Work in Progress - A Necessary Jump From Engineering Management to Engineering Leadership: Team Teaching, Team Learning

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Abstract - **This work in progress is a study of the evolution of a course taught to Civil Engineering Technology students. Engineers are taught to work with things. In today's global marketplace, engineers must have people skills to be effective on the job: especially, leadership. Management has been replaced by leadership in an effort to better prepare engineers for the workplace of tomorrow. The move to leadership was initiated by the Industrial Advisory Board due to concerns about a perceived lack of people skills of their new employees. Using an interdisciplinary instructor team (Management and Engineering) with a combined 65 years of leadership experience in vastly different industry and academic environments, students develop their leadership skills. The course is taught as both a lecture and active learning forum. The faculty member's experience, the texts used and the active learning produces a classroom environment that is lively and frank. Students are required to teach the material in two books and find that teaching is good for learning while overcoming concerns and gaining confidence when presenting to their peers. Students are required to relate life situations where they experienced leadership successes and failures, to perform a personal assessment, and to make a plan for future development. The results are astounding and worth discussion.**

Index Terms – Leadership, Management, Team learning, Team teaching.

BACKGROUND

Most engineering and engineering technology curricula contain a very comprehensive compendium of technical courses designed to insure students are competent upon graduation. ABET accreditation requirements necessitate the need for adequate and in depth coverage of the technical content in each discipline. Accreditation ensures a high academic standard exists in every program receiving ABET accreditation.

On the other hand, a typical engineering or engineering technology undergraduate education usually lacks a very critical element for succeeding in the workplace; the skills necessary to work effectively with other human beings. Undergraduate students must learn and develop the skills and abilities associated with becoming effective when working with a wide variety of people. The word 'leadership' finally surfaces as the area where the students are deficient. At this point discussing this educational shortcoming takes on a whole new meaning especially since it has never been addressed before in the undergraduate curriculum.

Conventional wisdom defines leadership as a skill and as such it can be learned [1]. The question is where to begin when teaching leadership skills? Researching the voluminous amount of leadership material available to industry clearly indicates the starting point must be with the individual focusing on themselves [1]. Students of leadership must first scrutinize their trustworthiness and integrity ensuring they are genuine and authentic in their personal character [2]. Once they have ascertained their trustworthiness, the students then focus on the level of trust they must develop with others to have a positive influence on them so as to create a synergistic relationship with the various members of a team.

The premise for teaching leadership is best summarized by a famous quote from a much respected general and president of the United States. It states, "The one quality that can be developed by studious reflection and practice is leadership". - General Dwight Eisenhower. This course was developed to provide students with both tenants ensuring a thorough understanding and comprehension of leadership.

COURSE DEVELOPMENT

The Civil Engineering Technology program at the University of Pittsburgh at Johnstown has a Construction Management thread and one of the courses offered was Engineering Management. In recent years, the emphasis from ABET, the desires of graduates, the experience from faculty who do regular consulting and the evolving understanding for the need of leadership training for graduates fueled a redesign of the Engineering Management course to specifically address leadership. The course is currently undergoing a name change to Engineering Leadership which more adequately reflects the new content taught to the students.

Research by the authors with extensive experience in the area of leadership, along with input from the Engineering Technology Advisory Board, served as the basis for the major course revisions necessary to convert the

'management' course to one with primary emphasis on leadership. With leadership considered a skill, efforts focused on identifying the various fundamental components important in the study of leadership. Much of the current national attention on character and integrity necessitated teaching these subjects to the students. It was also realized these two critical areas needed to be taught at the beginning of the course to help students understand how important character and integrity are to their personal and interpersonal effectiveness. After exposing the students to this essential need, the next step in the leadership skills development process required that students be given specific understanding of how to develop the leader which exists in every person [4]. This step was crucial since the entire premise of this course revolved around leadership being a skill which can be learned and "developed by studious reflection and practice . . ."

Two excellent bestselling books served as the texts for the course in its early years. The first book is *The Seven Habits of Highly Effective People* by Dr. Stephen R. Covey. This book specifically addresses the character and integrity development desired by the instructors for the course. The second book entitled *Developing the Leader Within You* by Dr. John C. Maxwell became a perfect match for the objectives for this portion of the course set by the instructors. In 2008, with the retirement of the original course developer, a new team took over the course and made several modifications. Since neither faculty member was 'Covey Trained' the Covey book was dropped. It was determined that the Maxwell book had sections on character and integrity so it was retained to address these Covey topics along with several others. Two additional texts were adopted to address attitude and the practical aspects of leadership in industry. *The Difference Maker* by Dr. John C. Maxwell and *Secrets of Effective Leadership* by Fred A. Manske, Jr. completed the new book set thus addressing every aspect of leadership from personal reflection through attitude to application in an industrial environment.

There were additional modifications to the course that include two team teaching presentations on chapters of the book, one presentation related to a book review on a leader of choice, and several team activities including the origami frog construction competition, the blind maze and 'ALL ABOARD' raft building exercise. The actual team structure utilizes triads with the project leader role being rotated at some point in the term to each team member. Thereby, each student leads a project and experiences the 'hands on' of leadership. Each of these presentations and exercises exposes the students to leadership opportunities within their group and to other leadership styles demonstrated by their peers. The model for student learning in this segment was developed based on ideas from books on teaching that remind us that the best way to learn is by teaching the material.[5,6] There are now two faculty who team-teach the course serving as role-models actively demonstrating leadership traits in class. Both have extensive leadership experience and use the texts and 'real world experience' anecdotes to reinforce leadership principles. Finally, the class votes on the meeting time and format (two days a week for 80 minutes or three days at 50 minutes): the former allowing expanded class time necessary to practice leadership on in-class exercises. To date, each class has voted for the expanded time meeting at 7:30 AM twice a week.

