Developing Team-work Skills in a First-Year Seminar

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Abstract

The First-year Seminar in Engineering at Gannon University is a two-credit course with nine course outcomes: five common to all seminars and four specific to engineering. ABET student learning outcome "d", an ability to function on multidisciplinary teams, is one of the seven ABET student learning outcomes mapped to this course. A semester long, community based, design project serves as a framework for team activities; therefore, it serves as the platform for outcome "d". This paper presents a brief overview of the seminar and the structure of the community-based engineering design project. The tools and strategies employed to foster team-work are discussed. Students use the zero-sum game tool to evaluate teamwork. The results of the team evaluation and the technical deliverables are discussed and correlated. Lessons learned on the effectiveness of the activities to develop team-work skills are presented.

Keywords

First year students, teamwork, skills, team assessment, zero sum game

Introduction

The First-year Seminar at Gannon University serves as a common experience for all university freshmen students. Six years ago, the structure of the Introduction to Engineering course was re-designed into a First-year Seminar in order to meet Liberal Core requirements while keeping its engineering essence[1-3]. This two-credit course has nine course outcomes: five common to all seminars and four specific to engineering. Seven ABET student learning outcomes (SLO) (refer to Figure 1) are mapped to these nine course outcomes. ABET student learning outcome "d", an ability to function on multidisciplinary teams", is one of them.

Student Outcomes Met	Course Outcomes
Ability to apply knowledge of mathematics, science, and engineering	1
Ability to function on multi-disciplinary teams	2
Broad education necessary to understand the impact of engineering solutions in a global and societal context	3, 7
Ability to design and conduct experiment, as well as to analyze and interpret data	4
Recognition of the need for, and the ability to engage in life-long learning	5, 9
Understanding of professional and ethical responsibility	6
Ability to communicate effectively	8

Figure 1: Relationship between ABET Student Learning Outcomes and Course Outcomes

A semester long, community based, design project serves as a framework for team activities[3-5]. The project is introduced the second week of the semester and teams are formed based on

students self-reported majors. The instructor provides constraints regarding the overall number of students from each major (biomedical, electrical, environmental, industrial, mechanical, undecided) that can be present in each team as well as a maximum number of team members. Throughout the first quarter of the semester, students are guided through a series of activities that include skills and attributes, learning styles, leadership attributes, and conflict reaction profiles. Team development models and problem-solving styles are discussed. As a team, deliverables are required throughout the semester; the instructor assesses these items for technical content. These deliverables are grouped in two phases. The first phase is the design conceptualization which includes three weekly progress reports, one conceptual design proposal and one oral presentation. The second phase is the implementation phase which includes one redesign report, three implementation progress reports, one oral presentation and one self-reflection[3].

Students are asked to assess the team using a tool, the zero-sum game, twice during the semester: at mid-semester and at the end of the semester. The zero-sum game asks each member of the team to evaluate four team-work attributes: enthusiasm & commitment, technical contribution, dependability & cooperation and communication.

Developing team-work skills

Teams are guided through a series of discussions and activities to understand the different styles in the team. At the end of each activity, the team compiles the answers from each member.

- Skills, Attributes and Experiences: Individually students are asked to list (1) the skills/attributes that they look in a team member and (2) the skills that they bring to the team. The team works on prioritizing the list and coming up with six to seven skills or attributes that are applicable to the project at hand. Each team member is then asked to rate himself/herself using a scale from 1 to 5 (where 5 means they excel or posses this skill/attribute). The goal is this exercise is to allow students recognize the strengths they bring to the team. A variation of this exercise is to have the students take the Strengths Finder quiz[6].

- Learning Styles: The Index of Learning Styles instrument[7] based on a learning style model developed by Richard M. Felder and Linda K. Silverman is deployed via the course management system. Students are asked to reflect on their preferences to four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) and compile their team's learning styles.

- Team Development Model: The Tuckman's team development model is presented and the teams discuss and list the characteristics or attributes of a successful team[8].

- Leadership Attributes: A session on leadership is included in the outline of the course. In teams the students are asked to list the most important attributes of a leader. After reaching a consensus, they are provided a copy of all the previous activities and asked to select a leader for their team.

- Conflict Reaction Profile: Students are prompted to individually take a generic conflict reaction quiz that allows them to understand, or possible confirm, their default mode:

passive, assertive or aggressive. This is follow by a discussion on how to manage conflict employing a five styles model: competing, collaborating, compromising, avoiding, and accommodating[9].

- Team Grading: The attributes of a successful team are re-visited. Peer-accountability, the use of a report card and other tools for team assessment are discussed[8, 10]. The students are provided the zero-sum game as the tool that will be submitted to the instructor twice during the semester to assess the team members' contributions.

Team Assessment as a Zero-Sum Game

The zero-sum game tool is a combination of category-based peer assessment and holistic peer assessment[11]. Four team-work attributes are evaluated: enthusiasm & commitment, technical contribution, dependability & cooperation and communication. Each student conducts the evaluation as an individual task. All members of the team, including the evaluating student, are listed on a table. Each student is given 100 points for each of the four attributes and is asked to allocate them amongst all members of the team based on their effort on the service-learning project. Figure 2 presents the form employed.

Enthusiasm & Commitment :: *Leader? Built Cohesion? In-Charge Person?*
Technical Contribution :: *Materials / Process Insights?*
Dependability & Cooperation :: *Reliable? Team Support? Enabler?*
Communication :: *Interpersonal Skills? Articulate? Clear?*

Group _____
Your Name:_____

Name	*Enthusiasm & Commitment*	*Technical Contribution*	*Dependability & Cooperation*	*Communication*
	⇓ ∑ 100	⇓ ∑ 100	⇓ ∑ 100	⇓ ∑ 100

Comments ?

