Measuring Faculty Preparation to Lead Teams in the Engineering Classroom: A Pilot Study

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Abstract

According to modern education practices, teaching students how to work in teams represents a big challenge for faculty members. In many cases they are the individuals who establish tasks for the teams and who form, monitor and evaluate them. Studies have shown that there is a strong statistical difference in the number of hours of training between low and high users of teams in the classroom suggesting that the more training faculty members have, the more they use teams in their classrooms.[1]

With increased expectations from industry for graduates to demonstrate a mastery of group effectiveness skills [teamwork, interpersonal skills and negotiation] faculty members are putting emphasis on teaching methods that use teams.[2] With an increased use of teams in the classroom, questions remain regarding how prepared are faculty members to lead teaming efforts? The purpose of this study was to obtain information from engineering faculty regarding their usage of teams, their attitudes toward teams and how they are currently using teams in engineering classrooms. This paper and the presentation will present the findings of a web-based survey of engineering faculty.

Introduction

As the use of teams in the engineering classroom increases so do the responsibilities of the faculty member. The faculty member has responsibility for creating an environment where students can work in teams and where interpersonal and collaborative learning can take place. The role of the faculty member is similar to that of a coach on a sports team. The coach is responsible for forming the team, establishing tasks for the team, monitoring the team and evaluating the teams' performance. For many faculty members teaching students how to work in teams represents a big challenge. Specifically the faculty member must:

- Help team members anticipate possible dysfunctional behaviors and brainstorm solutions.[3]
- Help team members accept responsibility for successful development of the team.[3]
- Provide training for students on how to work on teams.
- Evaluate team task and process performance.[4]

- Continually develop personal skills in facilitating group process and planning. Learn a variety of techniques to control digressive, difficult, or dominating participants, to encourage reluctant participants, and resolve conflict among participants.[4]

Training faculty members on how to lead teams could be one of the most important activities required to make engineering student teams function effectively. Lack of training results in bad teamwork experiences that hurt students' attitudes toward teams and affect their future performances and careers. According to Buckenmyer, "organizations that use teams successfully spend long hours and millions of dollars training individuals to work with teams, training team leaders and training managers to manage teams."[5]

The lack of student and faculty preparation on functioning properly in teams affects team effectiveness. To have an effective teaming experience requires well-qualified faculty to provide training to their students. Team participation and team functioning has to be taught, not only to students, but also to their teachers. However, "most of the teachers (faculty) have little or no staff development (skills)".[6] Therefore they often lack the expertise required to function effectively as a team member or to assist students in improving their teaming skills. Staff development activities include, among others, setting team goals, making decisions and assessing a team.[6]

The literature supports the need for training on the effective facilitation of teams in the classroom for engineering faculty. A study on faculty members conducted by Mead et. al. describes the results of a survey of 36 professors from various engineering disciplines. The authors found that, "nearly two thirds of the survey participants had taken no courses or workshops on team management and only one third of those interviewed had taken at least one course (workshop) on team management."[7] The question remains, "what about the remainder of the engineering faculty community?" There is limited information on the numbers of faculty members who have training on the facilitation of teams, although there are a number of opportunities to discuss teaming in the engineering classroom.   Opportunities such as New Century Scholars, sponsored by Stanford University and the National Science Foundation or the National Effective Teaching Institute.

Objectives

The objective of this study was to measure the proficiency of faculty members to lead teaming initiatives. To determine proficiency, a web-based survey was developed. The intent of the survey was to assess faculty members' attitudes, usage and comfort level regarding the use of teams in the engineering classroom.

Methodology

To examine faculty members' views regarding teams in the engineering classroom, a questionnaire was developed and posted on the web site of the University of Nebraska-Lincoln College of Engineering. Questions on the survey were designed to obtain data on demographics, team usage and faculty attitudes toward teams. The questionnaire consisted of 49 questions. A total of 86 survey responses were received with 82 usable, which were included in this study.

