

An Integrated Plan for Improving Team Functioning

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Abstract: The importance of effective team functioning is recognized by students, faculty, employers, and our accreditation board. Teams are often used to obtain all of the educational outcomes described by ABET, however, the explicit statement that students must learn how to work in teams highlights the increasing importance of this skill. Several teaching methods to help students learn to work effectively in teams have been discussed in the literature. These include having students work in teams on various projects; providing training in effective team functioning; and providing learning objectives that cover elements of effective multidisciplinary team functioning. Upon examination of our curriculum in the Civil and Environmental Engineering Department at Villanova University, we discovered that our students are often required to work in groups, but that we did not provide training nor did we routinely provide learning objectives relating to teams. Modules on team functioning have been developed and are currently being implemented in sophomore, junior, and senior level classes. These modules include in-class activities and homework. The students are also provided with reference materials on running effective meetings and assessing how their teams are functioning. Preliminary feedback from the students is very positive. Students appeared to most appreciate being provided with tools to improve team functioning. We believe this type of training in team functioning reinforced throughout the curriculum will lead to less interpersonal problems, improved participation by all group members, improved leadership capabilities, more effective learning, and higher quality reports. The effectiveness of the program will be evaluated by surveying the students to collect attitudinal data, analyzing the results of senior surveys, and by applying a rubric to student work.

Introduction

The ABET accreditation criteria adopted in the mid 1990s are a blend of outcomes-based education and continuous-quality improvement. Eleven skills are described, one of which (3d) is “an ability to function on multidisciplinary teams” (ABET 2003). Teams are often used to obtain all of the educational outcomes described by ABET, however, the explicit statement that students must learn how to work in teams highlights the increasing importance of this skill. Lovgren and Racer (2000) and Felder and Brent (2003) recommend several teaching methods to help students learn to work effectively in teams, such as having students work in teams on various projects; providing training in effective team functioning; and providing learning objectives that cover elements of effective multidisciplinary team functioning. Although we often require students to

work in groups in the Civil and Environmental Engineering (CEE) program at Villanova University, we did not, until recently, provide formal training on team functioning. It is anticipated that more formal training will lead to less interpersonal problems, improved participation by all group members, improved leadership capabilities, more effective learning, and better quality reports.

Solution

An integrated approach to teaching and reinforcing effective team functioning was developed by Andrea Welker and Walt Tymon at Villanova University. This collaborative effort brought together a member of the CEE Department and a member of the Management Department. The program is still in the early stages of implementation and is continuously undergoing refinement.

The freshman year curriculum is set by the College of Engineering; consequently, our focus was on the sophomore through senior years when the students take classes within the CEE Department. Villanova students work in teams throughout their time at the university from freshman to senior year. Our goal was to make the students more aware of how their teams were functioning, as well as to provide them with tools to improve team functioning. Because reinforcement is a critical component of learning, the students receive training on team functioning at least once a year during their sophomore, junior, and senior years. The classes in which the teamwork modules are included are shown in Table 1. The most intensive module, which lasts two class periods, occurs during the sophomore year. The tools the students receive during this first module will be used in their other CEE classes that require them to work in teams.

Table 1. Placement of modules on teamwork within the CEE curriculum

CLASS	YEAR	MODULE
CEE 2602, CE Measurements	Sophomore	Team Work: Awareness and Tools
CEE 3901, Soil Mechanics Laboratory	Junior	Conflicts
CEE 4601, CEE Professional Practice	Senior	Personality Types

Description of Modules

CEE 2602, CE Measurements

Students take this required course in the fall semester of their sophomore year. The students complete two group projects in this course, so it is an ideal time to provide the students with training on team functioning. A two class module was developed for use in this class. This module should be completed within the first 1/3 of the semester. The activities included in this module are described, with the time allotted for each activity, in Table 2.

