N Taking SAT	Mean	SD	*t*	*p*
SAT I Verbal	SECME	41	34	528.53	122.25	.361	.719
	Non-SECME	72	52	518.65	125.15		
SAT I Math	SECME	41	34	550.29	110.05	.464	.644
	Non-SECME	72	52	537.12	139.54		

pated in either math or science AP courses in 2000–2001. Furthermore, the SECME student sample had a higher participation rate in science AP courses than the non-SECME student sample. Regarding math AP courses, non-SECME students had a slightly higher participation rate during the 2000–2001 academic year. It is worth mentioning that when the data was gathered for the AP course participation rate, many of the students (roughly 40 percent in each sample) did not have course information listed. As such, the actual AP course participation rate could be higher than reported for both groups.

After course participation data was gathered, a comparison between SECME and non-SECME student grades was analyzed. Each year, SECME teachers participate in courses and workshops at SECME's annual Summer Institute. Teachers that attend the Summer Institute learn, among other things, teaching strategies and how to prepare students to enter in to science, math, engineering, and technology fields.

To determine if SECME students have benefited from the professional development of SECME teachers, a *t*-test was calculated comparing math and science course grades of SECME and non-SECME students. The results of the *t*-test suggest that there is no statistically significant difference between SECME and non-SECME students' math and science performance, as measured by their course grades (see **Table 6**).

Table 5: SECME and Non-SECME Student Participation in Math and Science Advanced Placement Courses, 2000–2001

	SECME[1]		Non-SECME[2]	
	N	%	N	%
Fall 2000				
Calculus AB	10	24.4	19	26.4
Calculus BC	2	4.9	2	2.8
Statistics	0	0.0	2	2.8
Total Math AP	**12**	**29.3**	**23**	**32.0**
Biology	8	19.5	8	11.1
Chemistry	2	4.9	1	1.4
Physics B	4	9.8	1	1.4
Physics C	0	0.0	2	2.8
Total Science AP	**14**	**34.2**	**12**	**16.7**
Spring 2001				
Calculus AB	8	19.5	15	20.8
Calculus BC	3	7.3	4	5.6
Statistics	0	0.0	2	2.8
Total Math AP	**11**	**26.8**	**21**	**29.2**
Biology	7	17.1	9	12.5
Chemistry	2	4.8	1	1.4
Physics B	4	9.8	1	1.4
Physics C	0	0	1	1.4
Total Science AP	**13**	**31.7**	**12**	**16.7**

[1] N = 41
[2] N = 72

What were the attitudes of HISD SECME students toward the organization, and toward the fields of science, math, engineering, and technology?

A survey was distributed to randomly selected SECME students in the spring of 2002 to assess their attitudes toward SECME and toward SMET fields. Quantitative analysis of the student attitudes survey included Cronbach's coefficient alpha and exploratory factor analysis. Cronbach's coefficient alpha value provides an indication of the homogeneity of survey items; an alpha value above .80 is considered "very good" (DeVellis, 1991). The coefficient alpha value of the SECME student general attitudes survey was .81, which provides evidence of high in-

Table 6: Independent-Samples T-tests for SECME and Non-SECME Math and Science Course Grades

		N	Mean Grade	SD	*t*	*p*
Fall Semester						
Math Course Grade	SECME	24	81.63	7.09	-0.416	.678
	Non-SECME	52	82.67	11.33		
Science Course Grade	SECME	34	82.88	8.18	0.450	.654
	Non-SECME	42	81.95	9.53		
Spring Semester						
Math Course Grade	SECME	22	82.68	7.59	-0.532	.596
	Non-SECME	48	84.02	10.61		
Science Course Grade	SECME	22	84.14	9.44	1.241	.219
	Non-SECME	43	81.51	7.28		

Table 7: Factor Analysis Results, SECME Student General Attitudes Scale, 2001–2002

Survey Item	Factor: Beneficial SECME Experience	Factor: Preparation for Postsecondary Goals	Factor: College/Career Aspirations
When I go to college, I intend to major in science, math, engineering, or technology.			.901
I plan to pursue a career in science, math, engineering, or technology.			.958
My involvement in SECME has helped me choose the college/technical school that is right for me.		.676	
I am confident that SECME has prepared me for the academic challenges I will face after high school.		.724	
My involvement in SECME has prepared me for the college application process.		.803	
Because of SECME, I have found a role model/mentor to help me reach my goals.		.510	
My SECME teacher(s) was/were knowledgeable in the area of science.	.839		
My SECME teacher(s) was/were knowledgeable in the area of math.	.830		
My SECME teacher(s) was/were knowledgeable in the area of computer science.	.633		
My SECME teacher(s) was/were knowledgeable in the area of engineering.	.695		
The SECME activities/competitions helped me learn more about science, math, engineering, and/or technology.	.731		
My participation in SECME has motivated me to learn more about science, math, engineering, or technology.	.645		
I would recommend SECME to other students.	.746		
Percent of Variance	31.106	21.132	15.691
Cronbach's Coefficient Alpha*	0.871	0.653	0.894

