Improving Students' Soft Skills through a NSF-Supported

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Improving Students' Soft Skills through a NSF-Supported S-STEM Scholarship Program

Abstract
In this paper we explore the soft skills and interpersonal confidence that students gained through a one-credit course. The course was delivered to students receiving the National Science Foundation (NSF) Scholarship in Science, Technology, Engineering, and Mathematics (S-STEM) that focused on teamwork. Students were grouped in teams of 5 students from sciences, mathematics, engineering technology and computer information systems disciplines. In addition to soft skills, students were exposed to job search skills which helped them develop teamwork skills by researching a company and presenting the results to the class. Besides class meetings, students regularly met in groups outside of class to discuss their findings and to create their PowerPoint presentations. Student's understanding of teamwork was periodically assessed for effectiveness. To make sure sufficient progress was accomplished, the instructor met with student groups and provided guidance and information to expedite the process.

Engineering and science curricula often focus on the technical abilities of students, neglecting the "soft skills" that could determine success or failure for graduates when they enter the workforce. As an example, project management skills are often neglected in an engineering or science curriculum, requiring additional training for those engineers who end up in management positions. Skills such as the ability to lead and work effectively as a member of a team are frequently identified as critical to the success of an engineer, but typically are lacking in new engineering graduates. [1] This article presents some information on impact of the NSF S-STEM on development of students' professional skills.

Introduction

Soft skills are important components of both industry and organizations. While soft skills are major components of industry core requirements, the students attending higher education institutions may not possess extensive soft skills.   Much has been made in the media of the skills required for the new economy and the role of professional including "soft" skills in getting and keeping a job. Technical skills alone are insufficient to prepare graduates in engineering and engineering technology for a career. ABET and other accreditation standards acknowledge the role of these skills in engineering and engineering technology education at the undergraduate level. [2] To help students improve their soft skills which includes oral communication, leadership skills, time management skills, and professional presentation skills in a multidisciplinary environment, the S-STEM recipients at our institution were required to register for a one-credit course that utilized a team project.

The team members in this one-credit course were from undergraduate disciplines in mathematics, computer science, electronic engineering technology, biology, computer information systems, chemistry and biochemistry**.** To provide mentorship to the freshman students, teams included students from freshman to senior level and students from different disciplines. A senior student in each team was appointed as the team leader at the beginning of the semester and the leadership role was rotated between the members for different portions of

the project. To improve students' professional skills, all team members were required to participate in the project activities and in presenting the project results. Each team member was expected to have a thorough understanding of the project, make a presentation and assume leadership responsibility for their portion of the project.

Soft skills can be seen in the Technology Accreditation Criteria of ABET. For example, TAC/ABET Criterion 23 lists the eleven areas of expertise a graduate must possess upon program completion, known as the "a-k" criterion. Under this standard an engineering technology program must demonstrate that graduates have: [2]

a. an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines,
b. an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology,
c. an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes,
d. an ability to apply creativity in the design of systems, components or processes appropriate to program objectives,
e. an ability to function effectively on teams,
f. an ability to identify, analyze and solve technical problems,
g. an ability to communicate effectively,
h. a recognition of the need for, and an ability to engage in lifelong learning,
i. an ability to understand professional, ethical and social responsibilities,
j. a respect for diversity and a knowledge of contemporary professional, societal and global issues, and
k. a commitment to quality, timeliness, and continuous improvement.

Only about half of the eleven criteria apply to technical mastery: all others cover "soft skills" (i.e., creativity, communication, teamwork, problem-solving, life-long learning, and appreciation for diversity). [2]

In addition suggested List of Professional Skills for Engineering/Engineering Technology Education [2]
- effective oral communication and presentation skills
- effective written communication
- creativity and/or creative problem solving
- interpersonal skills
- ability to work effectively on a team
- time management and planning
- conflict resolution
- ethical decision-making
- the importance of continuing self-education
- an appreciation for diversity,
- an understanding of the profession's place in a larger context (global/societal/professional issues),
- professionalism

- work ethic
- leadership

Course Activities

This course was offered during falls 2009 through 2012 semester. Every fall around twenty-five students, who were recipients of the NSF S-STEM scholarship, registered for the course. The first task for students was to create an updated resume. A sample resume was provided to the class by the instructor to aid students in the preparation of their resume. Next, each student participated in a simulated job interview. The second task for the job interview was for each student to give a presentation to the class and to discuss why he/she was the best candidate for the given job. Each interviewee used his/her education, experience and personal characteristics to convince the audience that he/she was the best fit for the job. Feedback was provided by the instructor and questions were asked by the students. Completing the above job preparation skills helped students to be more effective at job career fairs, forced them to have updated resumes, sharpen their oral communication skills, and get rid of their public speaking phobia.

To provide students with more information on teamwork, a guest speaker, who had extensive experience in team development and team-working, was invited to the class to speak about effective teamwork. The speaker emphasized the importance of collaboration and discussed Gregoric's Learning Style preferences. The speaker also indicated the importance of equally dividing the work among the team members and explained how team members have an opportunity to evaluate each other's contribution at the end of the project.

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

- Company Vision
- Company Products
- What are secrets to companies?
- 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 1, 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 1. Sample Student Presentation

Evaluation and Assessment

Adams and Simon[3] 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 these 7 characteristics to assess the effectiveness of teamwork. It became clear that the teams which were most cohesive tended to develop a more practical and effective project. According to Forsyth[4], cohesion is the strength of the relationship linking the members of the group to one another and to the group itself.

The data collected every fall indicated the same satisfaction as shown in Table 1 for one of the fall semesters, 9 of 21 students felt that their presentation skills were very effective. On 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 1. Subsequent semester generated the same data.

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 1. Presentation

Conclusion

One goal of the course was to create an environment where students could work in teams from different STEM programs. 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 was indicative of the same concerns that have been observed in the past year and 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.   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. Overall, students agreed that the course provided them with business and teamwork experience including enhanced their communication skills.

Acknowledgement

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