Table 2. Activities for CEE 2602

WHERE	ACTIVITY	TIME (MIN)
In class	Golf ball activity	10
	Debriefing of activity	10
	Distribute/explain assignment	10
	IDEO video	20
Homework	IDEO video questions	-
In class	Debriefing of homework	15
	Explanation/discussion of team assessment tools	20
	Handouts	10
	Evaluation of class	5
Homework	Use team assessment tools with next group project	-

During the first class of the two-class module, the students work in their pre-assigned teams for the “golf ball activity”. The students estimate how many golf balls will fill their class room. This task was selected because it can be completed quickly, but another task could easily be substituted. They also have a question sheet to answer regarding how the team functioned while attempting to solve this problem. We then discuss the activity and the answers they provide. The questions the students answer are:

1. Did you work as a team to solve this problem? If not, why not? If so, how did you work as a team (be specific)?
2. Are there any disadvantages to working as a team on this problem?
3. What possible advantages are there in working as a team on this problem?

The next activity is to show a video about the design firm IDEO (Nightline: The Deep Dive 2/9/1999). This video is available for purchase from ABC (<http://www.abcnewsstore.com>, code N990209 01). Note that a group license is required. Before watching the video, the students are handed a question sheet. The questions are:

1. Was an objective clearly established? Explain.
2. Was a deadline for the project established? Explain.
3. Were roles in the team clearly understood? Explain.
4. Were tasks and responsibilities identified? Explain.
5. Were milestones established? What were they? Did they “celebrate” milestones? How?
6. What is the “deep dive”? What are the rules for the “deep dive”? How relevant are these rules for an engineering team? Explain.
7. How was the belief that the team was drifting handled? How should this be handled in an engineering team?
8. How important is “playfulness” in an engineering team?
9. What does it mean to “fail often” to “succeed sooner”?
10. How important was information from outside the team?
11. What are the challenges of group process that teams face that the video did NOT explore? How would you handle these challenges?

The students are given a few minutes to discuss how to approach answering the questions as a group before we show the video. The students are told to bring the completed questions with them to the next class.

Class two begins with a discussion of the homework assignment. We discuss the answers themselves and then discuss how they approached the assignment. After concluding this discussion, we hand out the “Team Functioning Assessment Tool”. This tool has three components: Team Members and the Project, Team Functioning, and Peer Feedback. These handouts are available on the web at <http://www.homepage.villanova.edu/andrea.welker/>. The Team Members and the Project components answer the following questions on a five point Likert type scale:

1. I understand all of the objectives of this project.
2. I understand the milestones we have established for each phase of the project.
3. I agree with the deadlines for the completion of each milestone of the project.
4. I understand my responsibilities on this team project.
5. I understand the responsibilities of every other team member on this project.
6. I believe that all the elements necessary for the success of the project are being adequately addressed by the team.

The section on Team Functioning asks the student to put a plus sign next to the three items that are most true of their team. This tool is used to facilitate discussion of the team’s strong and weak points. The items to be evaluated are:

1. Team members do a good job of listening to one another.
2. Team members feel free to express their ideas.
3. The team does a good job of exploring together a number of ways of doing things.
4. Team members share the key things they have learned in doing their work on the project with the other team members.
5. Team members show a willingness to help one another.
6. The team stays on track in team meetings.
7. The team has done a good job meeting the deadlines for the milestones the team has set.
8. The team does a good job of integrating the work of each team member into a seamless project.

The Peer Feedback portion of the Team Assessment Tool asks the students to provide feedback to each other by completing two sentences:

1. You contribute to the effectiveness of the team by the way you...
2. You could help the team be even more effective if you...

It can be especially difficult for students to provide feedback to each other in a constructive, helpful manner. To encourage this, we also provide the students with a handout entitled “The Essentials of Feedback”. This handout provides students with information on both how to give and receive feedback. In total, we spend approximately 20 minutes discussing why and how to use the Team Assessment Tool.