The course has several other goals aside from teaching leadership. As a speaking enhanced course, team presentations of text materials are evaluated by the class based on a speaking rubric. Each student receives feedback from the teachers and peers in an effort to improve speaking abilities. Before the second presentation, each student is required to list those things being addressed in an effort to improve and to obtain specific feedback on said improvement. This has been very beneficial to the students as they develop their communication skills. Likewise, the book review on their chosen leader encourages the students to showcase the leader's application of leadership principles and traits particularly learned from the course texts and is thoroughly graded and returned to provide positive constructive feedback. Before submission, the book reviews are evaluated by peers so that suggestions can be offered on improving the writing before submission. Peer reviewers are required to sign the paper and take on some measure of responsibility for the resulting grade [8]. Finally, leadership exercises are developed wherein the leaders of the day are required to lead team competitions in a certain exercise – often there are team members who are encouraged to have a bad attitude or make mistakes to test the leader's abilities to influence and accomplish the task at hand. This motivational aspect of the course breeds creativity, competition, and innovation among the teams. The course is full and requires daily participation to acquire skills and practice them.

To date, the course has been well received by the students. Anecdotal evidence indicates that there has been good to excellent development in the areas of: speaking, leading small groups, development of self-discipline, and application of skills in such endeavors as senior projects. Several students claim that the skills learned in this class have been instrumental in obtaining employment after graduation. Members of the Engineering Technology Advisory Board indicate that new hires who have taken the course are better prepared for industrial situations. Unfortunately, the word anecdotal does not carry much weight when suggesting that this is the way forward: thus, it has been determined that a more aggressive study of the outcomes of this course needs to be undertaken. The remainder of this paper will address what is planned to determine the worth of the course before suggesting that this is the answer for other colleges and universities looking to more toward leadership as a skill to be addressed.

HYPOTHESIS

Changing the focus of the Engineering Management course within the Civil Engineering Technology program to

Engineering Leadership will produce a graduate who is better prepared for the roles assumed as a front line engineer within the industrial community.

MEASURES

With every good engineering course there must be outcomes that are traced to some need and related to the mission of the program. The mission of the Engineering Technology Division clearly states that the program will: *Ensure graduates have the requisite leadership, communication and technical skills to compete in the regional, national and global marketplace*. The technical skills are addressed in the myriad of technical courses required of the graduates. Communication is addressed across the curriculum and is further addressed in the Engineering Leadership course. Leadership can be taught, learned and practiced at UPJ with this course being one of the experiences in the four year program. There are four outcomes that are sought by our constituencies that are addressed in this course:

(1) The development of leaders who are sensitive to the motivational needs of their subordinates and peers.
(2) The development of leaders who can communicate effectively across a broad spectrum of associates.
(3) The development of leaders who are introspective and advance their leadership skills through critical analytical self evaluation.
(4) The development of leaders who exhibit knowledge of the difference between leadership and management.

The constituents include the Engineering Technology Advisory Board, employers who seek our graduates, the students (current and incoming) and graduate programs. With the exception of graduate programs, each of these constituents knows the mission statement and approve of this change.

As previously stated, it is important to note that the employers who have hired graduates since the inception of the original course are very pleased with their training and the exhibition of their leadership skills. The Advisory Board interviews students and finds that this leadership course is highly valued by the graduates.

EVALUATION METHODOLOGY

The evaluation of the course will employ several assessment techniques. The faculty team will develop a pre- and post-test to determine the growth during the course. The test will consist of a series of management and leadership questions that will focus on prior knowledge and thoughts about management and leadership as compared to post course knowledge and thoughts. One question that is already used asks the students: What is leadership? Many state going into the course that it is control of people, whereas, after the course the answer is influence. This is an important growth in their ability to lead as control often leads them to failed leadership. The test will include a series of approximately 30 questions. The exit interviews by the Engineering Technology Advisory Board will continue to be used as an assessment tool since many of the advisory board members are also employers. Specific questions will replace the question about how the students liked the course: these questions will be developed with the aid of the advisory board. Since there is a requirement to conduct surveys of employers and graduates as part of the ABET accreditation process, question regarding leadership will be included. There is a natural test group, Civil Engineering Technology graduates, and a control group, all other Engineering Technology graduates, against which results can be compared. All students do receive some leadership experience, but only the civil students have a specific course on leadership. The accumulation of data will take approximately three years. Since communication is also covered in this course, that outcome may also be affected by the additional exposure experienced in the course.

DISSEMINATION

It is envisioned that dissemination will not occur for three years: however, results of the pre- and post-tests may provide some initial insight into the value of the course and may be reported on sooner. Similarly, the results of exit interviews and any other anecdotal evidence could be worthy of a brief update on the direction of the findings. Certainly, there may be enough data collected that a follow-on paper could be presented that includes changes that are made to further improve the course.

CONCLUSION

The introduction of leadership as a topic in Engineering Technology courses appears to be important in the development of graduates who will enter industrial settings. There has been some evidence that students taking the course benefit during their senior project courses and during interviews for jobs. One student said that during his interview the president of the company remarked that he had extensive knowledge of the character and values of the kind of leaders being hired and was actually hired because of this knowledge. Without more information it would be difficult to attribute this to the course, but the student attributed his ready knowledge to the time he spent thinking about leadership while taking the course.

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