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Two Preferred Activities Using S-STEM

Abstract

This article presents a summary of the two years activities of the Nation Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) that includes the model used, expectations from scholarship recipients (scholars) and their responses to a survey. Scholars were required to register in a one credit-hour course. Having scholars in a class enabled us to team them up in small groups. Each team was given a task and each team's activities were monitored to make sure all the team members were involved and contributed equally. The main goal of the S-STEM project was to enable academically talented students with financial need as defined by the federal government to either enter a STEM discipline (in order to complete their bachelor degree and then enter the workforce) or to pursue a graduate degree.

According to a study conducted by J. D. Angrist (MIT) and colleagues,[1] involving 1,600 students at a large Canadian university (the equivalent of an American state university with heavily subsidized tuition), the combination of participation in (a) a scholarship program and (b) academic support services resulted in higher academic achievement and retention for females (but both males and females used support services and peer advising at higher rates) compared to groups of students who participated in either (a) or (b) but not both. This article presents a summary of NSF S-STEM activities for the past two years and discusses a few lessons learned.

Introduction

In a world of rapidly changing technology, the knowledge explosion, and the expanding global economy, there is growing concern regarding the American ability to remain competitive. Some studies have shown that underrepresented students drop out of STEM programs at much higher rates than non-STEM programs. Although, providing equal access to higher education is necessary, colleges and universities must also provide equal opportunity for retention, graduation, and advancement.[2] In the book *Talking About Leaving, Why Undergraduates Leave the Sciences,* [1,3] it is stated that nationally 40 percent of undergraduate students leave engineering programs, 50 percent leave the physical and biological sciences programs, and 60 percent leave mathematics programs to pursue other non-STEM programs.

Recent findings from the Academic Pathways Study (APS) have shown that among the factors that predict the post-graduation plans of seniors—plans to pursue engineering or non-engineering work and plans to attend engineering or non-engineering graduate school—are students' confidence in their professional and interpersonal skills and their level of intrinsic psychological motivation to study engineering. These two variables, when taken in combination, also distinguish the overall college experience of students. [4]

Teams and teamwork are important components of both industry and organizations. While teamwork is a major component of industry core requirements, the students attending higher education institutions may not possess extensive teamwork experience. Employers, along with the Accreditation Board for Engineering and Technology (ABET), expect that engineering

programs expose their students to these important skills. The ABET stated in EC 2000, Criteria for Accrediting Programs that "one program outcome and assessment measure for engineering programs is to demonstrate that their graduates have an ability to function on multi-disciplinary teams." To help students be effective team members and develop leadership skills in a multidisciplinary environment, S-STEM recipients were required to register for a one-credit course that utilizes a team project.

Major Components

Recruiting: The 2008-2009 was the preparation year. An S-STEM website that contains information about the S-STEM grant, application, requirements and contacts was developed. Applicants used this website (http://www.enmu.edu/S-STEM) to submit applications, review the criteria, and contact Principal Investigators (PIs) if needed. Other recruiting materials included postcards and posters. The postcards and posters contained sufficient information about the scholarship including the address to the S-STEM website. The recruiting activities started by emailing a copy of the postcard to every high school principal in the state of New Mexico. Recruitment included visiting high schools in the Eastern part of New Mexico and Western part of Texas and asking the counselors to disseminate the scholarship information to the math and science teachers as well as senior students. A list of sophomore students in five community colleges within 120 miles of ENMU was requested and received. A flyer about the S-STEM was mailed or emailed to every student on that list. Information was also provided to the faculty and students in math and sciences programs through meetings with the deans of math and sciences at five community colleges.

Scholarships in Science, Technology, Engineering and Mathematics (S-STEM)
(http://www.enmu.edu/S-STEM)

Figure 1. First page of the website

One-Credit Course

The recipients of the NSF scholarship were required to register for a one-credit project course. The course encourages scholars to hone their communication skills and gain knowledge in functioning effectively on a multidisciplinary team. The first project was to create and present a conceptual business plan. The goal of this project was to have students achieve competency in various business practices. These business practices help students develop leadership skills in a multidisciplinary environment, and understand the components of effective teamwork and the importance of good communication skills. Students were provided with a weekly task. The first task of this project included choosing a company name, and providing descriptions for the business, product or service, business location, the target market, and the business competition. The final task includes 'the first year, business survival" such as information on monitoring and evaluation, critical communication and credit, collections, product advances, market trends and summary. In addition to class meetings, students regularly meet outside the class to create a PowerPoint presentation. Students were required to demonstrate that they were making progress by understanding the issues involved in having a successful business. For the first project students worked in groups. Each group included 4-5 scholars. Each group was to devise a business plan for a marketable product or service. Each group consisted of a President, Financial Officer, Marketing Specialist, Planning and Analysis person, Sales Manager and so on. The outline that students were to use in developing their proposals was provided for them. Groups were required to give presentations on a weekly basis. The instructor and other groups used the opportunity to critique each presentation as to clarity, viability, and practicality.