The penultimate activity is to provide the students with a handout on how to run a good meeting. This handout includes advice on what to do before, during, and after a meeting. In our discussion, we stress the difference between the team evaluation tools given to them by us and the peer evaluations they will perform later. Our tools are to be used internally by the group for developmental purposes, whereas the peer evaluation forms are used for the professors to develop grades. We then stress that they will continue to use these tools throughout their time at Villanova. Class two ends with a class evaluation.

CEE 3901, Soil Mechanics Laboratory

Students take this required course in the spring of their junior year. The students work in teams throughout the semester to complete a project that incorporates soil testing. The students self-select their groups in this course. The students are required to use the team assessment tools that they received their sophomore year in CEE 2602 and complete a homework assignment on handling “hitchhikers and couch potatoes” (Oakley 2003) These activities, which are described in Table 3, will be completed as early in the semester as possible.

Table 3. Activities for CEE 3901

WHERE	ACTIVITY	TIME (MIN)
In class	Distribute and remind students how to use team assessment tools	10
Homework	Read and write a discussion about articles on “hitchhikers and couch potatoes”	-
In class	Discussion of articles	10
Homework	Use team assessment tools throughout semester	-

CEE 4601, CEE Professional Practice

Students take this required course in the fall of their senior year. The students complete a semester-long feasibility study as part of this project. The students are assigned to groups in this course. The students are introduced to the concept of Meyers Briggs personality types in this course module. An expert on Meyers Briggs is invited to talk to the students. This expert discusses the different traits associated with each personality type. For homework, the students take an on-line test to determine their Meyers Briggs personality type (Humanmetrics 2003). The goal of the personality testing is to help the students appreciate and benefit from the differences amongst their group members. The activities associated with this module are described in Table 4.

Table 4. Activities for CEE 4601

WHERE	ACTIVITY	TIME (MIN)
In class	Distribute and remind students how to use team assessment tools	5
In class	Presentation on Meyers Briggs	30
Homework	Take on-line quiz to determine Meyers Briggs Personality Type	-
In class	Discuss results and provide Meyers Briggs Personality Types for celebrities and professors	10
Homework	Use team assessment tools throughout semester	-

Implementation Schedule

As mentioned previously, this program to integrate training on team work is under development and has not yet been fully implemented. To date, the authors developed a one-class and two-class module using the golf-ball problem described previously. These modules were implemented in

CEE 2602 and CEE 4601, respectively. After reviewing the evaluations from the students, we decided that the students would be better served by using the two-class module described in Table 2 in the sophomore year. Placing this module early on in the student's time at Villanova would allow them the opportunity to use their skills repeatedly. Furthermore, by senior year, the students are more receptive to the Meyers Briggs testing. The implementation schedule is presented below:

CEE 2602, CE Measurements	Fall 2004
CEE 3901, Soil Mechanics Laboratory	Spring 2005
CEE 4601, CE Professional Practice	Fall 2004

Although the program will be most effective for students that experience all three modules, the modules can stand alone. Consequently, we are implementing all three modules within a two semester time frame. It will take approximately one year to have the program fully operational.

Assessment Program

The effectiveness of these modules will be evaluated using several techniques:

1. End of class evaluations.
2. Internal and external senior exit survey questions relating to teams.
3. Rubrics to be completed by those assessing the reports in CEE 2602, CEE 3901, and CEE 4601. Depending on the class, reports are evaluated by faculty teaching the course, other CEE faculty, and members of our advisory committee.

End of Class Evaluations

The end of class evaluations will provide instantaneous feedback to the instructors on how the course materials were received by the students. Questions on the end of class evaluations include:

1. What is the most confusing aspect from the material covered?
2. What is the most important thing you learned today?
3. Is there something you wanted to learn about working in teams that was not covered?
4. Do you think this class will improve your ability to work in teams?