Results

Questionnaire respondents represented engineering faculty members from several disciplines and universities across the United States. The distribution by disciplines were as follows: industrial engineering, 27; mechanical engineering, 16; electrical engineering, 8; engineering management, 5; materials engineering (mineral engineering), 5; chemical engineering, 4; civil engineering, 3; biomedical engineering, engineering technology, and computer science, 2; and biological engineering, nuclear engineering and geological engineering, each had one respondent.

The teaching experience of the participators ranged from 1 to 35 years, with an average of 12.268 years. More than one third (36.59%) currently hold the status of associate professor, 31.71% are assistant professors, 20.73% are professors, 7.32% are deans and the rest (3.66%) are lecturers/instructors, assistant/associate deans or adjunct professors.

Other findings: the majorities held a doctorate degree (97.56%), are White/Caucasian (80.49%) and are male (82.93%). The remainder of the respondents were: Asian Americans (7.32%), Black/African Americans (4.88%), Foreign Nationals (4.88%), Hispanics/Latinos/Mexican Americans and female (14.63%).

Participants were asked about their team training experiences and how they use teams in their classroom. Findings show that more than two thirds (68.29%) of respondents have participated in a workshop on effective teaming or teaming techniques. Among all the respondents, 80.49% use teams for design projects suggesting that they consider this an essential training activity in preparing students for the work place. More than half of those surveyed (51.22%) use teams for homework/problem activities, 70.73% for in-class activities and 35.37% for case studies.

Faculty members form their teams in different ways: a little less than half of the teams (46.34%) are assembled by the instructor, who tries to use a set of attributes to balance the skills and interests of students. These attributes could vary from grade point average, schedule availability, residential closeness, ethnical and gender diversity etc. Other instructors (37.80%) form their teams by self-selection. A small percentage (9.76%) tries to simulate the work environment and form teams randomly. Finally, a small percentage (6.10%) uses other non-specified methods to form teams.

When the professors were asked about team size, 79% responded that they form groups that consist of a specific number of students. This number averaged 3.79 students per team. Two of the professors responded that they use a team size that ranges from 2 to 3 and 3 to 5 students, indicating that the team size depended on the nature of the assignment.

Although teachers recognize the importance of teams in the engineering classroom, they do not use the teaming approach in all their classes. On average, respondents teach 2.13 classes but they only use teams in 1.64 of them. This happens because the team approach tends to be less used in lower level classes. The survey results indicates that only 39.02% of the faculty members use teams in introductory level classes while 64.63%, 52.44% and 51.22% of them use teams in

core requirements, technical electives and capstone/senior design classes, respectively. This indicates that the more advanced an undergraduate student is, the more team-focused classes he/she can expect.

Faculty members were asked: "When forming student teams, I make every attempt not to isolate women" and "When forming student teams, I make every attempt not to isolate underrepresented minorities." With regard of female students, 62.20% of the faculty members answered that this statement was true and 37.80% that it was false. In the case of underrepresented minorities, 59.76% responded this statement was true and 40.24% that it was false.

An important characteristic of well functioning teams is training. To improve teams' performance, faculty members should instruct their students on how to work well with others in teams. To assess what training faculty members provide to their students when forming teams, participants were given a list of topics and asked to indicate which ones they covered when training students. The results indicated that 41.46% of them provide training on role definitions, 37.80% on effective learning and communication, 36.59% on effective meetings, 35.37% on goal setting, 34.15% on decision making techniques, 31.71% on conflict resolution, 19.51% on effective evaluation, 13.41% on trust building and 12.20% on negotiation skills.

The third part of the questionnaire consisted of an assessment of the faculty attitudes toward teams in the classroom. A group of 19 questions (see table 1) were asked to test this item. A Likert scale was used where the value of 1 was assigned to the answer "strongly agree" and the value of 5 was assigned to the answer of "strongly disagree." The first four questions of this section (questions 13, 14, 15 and 16 of the complete questionnaire) were related to the recognition of the importance of teams in the engineering classroom. The responses were very favorable to the use of this approach, with responses averaging 1.30, 1.71, 1.45 and 1.70 respectively.