Business Proposal

Cover Sheet (Title Page)
(first week)
The first page of the proposal was the cover sheet. It should contain the following items:
- Name of the Company
- Company Address, Phone-Number
- Web-address
- Name of the Preparer

Body (Narrative)
(second and third weeks)
- Description of the Business
- Description of the Product or Service
- Description of Business Location
- Description of the Target Market
- Description of Competition
- Method of Distribution
- Advertising to Your Target Market
- Timing of Market Entry

- Industry Trend
- Management Background and Strategic Plan
- Description of Personnel

Financial Section
(fourth and fifth weeks)
- Identification of Existing or Expected Funding Needs
- Capital Equipment
- Preparation of a Balance Sheet for Day one of the first Year
- Cash Flow Projection for the First Year
- Profit and Loss Statement for the First year
- Current Personnel Cost including Fringe Benefits
- Supporting Documents
  Resumes, References, Recommendations, Equipment Cost, Supplier Price List, Needs Assessment

Pre-Planning Stages
(sixth week)
- Select the Business
- Initial Research
- Acquire the Skills

Defining the Business
(seventh week)
- Feasibility Study and Business Plan
- Market Research and Plan Financial Projection
- Cash Flow Projection

Getting Ready
(eight and ninth weeks)
- Selecting a Location
- Initial Equipment and Supply
- Pricing, Sales Forecasting
- Securing the Financing

Starting --Action Plan
(tenth, eleventh and twelfth weeks)
- Review and Adjust all Plans
- Staff Selection and Training
- Independent Contractors and Sales Representatives
- Marketing Implementation
- Customer Service and Satisfaction

Ongoing Operation -- The First Year: Business Survival
(thirteen and fourteen weeks)

- Monitoring and Evaluation
- Critical Communication and Credit
- Collections
- Product Advances and Market Trends
- Summary

Second Year Project

For the second project, the 25 students were divided into 5 teams with 5 students per team. The task for each team was to choose a real company that hires graduates from their disciplines, interview a person from the company and give a 30 – 45 minutes presentation about the company. A set of suggested questions was made available for students to ask the company's representative during the interview. The following list is a suggested set of topics that could be discussed while interviewing a company's representative:

- Company Vision
- Company Products
- What are secrets to company's success?
- What are secrets to individual success?
- How to increase productivity
- Their competitors
- How do they compete?
- How to increase worker's loyalty
- Magic Box: How do you keep the new products secret?
- How do you make sure the workers are happy? High Moral?
- Retirement
- In terms of loyalty on a scale of 1 to 10, how would you rate yourself?
- What are the strengths and weaknesses of your company?
- Future Forecast of your company
- What do you see as a threat to your company?
- What are strengths and weaknesses of your company?

The companies chosen by students were Intel Corporation, as shown in Figure 2, ENMR-Plateau Telecommunications, LabCorp, Presbyterian Healthcare Services, and Merck & Company Incorporated**.** Some teams were able to contact the company's representative quickly, while other teams had to be more aggressive by making multiple calls.

Figure 2. Sample Student Presentation

Evaluation and Assessment (Second Year)

Adams and Simon Vena[5] argue that highly effective teams exhibit 7 characteristics: common purpose, clearly defined goals, psychological safety, role clarity, mature communication, productive conflict resolution, and team member accountability. An assessment tool was developed that uses those 7 characteristics to assess the effectiveness of teamwork. It became clear that the teams which were most cohesive (team members were in the same discipline, or team members developed friendship) tended to develop a more practical and effective job.

As indicated in Table 1, twenty-one of the students participated in the survey and the majority of students felt that the project they worked on was effective in increasing their teamwork skills. As indicated in the Table 1 for the first question, "Was your team effective in accomplishing the given task?"   Eleven students out of twenty one rated the project Effective and ten students rated it as Very Effective.