We currently have information from only this assessment tool. The students in CEE 4601, who received the two-class module described above, viewed the instruction they received favorably. Figures 1, 2, and 3 graphically display their answers to the first three questions. Suggestions for improvement included providing guidance on how to handle conflicts such as students who do not contribute as much as they should. These comments led to the development of the modules in the junior and senior year using the paper by Oakley and the Meyers Briggs testing. All of the students indicated that they believed the class would improve their ability to work in teams.

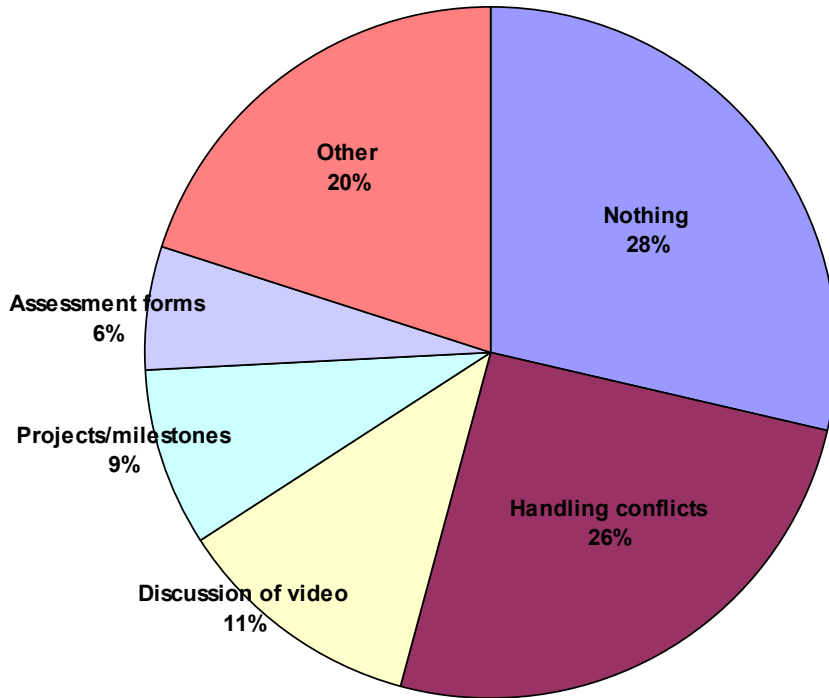


Figure 1. Responses to “What is the most confusing point from the material covered?”

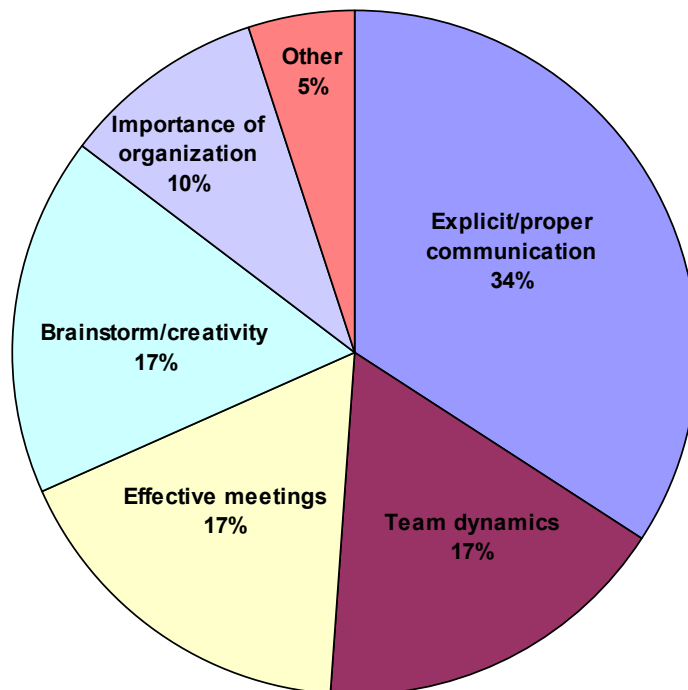


Figure 2. Responses to “What is the most important thing you learned today?”