Figure 2: Team Assessment as a Zero-Sum Game

Team Assessment and Team Academic Performance

There is not a direct correlation between team self-assessment and the technical performance grades (refer to Table 1 and Table 3). The following observations can be made:

- An even distribution of effort in all categories can mean two things: (1) everyone contributed to the process or (2) there has not been a thoughtful process to provide the scores
- It is ease to differentiate between high performers and slackers in a team
- The qualitative analysis of the team assessment provides context to the quantitative analysis.

Table 1: Fall 2015 Team Assessment at the end of the semester and academic performance in the project

	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6
Members (count)	6	6	5	6	6	6
Average	16.67	16.69	20.00	17.02	16.63	16.65
Standard Deviation	2.02	5.66	0.00	2.45	5.76	5.10
Maximum	18.36	23.40	20.00	19.80	23.88	24.22
Minimum	13.28	8.87	20.00	14.50	10.67	10.37
Team Technical Performance	96.26%	95.62%	85.10%	96.09%	93.23%	84.35%

The comments provided by the students in the team assessment form provided a great insight to the team dynamics. A sample of the comments is presented in Table 2. During fall of 2015, a few connections can be made. First, members of a team who did not contribute their expected share were clearly identified by the team members as seen in Teams 2, 5 and 6 where the minimum values of contribution are low. For these three teams, the standard deviations are larger (above 5). The representative quantitative comment presented by the members of these teams (refer to Table 2) correlate to the uneven effort by team members. Second, there does not seem to be a direct correlation between the team's technical performance and the presence uneven effort. As in most team environments, there are always high performers. Data in Table 1 presents high performers (i.e. maximum) as identified by the team members.

Table 2: Fall 2015, Comments from the Team Assessment, Zero-sum game

Team 1	*Our team got along very well and worked together very smoothly and efficiently.*
Team 2	*Our original team leader was ___, but it seemed it was really ____, she got everything together and made sure we all knew where we were at.*
Team 3	*No comments*
Team 4	*Everyone honestly contributed and was cooperating during the entire process. This is evident through our group messaging and meetings at least twice a week.*
Team 5	*We had our struggles as a team. I failed as a leader because I allowed people to miss meetings without excuses*
Team 6	*On more than one occasion, some members failed to do their task resulting in it having to be completed by the rest of the group, usually at the last minute. I feel this significantly affected the quality of our work as a whole.*

Results from fall of 2016 support the same observations (refer to Table 3). This data represents the team assessment at mid-semester. Overall, the results from the team assessments provide the instructor data to make adjustments to individual grades. Without this information, the instructor relies on perceptions if effort is to be part of each student's grade. CATME[10] provides weight factors to allocate these individual grades.

Table 3: Fall 2016 Team Assessment at the middle of the semester and academic performance on the project at that point

	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6
Members (count)	5	5	5	5	5	4
Average	20.00	19.39	19.98	19.83	14.98	24.98
Standard Deviation	5.47	2.89	5.91	1.25	1.78	7.74
Maximum	28.25	21.60	26.38	21.50	16.65	34.44
Minimum	14.55	14.40	10.50	18.16	12.35	16.03
Team Technical Performance	91.12%	88.66%	85.28%	89.99%	91.81%	94.56%

Table 4: Fall 2016 Team Assessment at the end of the semester and overall academic performance on the project

	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6
Members (count)	5	5	5	5	5	3*
Average	20.00	20.00	20.00	20.00	15.00	33.33
Standard Deviation	2.13	5.15	3.45	3.04	1.86	6.14
Maximum	21.94	25.63	23.00	24.75	17.03	40.28
Minimum	17.04	15.56	15.92	16.83	13.44	28.61
Team Technical Performance	91.40%	90.72%	86.41%	90.85%	91.42%	95.52%

*A student dropped the course during the second half of the semester

As the results from mid-semester are compared to the results at the end of the semester, no significant changes are observed. Note that in a few instances (Teams 1 and 3), teams members contribution became more even as supported by a lower standard deviation and an increase in the minimum contribution value. In other cases (Teams 2 and 4), there was an increase in standard deviation accompanied by a lower or similar minimum contribution values; this indicates that the individual contribution within did not even out. The qualitative comments provide context to these statements as presented in Table 5.

Table 5: Fall 2016, Comments from the Team Assessment, Zero-sum game

Team 1 (+)	*Overall our group worked well together. Everyone was very enthusiastic about the project and wanted to be involved.*
Team 2 (-)	*During the second half of the project, _____ were not involved until the end. They were not responding to messages and were not trying to be a part of the project*
Team 3 (+)	*I believe each member did hard work to have a good little free library.*

Team 4 (-)	*Within this group, there was a concerning lack of enthusiasm and commitment which may or not have been related to course load. There were many time conflicts with classes and the work needed to finish in this class.*

Lessons Learned

After teaching this course for more than five years, it is clear that the tools that are effective for a group might not work for others. It takes time to define an objective process to evaluate team performance.

It is necessary to provide students with a confidential mechanism to evaluate their teammates. Many team assessment tools are available for instructors but for small class sizes, the approach presented here has proven to be effective. Instructors can decide how to employ the results: perform interventions to help improve team dynamics, incorporate the information into the individual students' grade, amongst other measures.

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