Mark only one	Not at all	Partially	Effective	Very Effective
Was your team effective in accomplishing the given task?	0	0	11	10
Were you an effective member of the team?	0	0	12	9
Did you increase your own teamwork skills?	0	5	11	5
Did you and every team member have a positive attitude toward the teamwork activity?	0	3	9	9
Did every team member behave professionally and positively toward the teamwork?	0	1	9	11
Did team members add to team effectiveness?	0	1	10	10

Table 1. Team Work

As suggested by the speaker, the students should have an opportunity to evaluate themselves and their fellow team members. As indicated in the "Yourself" column from Table 2, the students rated themselves on average from 4.00 to 4.92 and their fellow team members from 2.94 to 4.88.

CHECKLIST SCALE FOR RATING COLLABORATIVE SKILLS OF SELF AND GROUP MEMBERS

5 = Ideal team member
4 = Very good team member; mostly helpful; mostly reliable
3 = Helpful when present, but not always reliable
2 = Causes more problems than providing benefits
1 = Quality of work poor; did not share equally in completing
N.A. = not applicable

NOTE: unless your group is unique, it is not likely that everyone will receive 5's in every category.

Collaborative Skills	Yourself	Member-1	Member-2	Member-3	Member-4
Common Purpose: was the main objective of the team understood and shared by all team members?	4.29	4.43	4.38	4.33	3.47
Clearly Defined Goals: were the goals of your project clearly defined?	4.30	4.25	4.30	4.25	3.36
Role Clarity: was the role of each member clear?	4.92	4.33	4.48	4.38	4.00
Mature Communication: was each member communicating in a mature fashion?	4.48	4.33	4.29	4.29	2.94
Behavior: was every member behaving professionally?	4.00	4.57	4.43	4.62	3.63
Performance: was each member performing professionally during the length of the project?	4.67	4.38	4.62	4.38	3.75
Attitude: did each member have positive attitude toward the common goal?	4.48	4.33	4.33	4.88	3.81

Table 2. Evaluation

One of the goals of this project was to improve students' oral communication skills. As indicated in the Table 3, 9 of 21 students felt that their presentation skills were very effective. As a whole the majority (13 of 21 students) felt no changes needed to be made in future classes as indicated in the row 2 of the Table 3.

Mark only one	Not at all	Partially	Effective	Very Effective
Did your presentation help you with your presentation skills?	2	5	5	9
	No Change	More Presentations	More Individual Presentations	More Group Presentation
How can we make the presentations more useful?	13	2	5	1

Table 3. Presentation

Lessons Learned

Not all students seemed to be aware that they needed to complete the Free Application for the Federal Student Aid (FAFSA) especially when they met S-STEM eligibility criteria. Once we asked students to complete the FAFSA application there was quite a wait through the ENMU Financial Aid office while they assessed student's eligibility. To remedy this wait, we posted a statement on the S-STEM website "Please check with the financial aid office at your institution (ENMU, CCC, ENMUR, or NMJC) to make sure you have a complete FAFSA on file and you have unmet financial need."

Also, advertising was more expensive and time consuming that we were anticipating. Creating postcards and mailing them to all sophomore students in the Associate of Science programs at the five regional community colleges (around 1800 students) became expensive, thus, in the future more funding and time would need to be allocated.

Demographics

The tables and the graphs below provide information on the number of scholarships given and the demographic of scholars.

| Discipline	# of Scholarships	Male	Female	White	Hispanic	African American
EET	6	5	1	5	1	0
CS	2	2	0	1	1	0
CIS	2	0	2	0	0	2
CHEM	1	1	0	0	1	0
MATH	3	1	2	1	2	0
BIOL	5	1	4	4	1	0
Associate	6	2	4	2	3	1
Total	25	12	13	13	9	3