Note. Only coefficients above .500 are reported.
*The scale's overall reliability was α = 0.81.

ternal consistency. In other words, it can be inferred from the alpha value of .81 that the SECME student general attitudes scale items were highly intercorrelated.

As previously mentioned, factor analysis groups items that are correlated with one another into a "factor." Items that are highly correlated with one another (i.e., greater than .50) are ostensibly measuring the same underlying factor. **Table 7** shows the survey items loading on three factors, which were given the labels (1) "Beneficial SECME experience," (2) "Preparation for postsecondary goals," and (3) "College/career aspirations."

A reliability analysis on each of the three factors showed relatively high internal consistency (.65 to .89). Regarding overall fit, the three factors combined explained 68% of the variance in students' general attitudes toward SECME, with Factor 1, "Beneficial SECME experience," explaining 31.1% of the variance.

After the survey data was analyzed for internal consistency (i.e., reliability) and for the number and nature of underlying causal factors, simple frequency distributions were calculated using SPSS (see **Table 6**). The results of the frequency analysis showed most respondents agreed that SECME was beneficial, as evidenced by the percentage of students who strongly agreed to the items in Factor 1 (Beneficial SECME experience). In general, respondents also strongly agreed with items in Factor 3, "College/Career aspirations." In other words, most SECME students who participated in the survey research strongly

Table 8: Student Responses to Items on the SECME Student General Attitudes Scale, 2001–2002 (Sorted by Percent "Strongly Agree")

Survey Item	Factor	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
My SECME teacher(s) was/were knowledgeable in the area of math.	1	70%	25%	0%	0%	5%
I would recommend SECME to other students.	1	66%	23%	2%	0%	9%
My SECME teacher(s) was/were knowledgeable in the area of science.	1	64%	32%	0%	0%	4%
I plan to pursue a career in science, math, engineering, or technology.	3	63%	23%	5%	4%	5%
When I go to college, I intend to major in science, math, engineering, or technology.	3	61%	18%	13%	5%	4%
My SECME teacher(s) was/were knowledgeable in the area of engineering.	1	57%	27%	7%	0%	9%
The SECME activities/competitions helped me learn more about science, math, engineering, and/or technology.	1	46%	39%	7%	0%	7%
My SECME teacher(s) was/were knowledgeable in the area of computer science.	1	41%	27%	16%	2%	14%
My participation in SECME has motivated me to learn more about science, math, engineering, or technology.	1	27%	54%	11%	0%	9%
My involvement in SECME has helped me choose the college/technical school that is right for me.	2	18%	45%	27%	4%	7%
Because of SECME, I have found a role model/mentor to help me reach my goals.	2	18%	39%	27%	2%	14%
I am confident that SECME has prepared me for the academic challenges I will face after high school.	2	16%	54%	23%	2%	5%
My involvement in SECME has prepared me for the college application process.	2	7%	38%	30%	5%	20%

Factor 1: Beneficial SECME experience
Factor 2: Preparation for college/career
Factor 3: College/career aspirations

N = 56

agreed that they intend to pursue postsecondary training in SMET and/or a career in SMET.

Although most SECME students agreed to all of the items on the SECME student general attitudes scale, the factor that students responded disagreeably to was Factor 2, "Preparation for postsecondary goals." In other words, many students disagreed with the assertion that their participation in SECME had prepared them for (1) the college application/selection process, and (2) the academic challenges after high school. Furthermore, over a quarter of the respondents indicated that SECME did not provide them with a role model or mentor to help them reach their goals. On average, 27% of respondents disagreed with items related to SECME's ability to prepare them for the college application/selection process and for postsecondary academic challenges.

Open-ended questions on the SECME student general attitudes scale asked students (1) their primary field of interest, (2) the strengths of SECME, and (3) the weaknesses of SECME (see results in **Table 9)**. The item probing the student's field of interest offered nine response choices, including "other," but 9% of the respondents chose not to answer the question (see question 21 on the survey, Appendix A). The questions pertaining to the strengths and weaknesses of SECME (questions 22 and 23 on the survey) were open-ended, and emergent categories were created from student responses.

