Team Toolbox: Activities & Suggestions for Facilitating Project Teams

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Abstract - **This paper shares the experience of facilitating project design teams and offers practical suggestions and activities for improving workgroup performance. The activities presented here represent a series of mini-lectures and class exercises used to promote team development in a yearlong engineering project design course for first-year students. These short activities are useful in engaging college students and getting them to examine the effectiveness of their own teams. Attention is paid to group process, with different activities throughout the project design cycle, from icebreakers at team inception through reflection on strengths and areas for improvement at project completion. Included in this paper are semi-structured exercises for many various situations, including increasing communication, examining group norms, managing conflict, providing guidelines for creative brainstorming, monitoring team progress, and utilizing strengths of all team members. The information offered here is intended to give fresh ideas to those who work with teams so that they may more easily and confidently incorporate a focus on group process into project design courses.**

Index Terms – Facilitation, Multidisciplinary Teaming, Project Design Teams, Workgroup Performance

INTRODUCTION

Within the discipline of engineering, the ability to function effectively in a team is becoming increasingly important in educational and work-related environments. Engineering educators have restructured programs to include teamwork skills as an educational goal [1]. Accreditation and curriculum changes call for "an ability to communicate effectively" and "an ability to function in multidisciplinary teams [2]." It is no longer adequate for engineering students to graduate with strong technical skills; they also must be able to work effectively on teams. Effective teamwork involves both technical and relational performance to ensure the team not only completes the project, but also maintains viability as a group.

In response, the College of Engineering at the University of Tennessee (UT) has incorporated a teamwork and interpersonal communication skills component into the *engage* Freshman Engineering Program [3]. All entering first-year students are placed into project-oriented work groups responsible for the design of working models as part of course requirements. Along with meeting technical design specifications, these teams also must contend with the factors of interpersonal dynamics and group cohesion when working towards project completion.

First-year engineering students often lack the skills and experience necessary to succeed in an unsupervised team atmosphere. Though engineers employ a cognitive style that lends itself well to problem solving, this style can lead to an inability to work well with other people [4]. The result is often conflict and ineffective work group performance. Providing first-year engineering students with project team experiences and giving them the tools necessary to work effectively on these teams has become a critical component of the *engage* program.

BACKGROUND

The activities and information presented here have been developed in consultation with experts in diverse fields of engineering education, counseling, and performance psychology. These instructional exercises and mini-lectures have been developed to guide work group progress and promote skills needed to succeed in the team environment. These skills allow students to use their technical abilities as part of a team, to understand conflict as a means for discussion instead of an angry confrontation, and to respect difference as a creative opportunity rather than an obstacle.

When a group composed of diverse individuals is first assembled, it is common for members to experience initial anxiety and focus on questions of group purpose. Often there is marked tension and conflict between group members' personalities and expectations for the group. Through utilizing conflict management, decision-making strategies, communication techniques, and project timeline scheduling, team members are able to work through their individual differences. Reliance on these strategies allows group members to improve their ability to engage in collaborative

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problem solving, while avoiding unnecessary impasses in the project completion cycle.

The learning activities presented in this paper are useful in engaging college students and getting them to examine the effectiveness of their own teams. Emphasis has been placed on active participation and experiential learning, as structured interaction within the team atmosphere facilitates interpersonal learning and fosters group cohesiveness. Team time is structured to incorporate times for reflection on group dynamics, in addition to the focus on successful project completion. The information offered here is intended to give fresh ideas to those who work with teams so that they may more easily and confidently incorporate a focus on group process into project design courses.

GETTING GROUPS STARTED

Getting a group off to a good start is important, as it will set the tone for coming weeks. During group startup, key issues will revolve around relationships among team members and how different group members' personalities will interact in the team environment. These concerns are magnified in the *engage* project design room, where few first-year engineering students have previous experience with self-directed work teams. It has been found that differences among students along the lines of gender, age, racial ethnicity, and other, more hidden variables, also impact team dynamics. To be successful, students need to find ways to collaborate and productively work with people whom they may not otherwise choose. The benefit in working through these social and emotional issues comes in quickly developing relationships among team members so that they can shift their time and energy to task efficiency [5].

Implementing structured tasks designed to improve communication and interpersonal learning is helpful at team inception, as they serve to make the group environment a safer and more open place. Lack of relationship building at group formation can result in diminished group cohesion and communication. Ignoring the relationship component at group startup can interfere with later team development and member contribution of his or her unique problem solving skills during later projects.

The following activities comprise the first few class sessions, allowing team roles and member strengths to evolve and emerge gradually. Students need this space at the beginning of an often hectic first year of college to get comfortable with each other before the added pressure of project grading and testing is introduced.