Table 4. The number of S-STEM Scholarships awarded as a function of demographics for 2009-10 academic year.
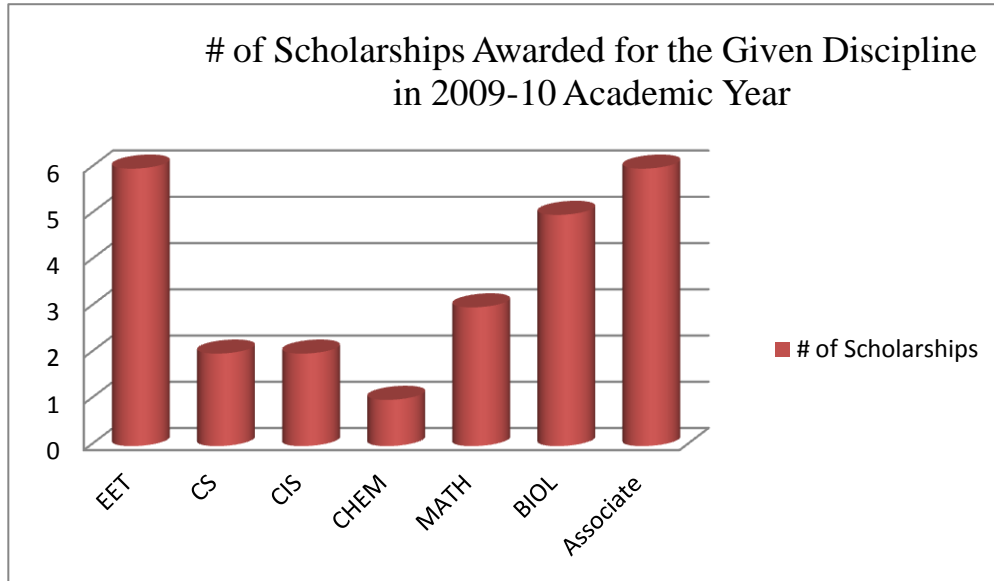
Graph 1. Number of scholarships awarded per discipline for 2009-10 academic year

Discipline	# of Scholarships	Male	Female	White	Hispanic	African American
EET	4	4	0	4	0	0
CS	4	2	2	3	1	0
CIS	3	2	1	2	0	1
CHEM	3	1	2	3	0	0
MATH	2	1	1	1	0	1
BIOL	9	2	7	5	4	0
Associate	7	3	4	4	3	0
Total	32	15	17	22	8	2

Table 5. Number of S-STEM Scholarships awarded as a function of demographics for 2010 - 11 academic year.

# of Scholarships Awarded for the Given Discipline in 2010-11 Academic Year
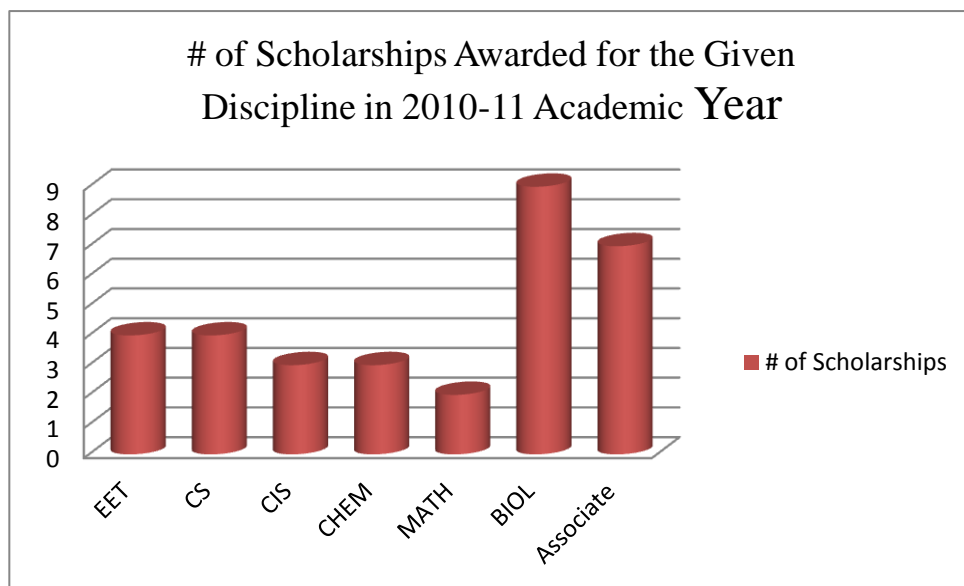
Graph 2. Number of scholarships awarded per discipline in 2010-11 academic year

Conclusion

The goal of offering this course was to create an environment where students could work in teams from multidisciplinary STEM programs and demonstrate that students can function effectively and gain valuable experience in creating a business, time management and marketing. Also, an additional goal was to enhance student's communication skills, as well as their ability to work together on team-oriented projects. The data collected implies that: [1] every team was effective in accomplishing the given task [2] every team member increased his/her teamwork skills [3] every team member had a positive attitude toward the teamwork activity and [4] team member's presentation skills were enhanced significantly.   Also, there were some concerns and suggestions that included: [1] it would be more practical to group students in the same discipline [2] the project was too time consuming for a one-hour credit [3] some members did not work as hard as others and [4] it would help if there was a speaker at the beginning of the course to discuss a practical business plan. Overall, students agreed that the course provided them with business and teamwork experience as well as it enhanced their communication skills.

Acknowledgement

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