Incorporating a Team Building Experiment into a Senior Level Laboratory Course

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I. Introduction

In spring of 1995 Ford Motor Company established a continuous quality improvement (CQI) partnership with the colleges of business and engineering at Michigan State University. To initiate the program, Ford held workshops for the faculty and staff that focused on CQI principles and their implementation. During these workshops there was considerable interaction among personnel from the two organizations. One consistent theme in these discussions was Ford's desire to have engineers with good teaming skills. The response of one faculty member was the observation that the undergraduate mechanical engineering program at MSU provides numerous teaming opportunities. Students team in all four of the program's required laboratory courses, as well as in the machine design course and the capstone design course. However, even though graduates from this program have several teaming experiences, it was also clear that there was no team training experience. That is, an experience where students learn about how a team functions and how to work effectively on teams. To fill this void, one of the technical experiments in a senior level laboratory course was dropped and replaced by a team building experiment. This development and its results is the focus of this paper.

ME 412, Heat Transfer Laboratory, is a senior level, one credit hour laboratory course. The heat transfer course, ME 410, is a required prerequisite. Most students in the undergraduate program take the course during their last semester. Prior to the introduction of the team building experiment, ME 412 included both a natural convection experiment and a forced convection experiment. Due to the importance that industry is placing on teaming skills (as indicated through the interaction with Ford), it was decided to drop one of these convection experiments, and introduce a team building experiment. The lab course has a one hour lecture session and a two hour laboratory session. Both components are incorporated into the team building experiment. This paper continues by presenting a summary of the lecture component, including an in class team building exercise. Next the team building exercises completed in the two hour laboratory session are discussed. The paper concludes with some observations about these exercises and the students' response to them.

II. Lecture Component

During the one hour lecture session, a brief introduction is given on teaming. This includes such issues as:

- What is a team?
- Why teams?

• Aspects of team operation, including team selection, setting an objective, developing camaraderie, leadership, brainstorming, and running an effective team meeting

One aspect of teams that is constantly emphasized is the importance of taking individual responsibility in a team context. The definition of a team that is provided is:

A collection of individuals brought together to address or achieve an objective or set of objectives. When functioning properly team members will have some individual responsibilities in helping the team achieve its goals.

Some analogies from sports teams are used to emphasize this, such as the team and individual responsibilities a setter on a volleyball team will have or those that a middle linebacker might have on a football team. With these examples, the idea that without team members fulfilling individual responsibilities the team may well fail is effectively communicated.

Quite often students are confused about all this emphasis on teams, particularly the exceptional students. They are provided with the following explanation concerning the growth of teams:

The world has become sufficiently complicated that one individual can not have the knowledge needed to achieve the specified objectives

Since the lab exercise will involve a design and build project, a set of rules concerning brainstorming is provided, shown in Figure 1, and discussed.

Following this introduction, the class is broken into its lab teams and a team building exercise is conducted that involves individuals assessing their strengths and weaknesses as they relate to contributing to a heat transfer lab team. Students are asked to complete the form shown in Fig. 2. Following the completion of this individual task, the course instructor and teaching assistants share their individual strengths and weaknesses with the class. The course instructor then uses this information to formulate the instructional team's strengths and weaknesses. The lab teams are then asked to share their individual information among themselves and formulate the lab team's strengths and weaknesses. These are summarized on a form shown in Fig. 3. The exercise concludes with lab teams sharing the team's characteristics with the rest of the class. The instructor discusses the team weaknesses with the class, as well as how these sort of weaknesses might be addressed by industrial teams. For example, a common team weakness is procrastination. One way to address this weakness would be to set a firm schedule and select one team member as a schedule enforcer.

III. Laboratory Component

During the two hour laboratory session the lab teams complete an impromptu design exercise. Many of these come from the ASME Region V Regional Student Conference over the years. The teams are given a set of supplies and are instructed to build a device to achieve a specified

Figure 1. Rules for Brainstorming

Brainstorming

- 1. Appoint a moderator and a recorder.
- 2. Record all ideas suggested.
- 3. During the session there should be no comments on the appropriateness of the ideas.
- 4. Let the session run its course. Normally after 20-25 minute the ideas will run out.
- 5. Plant some seeds to get the session going or continuing
- 6. Immediately after the session evaluate ideas to identify those that are functional and satisfactory with respect to the team's objective.