On question 17, participants were asked if they consider that the use of teams required far too much work. Their answer averaged 3.62, suggesting that they mostly disagree or are neutral on this issue. Question 18 was related to their team-forming techniques. With an average response of 2.37, professors do not consistently agree on this topic. An agree/neutral answer (confirmed by the usage responses) indicates that instructor involvement on team formation is not always practiced. However, self-selection and random techniques on questions 19 and 20 received a more neutral/disagree response, with averages over 3.0 (3.11 and 3.22 respectively).

The next two questions, 21 and 22, were related to the benefits of teams in the classroom from a faculty member's perspective. With answers between strongly agree/agree (averages 1.85 and 1.77 respectively), the general response indicates professors recognize that the use of teams facilitates their job and helps them fulfill the goals of their courses. Questions 23 and 24 asked about the teachers' preparedness to incorporate teams and manage them. The respondents indicated they felt they were prepared to manage teams in the classroom. On Question 25, the professors were asked if they would know when their teams are working well. The response was favorable (average 2.21).

Questions 26 and 27 were related to the quickness of team formation. Professors were asked if they understood what it takes to form a team quickly and if they had the skills to help their students form them quickly. Responses (average 2.57 and 2.55) indicate that professors perceive a need for instruction in the quickness/efficacy of team formation. The next inquiry concluded the attitude part of the questionnaire. It was in reference to their previous experience with teams. The average of the responses (1.89) indicates that the respondents have effectively used teams to improve student learning in their courses.

Table 1. Faculty Attitude Questions

13. I believe that working in a team prepares students for the workplace.
14. I think teams are an effective way to teach engineering.
15. I believe that teaming experiences in the engineering curriculum will contribute to my students' career success.
16. I believe teaming activities will assist my students in attaining the goals of the course(s).
17. The use of teams requires far too much work.
18. Assigning students to teams is an effective way to form teams.
19. Allowing students to choose their own teammates is an effective way to form teams.
20. Randomly assigning (i.e. birthday, height, count off by 1, 2, 3) students to team is an effective way to form teams.
21. The benefits to student learning outweighs the amount of work required to incorporate teams in my course(s).
22. I believe that teams will help me fulfill the goals of my courses
23. I am prepared to effectively incorporate student teams into my course(s).
24. I am prepared to manage teams used in my course(s).
25. I would know when a team is working well.
26. I understand what is takes to help teams form quickly.
27. I have the skills to help teams form quickly.
28. I have effectively used teams to improve student learning in my course(s).
29. I feel fully equipped to assist student teams when they experience difficulties with poorly run meeting
30. I feel fully equipped to assist student teams when they experience difficulties with poor performance
31. I feel fully equipped to assist student teams when they experience difficulties with resolving conflict
32. I feel fully equipped to assist student teams when they experience difficulties when dealing with apathetic team members

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Finally, in the attitude section, questions 29, 30, 31 and 32, sought to determine if faculty felt fully equipped to assist their students in dealing with: poorly run meetings, poor performance, resolving conflict and dealing with apathetic team members. The responses were 2.28, 2.45, 2.38 and 2.67 respectively indicating that respondents were between agree and neutral with regards to assisting their students with these issues.

The final part of the faculty teamwork questionnaire was designed to measure the preparedness of professors in terms of their ability to lead teams. This section, consisting of 15 questions (questions 33 through 48 shown in table 2), related to how much faculty members

knew about teamwork issues when using teams in the engineering classroom. Answers for this section were scaled according to the following measures:

1. Never heard of it.
2. Heard of it but do not understand it.
3. Understand it but not comfortable to teach it.
4. Understand it and I could teach it to some one else.

As in the previous part, the average of the data collected, was obtained for each question. With the exception of question 35, all other questions averaged more than 3.00. These questions suggest that while faculty members understand topics leading to an effective teaming experience at times they are comfortable teaching them to others.

The only question in this section that did not follow this pattern was question 35. This question inquired about the learned principles of problem-based conflict management. The response in this question averaged 2.76. In contrast with the rest of the questions in this section, 19.51% of the respondents implied that they had never heard of this issue, 18.29% that had heard of it but that they did not understand it, 30.49% that understood it but were not comfortable to teach it and 31.71% understand it and could teach it to some one else. This means that 62.20% understood the topic while the rest do not know much about it.