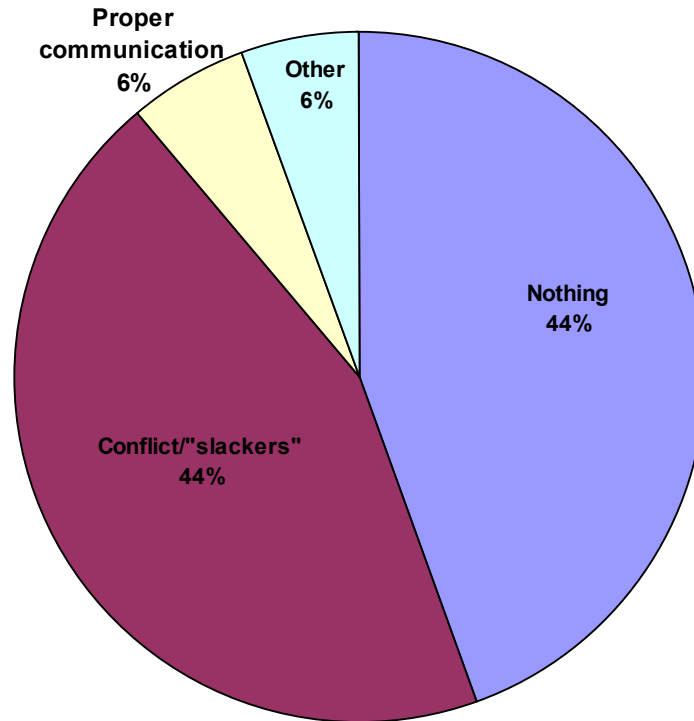


Figure 3. Responses to “Is there something you wanted to learn about working in teams that was not covered?”

Senior Exit Surveys

The Civil and Environmental Engineering Department currently gathers survey data from our seniors from two sources: an internally developed survey and a survey created by Engineering Benchmark Incorporated (EBI). The advantage of the internally developed survey is that we can tailor it to our needs. The advantage of the EBI survey is that we are able to compare our results to many schools throughout the country.

The questions from the internal survey that we will use as part of our evaluation are:

1. Did the instruction you received on teams during your time at Villanova improve your ability to work in teams?

The questions from the EBI survey that we will use as part of our evaluation are:

1. How satisfied were you with the ability of your fellow students to work in teams?
2. To what degree did your engineering education enhance your ability to function on multidisciplinary teams?

Evaluation of Student Work

The most important tool that will be used to evaluate the effectiveness of this program will be the work that students create. Group projects from CEE 2602, CEE 3901, and CEE 4601 will be evaluated with a rubric. The student work will be evaluated as part of our program assessment that occurs each spring. The evaluators will be asked if the “students are able to collaborate

effectively as members of a team.” There will be four categories ranging from “limited” to “mastered”. “Limited” achievement of this goal will mean the group “performs a group task, with minimal group collaboration, which achieves only a small part of the task goals”. “Mastered” achievement of this goal will mean that the group “performs a group task with significant collaboration, which fully achieves the task goals.”

Conclusions

A program to provide training on team functioning has been developed and is currently being implemented within the Civil and Environmental Engineering curriculum at Villanova University. The students within the CEE program will receive instruction on team functioning at least once a year during their sophomore, junior, and senior years. The instruction covers many aspects of team functioning such as how to run an effective meeting, how to give feedback to your peers, and how to handle “slackers” or “freeloaders”. During the senior year, students determine their Meyers Briggs personality type. Students in the CEE Department work in teams continuously throughout their time in our department. The students will use the tools provided to them in the sophomore year in all of their team projects. The effectiveness of this program will be evaluated using three tools: end of class evaluations, senior surveys, and student work. The end of class of evaluations performed thus far were positive with all of the respondents indicating that they believe they will be better team mates as a result of the class. In addition, changes to the program have already been made based on these evaluations.

Acknowledgements

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