Figure 2. Individual Strength/Weakness Evaluation Form

Strengths/Weakness Identification Individual Evaluation

	Three most positive traits you bring to the team (Your Strengths)
1.	
2.	
3.	

	Three most negative traits you bring to the team (Your Weaknesses)
1.	
2.	
-	
3.	
1	

Figure 3. Team Strength/Weakness Evaluation Form

Team Evaluation

	Team's Three Greatest Strengths
1.	
2.	
3.	

	Team's Three Greatest Weaknesses
1.	
2.	
3.	

objective. Currently, there are five of these exercise that are rotated semester from to semester. A summary of these exercises is provided in Table 1. An example of the write-up for the Toothpick Table Exercise is given in Fig. 4. Note that this write-up is focused on this as a team building exercise. Following this exercise the students complete an evaluation of the team building experiment, shown in Fig. 5.

Concluding Remarks

Results of the evaluation indicate that the students feel they receive a good introduction to team building through this experiment. When the survey was administered to the Fall 1999 offering of ME 412, thirty-six (36) students responded. Thirty-four (34) of these 36 felt that the experiment had enhanced their teaming skills. Many commented that the experiment allowed them to get to know their lab partners better and improved the communication among team members. Thirty (30) of the thirty-six students felt that the experiment had increased their understanding of team building issues. Some of the more interesting responses to the how questions are given below:

"I really learned how initiative and leadership is important to a team." "Roles for each member improved efficiency; our group worked well together." "Not to be biased toward other people ideas and to be open minded." "By effectively communicating"

One problem does seem to be the preoccupation with the competition. Some students will indicate that the best of worse thing about the experiment was winning or losing the competition. The lack of a heat transfer focus in most of the projects is a common negative comment. Probably the real challenge comes in that this course is taken late in the student's program, well after they have been involved in several team assignments. Unfortunately, instructors for the courses earlier in the program seem unwilling to sacrifice technical material for this sort of team training experience.

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Exercise	Objective
Straw Structure	Construct a structure out of drinking straws and masking tape that will support a can of soda at the greatest height possible.
Toothpick Table	Construct a table out of toothpicks, drinking straws, and sticky labels no shorter than the height of half a drinking straw that will support the maximum amount of weight.
Hot Cup	Construct an insulated cup that will maintain the lowest outside surface temperature when the cup is filled with hot water.
Balloon Drop	Construct a device when dropped from six feet will take the longest time possible to reach the ground

Table 1. Team Building Exercises

Figure 4. Write-up for Toothpick Table Exercise

Toothpick Table Exercise

Each design team will be provided with the following items:

2 sheets of plain typing paper4 straws8 paper clips10 strips of "sticky" label paper20 toothpicks

The team is to construct a table no shorter than the height of half a straw that will support the maximum amount of weight. Circular weights of approximately 6 inch diameter will be placed on the table by a member of the team one at a time until the table collapses or the weights slide off the table. You may not anchor your table to any surrounding structure. You will have 20 minutes to plan your project and then you will have 30 minutes to construct the table.

Since this is a team building exercise, it will prove useful to follow some team guidelines (meeting agenda).

- 1. As a team discuss the objective. Make sure every member is clear of the goal(s).
- 2. Conduct a brainstorming session. Identify one of your team members to serve as moderator and one to serve as recorder. Each member of the team will need to sign the list generated by the recorder, your grade will be based upon this list.
- 3. Decide on your solution.
- 4. Identify the build process and distribute individual responsibilities to team members.
- 5. Begin construction when the instructor indicates.

Figure 5. Student Evaluation Form

ME 412 Heat Transfer Laboratory

Team Building Experiment Evaluation

Do you feel that this experience has enhanced your teaming skills? Yes ____ No ____ If yes, how?

Do you feel that this experience has increased you understanding of team building issues? Yes ____ No ____ If yes, how?

What was the best part of today's lab?

What was the worst part of today's lab?