The survey results showed most students were interested in engineering and science (59%), while 18% of the respondents were interested in a non-SMET field (e.g., business, art, music, etc.). Regarding the strengths of SECME, many students had the opinion that the team effort and the hands-on experiences involved in the activities were a major strength of the organization. One student from Booker T. Washington wrote, "The strength [of SECME is] that you (sic) are always doing something fun while learning about engineering." Another student from the same school responded, SECME "allows students to come together to share ideas."

Respondents' answers to the weaknesses of SECME were varied, but the most common response was that there were not enough competitions. This response may be reflective of the enthusiasm students had for participating in SECME competitions. A student from Washington replied, "There are too few competitions and opportunities to meet students in SECME from other schools." Several students (11%) claimed there were no weaknesses. A student from Scarborough noted, "[there] are no weaknesses, we are a strong team." Another 11% of the respondents (all from the same high school) claimed the club officers at their school were disorganized. One Washington student complained that SECME was "not as organized as it could be when it comes to announcing meetings." Similarly, another student from the same school noted that "communication between members and officers about activities" was a weakness of SECME.

Aside from the students' general attitudes toward SECME, the survey also asked questions pertaining to the number of years involved in SECME, the student's postsecondary plans, the college entrance exams taken by the students, and the name of the colleges students plan to attend.

The analysis of the non-attitude items showed that the average number of years respondents were involved in SECME was 2 years, and that 86% of the students plan to attend a college or technical school. The most frequent response for the postsecondary institution SECME students plan to attend was the University of Texas (13%), followed by Texas A&M University (5%). Overall, 35% of the colleges named were located in the state of Texas. Regarding col-

Table 9: SECME Student Responses to Open-ended Items on the General Attitudes Scale, 2001–2002 (Sorted by Response Frequency)

Field of Interest	N	%
Engineering	23	41
Science	10	18
Social Science	4	7
Business	3	5
Other	3	5
Math	2	4
Art	2	4
Technology	2	4
Music	2	4
No answer	5	9
SECME Strengths		
Team effort	10	18
Hands-on experiences	10	18
Encourages learning	7	13
Competitions	5	9
Student involvement	5	9
Well-organized	3	5
Real life preparation	3	5
Student outreach	2	4
Teachers	2	4
Other	3	5
No answer	6	11
SECME Weaknesses		
Not enough competitions	8	14
No weaknesses	6	11
Club officers (disorganized)	6	11
No college preparation	4	7
Not enough participation	4	7
Not enough time for meetings	4	7
Not enough support	3	5
Activities are rudimentary	2	4
Apathetic sponsors	2	4
Lack of student involvement	2	4
Other	5	10
No answer	10	18
N = 56		

lege-entrance exams taken by the respondents, 86% of the respondents had taken either the PSAT, the SAT I, or the ACT.

Discussion

The goal of the Science, Engineering, Communication, and Mathematics Enhancement (SECME) program is to prepare underrepresented minorities for postsecondary endeavors in the fields of science, math, engineering, and/or technology (SMET). To determine if this goal was being met a summative evaluation was done during the 2001–2002 school year using primarily quantitative methods. One method used to assess SECME participants' readiness for postsecondary academic challenges was to analyze their verbal and math SAT I scores. The SAT I, along with high school grade point average, is generally used by college admission committees to assess an applicant's college preparedness.

The results of the comparison between the SAT performance by the SECME students and the non-SECME control group indicated that SECME students were no more prepared for the SAT than non-SECME students. However, SECME students did have a higher participation rate on the SAT than did the control group, which may indicate that SECME teachers encourage their students to take the SAT I.

An analysis of course enrollment data revealed SECME students had a higher participation rate in science AP courses than the non-SECME sample, and a slightly lower participation rate in math AP courses than the non-SECME sample. Overall, about one-third of the students in the SECME sample participated in science AP courses in 2000–2001, while roughly 17 percent of the non-SECME students participated in science AP courses. Regarding math AP courses, approximately 31 percent of non-SECME, and 28 percent of SECME students participated in the aforementioned courses.

In an effort to determine if SECME students have benefited from the professional development of SECME teachers, a *t*-test was calculated comparing math and science course grades of SECME and non-SECME students for the 2001–2002 school year. At first glance, a comparison of mean math and science course grades suggests SECME students outperformed non-SECME students in science, while non-SECME students performed better in math. However, the results of the statistical analysis suggest that there were no statistically significant differences between SECME and non-SECME students' math and science performance. However, this finding may be due to the relatively small sample size.