Table 2. Faculty Efficacy Questions
33. Understand basic principles of group development and interpersonal dynamics.
34. Recognize and capitalize on differences in style and perspective.
35. Learn principles of problem-based conflict management.
36. Understand the importance of being fully involved in team efforts.
37. Use listening skills to move a conversation forward.
38. Give and receive constructive criticism.
39. Persuade others through well-reasoned use of facts and clear conveyance of ideas.
40. Provide and review information in a timely manner.
41. Identify and articulate problem(s) to be solved.
42. Generate creative and viable solutions.
43. Reach conclusions based upon clear analysis of facts and ideas.
44. Ensure buy-in and commitment to decisions reached.
45. Create plans and structure for the team.
46. Use principles of effective team meetings.
47. Demonstrate personal responsibility and respect.
48. Conduct effective evaluations of participation and performance.

The last part of the questionnaire contained a free response section to allow respondents the opportunity to comment on what they needed in order to improve their performance as team trainers. The faculty members were asked to list the top 3 resources that they felt would improve their preparedness for developing and using teams in the classroom. Though there were a wide range of responses submitted for this statement, the responses were clustered around the following topics that will help facilitate their usage of teams: textbooks (manuals), articles, case studies, websites or collaborative software, experience, institutional support, classroom infrastructure, time (to prepare, monitor and assess teams), teaching assistants properly trained to provide support, interdepartmental cooperation, video tapes, a class to teach students project management and teams, etc.

There were some comments related to more specific team management areas. These comments suggested that faculty members do not only need resources but also training in how to develop effective teams in their classroom. Remarks that support this conclusion were the following topics: how to manage team conflict, how to deal with apathetic students, how to help students divide work fairly and how to understand behavioral aspects people working with teams.

Discussion

This study provided some insight into the preparedness and proficiency of engineering faculty to effectively facilitate and manage teams in engineering classrooms. Unfortunately, there were some problems with the questionnaire. It appears that some of the questions caused a great deal of confusion for the respondents. Particularly the questions regarding the isolation of women and minority students. These questions created confusion among faculty members that form teams randomly since women and minorities are not a factor for them. The following comments were received regarding these two questions. "This means that, if I simply form teams at random (i.e., in a totally color-blind, gender-blind, etc. manner), I would have to answer FALSE to such questions. And that implies that I make every attempt TO isolate women, minorities, etc." and "…Answering no to questions 9 and 10 does NOT mean that you attempt to isolate women and minorities, only that you do not take ACTIVE STEPS to ensure that they are not isolated." Furthermore, it was mentioned that some of the questions were ambiguous. For example, it was unclear who certain questions were referring to, the instructor or the students.

A final concern with the study is the fact that it was a web-based survey. This was a concern because it was completed on a volunteer basis. The fact that they were volunteers may indicate that the respondents have some kind of interest in improving their teamwork training skills. This suggests that the volunteers may not represent a random sample of the entire engineering faculty population but only those who have a drive for self-improvement in teamwork training areas.

Despite these shortcomings this study was a good first step towards understanding the proficiency of faculty members with regards to teamwork. The results obtained and the feedback from participants will be useful in subsequent studies. The results and comments show that while faculty members are increasing their usage of teams additional work is needed in the area of faculty development and preparation to lead teaming initiatives.

Furthermore, the study shows that there is lack of consistency among faculty members regarding their use of teams, their attitudes about teams and their ability to lead teaming in the engineering classroom. For this reason more support for training for faculty members should be provided in order to enhance the use of teams in the engineering classroom. More support to help professors achieve better team training standards is needed. Institutions should not only provide training, but also give systematic assistance with materials, and make available consulting staff, infrastructure and technology to help professors achieve this necessary goal. Skill development for faculty on how to facilitate effective teamwork in the engineering

classroom is highly recommended. In addition, faculty members should be encouraged to continuously seek self-improvement on teaming issues.

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