To determine if SECME participants believed they were being prepared for postsecondary endeavors in SMET, a general attitudes scale was administered to SECME students. Overall, most participants believed they benefitted from SECME's teachers and the activities and competitions. Furthermore, most SECME participants planned to pursue a career in SMET and to major in SMET when they attend college. Lastly, the general attitudes scale revealed that over 25% of the participants believed SECME had not helped them prepare for the college application process or for the academic challenges they will face in college.

Recommendations

1. Because of the large minority population in HISD, it is recommended that SECME teachers and coordinators continue to recruit minority students into its organization so that more students can benefit from SECME.

2. An analysis of SAT data revealed SECME students did not perform any better on the SAT than non-SECME students; therefore, it is recommended that SECME teachers encourage SECME students to prepare for college-bound tests such as the SAT I so they can pursue postsecondary endeavors in the fields of science, math, engineering, or technology.

3. Because AP courses and examinations help students prepare for postsecondary studies, it is recommended that SECME teachers continue to encourage participants to enroll in such courses and prepare for corresponding exams.

4. An analysis of course grades in math and science revealed no statistically significant difference between SECME and non-SECME students. Therefore, it is recommended that SECME coordinators encourage professional development for teacher participants in an effort to ameliorate the teaching efficacy of SECME teachers.

5. One of SECME's goals includes preparing HISD participants for postsecondary challenges; therefore, it is recommended that SECME teachers

and coordinators attempt to assist their students in the college selection and application process by creating a workshop designed to help juniors and seniors choose and apply to college.

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Appendix A
SECME Student Survey
Spring 2002

Instructions: The goal of this survey is to learn more about the **SECME, Inc**. program, and your opinion about your involvement in the program. Your input is important and will play a key role in evaluating the program. All responses from this survey will remain anonymous. When you have completed this survey, please use the enclosed envelope and return it to the SECME Teacher on your campus no later than **April 19, 2002**.

Thank you very much for your cooperation!

1. Which of the following categories describes your race/ethnic background?

❒ African American ❒ Caucasian ❒ Native American
❒ Hispanic ❒ Asian ❒ Other

2. What is your gender?

❒ Male ❒ Female

3. What grade level are you in this year (2001–2002)?

❒ 9 ❒ 10 ❒ 11 ❒ 12 ❒ Other

4. How long have you been involved in SECME? _____

5. Do you plan to attend a college or technical school after graduating from high school?

❒ Yes ❒ No ❒ Not sure

6. If so, name the college or technical school you plan to attend:

7. Which of the following pre-college tests have you taken (check all that apply)

❒ SAT I ❒ ACT ❒ None
❒ SAT II ❒ PSAT ❒ Other _____

Using the scantron sheet provided, bubble in the box that best represents your opinion.

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
8. My involvement in SECME has helped me choose the college/technical school that is right for me.	(A)	(B)	(C)	(D)	(E)
9. I am confident that SECME has prepared me for the academic challenges I will face after high school.	(A)	(B)	(C)	(D)	(E)
10. My involvement in SECME has prepared me for the college application process.	(A)	(B)	(C)	(D)	(E)

Appendix A (continued)

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
11. Because of SECME, I have found a role model/mentor to help me reach my goals.	(A)	(B)	(C)	(D)	(E)
12. When I go to college, I intend to major in science, math, engineering, or technology.	(A)	(B)	(C)	(D)	(E)
13. I plan to pursue a career in science, math, engineering, or technology.	(A)	(B)	(C)	(D)	(E)
14. My SECME teacher(s) was/were knowledgeable in the area of science.	(A)	(B)	(C)	(D)	(E)
15. My SECME teacher(s) was/were knowledgeable in the area of math.	(A)	(B)	(C)	(D)	(E)
16. My SECME teacher(s) was/were knowledgeable in the area of computer science.					
17. My SECME teacher(s) was/were knowledgeable in the area of engineering.	(A)	(B)	(C)	(D)	(E)
18. The SECME activities/competitions helped me learn more about science, math, engineering, and/or technology.	(A)	(B)	(C)	(D)	(E)
19. My participation in SECME has motivated me to learn more about science, math, engineering, or technology.	(A)	(B)	(C)	(D)	(E)
20. I would recommend SECME to other students.	(A)	(B)	(C)	(D)	(E)

21. The field I am **most** interested in is…(**please check only one**)

❒	Science (e.g., biology, chemistry, physics)	❒	Engineering	❒	Social science (e.g., sociology, psychology)
❒	Math	❒	Technology	❒	Business
❒	Art	❒	Music	❒	Other

22. In your opinion, what are the major strengths of SECME?

23. In your opinion, what are the major weaknesses of SECME?