Icebreakers

Brief structured activities, known as icebreakers, are designed to increase communication and facilitate group bonding among members. The icebreaker presented here excels in building trust among team members and requires only moderate facilitator skill. It is a direct, simple, and fun way to begin the exchange of personal histories among group members. This exercise, imported from residence hall programming, fosters the type of creative and open atmosphere that is a hallmark in cohesive groups. At the beginning of this activity, students are given a handout similar to that shown in FIGURE 1.

This activity works well with college students for a number of reasons. First, the information is fairly personal and tends to break down some of the barriers people erect when they perceive others as *strangers*. Second, team members get a turn to tell a story about themselves—something that makes them unique—at a time in life where one's identity is a personal concern. Finally, making a game out of revealing personal information marks the team environment as a place where members can feel safe to let down their guard.

Team Activity: Two Truths and A Lie

Background: When a team is first formed, the most important issues revolve around the relationships among team members. Questions such as "Who *are* these people sitting around the table with me?" and "What makes them tick?" are likely to be going through everyone's heads.

Teams who take time to get to know each other will outperform those that do not. This activity is designed to get you to reveal a little bit about who you are to your teammates, and perhaps discover facts of interest about them in return.

Activity: Write down two truths and one lie about yourself in your team notebook. Be as creative as you wish. When everyone has finished, select one person to read his or her "two truths and a lie" to the rest of the group and have everyone else guess as to which is the falsehood. After revealing the fib, have the speaker relate a brief story about one of the truths. Repeat for all group members.

FIGURE 1
HANDOUT FOR "TWO TRUTHS AND A LIE" ICEBREAKER.

This activity works best when the facilitator models it in front of the class, creating a safe atmosphere and getting the students involved. First, the activity is introduced. Then, the facilitator would say something like this: "Okay, here are my two truths and a lie: I'm from Midland, Michigan-home of Dow Chemical; I went to Las Vegas this summer; and I have never smoked a cigarette." Give the class a chance to ponder for a moment and then solicit a few guesses from the class as to which statement is false. Modeling of this activity has the secondary effect of letting the students get to know the instructor on a more personal level. One final caveat: for this activity to be successful, all participants *must* have their two truths and a lie written down on a piece of paper *before* the group starts sharing.

The unknown facts that arise about team members are amazing. Following are just a few facts discovered about this year's entering class: One student spent the day with Wayne Gretzky, one ate dinner at the Governor's house, one played professional basketball in Europe, and one student turned down a professional recording contract to enter college. Student receptivity to this activity was evidenced at the

beginning of the second semester when many of the teams performed this icebreaker without prompting.

Beginning Projects

For years, the first assigned project in team time has been to build and test the *Gummi Bear Tower*. This brief exercise introduces all aspects of project design within one class period—problem statement, decision-making, construction, reporting, and testing. In addition, everyone on the team is equal in terms of experience with building gummi bear towers – they have none. To begin this project, each team is given a handout similar to the one shown in FIGURE 2.

Team Activity: Gummi Bear Tower

Materials: Deck of playing cards, weights (team supplied change, not to exceed 10 coins or 50 cents), a roll of transparent tape, a few Gummi Bears.

Activity: Design and construct a free-standing tower (not taped down) at least 15 inches tall that supports a platform where 3 Gummi Bears can observe the valley below. Tower must be able to survive the West Wind, which is described as… *roughly the equivalent of a hair dryer at the distance of 10 inches*. Tower design should use the minimum number of cards possible. Your team has 30 minutes to brainstorm ideas, select a concept, construct the tower, and plan a short (2 min.) oral presentation. Include details of decision-making process and total number of cards used.

FIGURE 2
HANDOUT FOR GUMMI BEAR TOWER PROJECT.

This activity brings together collaboration and creative problem solving in an entertaining team-building exercise. Because it is a non-graded assignment, it gives teammates a chance to feel each other out. *Engage* staff have used this portable initiative with success in kicking off a FIRST robotics team at a local high school. Here, science honors students, teachers, parents, and volunteer technical personnel from Oak Ridge National Laboratories formed teams for a quick competition. The incorporation of this hands-on activity was crucial in generating excitement and encouraging student involvement in the program.

The next assignment used to get *engage* project teams underway is the design of a team name and logo, which is to be completed over the weekend and presented in front of the class. Like the *Gummi Bear Tower*, this non-graded assignment involves many skills that will be needed to complete later projects. It also introduces new components of project design including division of labor, communication outside class, scheduling, and utilization of individual team member strengths, such as drawing and report writing.

The use of these initial structured learning activities allows teams to take form gradually and helps members to learn about team roles and unique individual strengths of both themselves and others. It is crucial for teams to have this *honeymoon* period where their diverse interpersonal styles are allowed to form into a team without the added stressor of evaluation apprehension.

DEVELOPING WORK GROUP SKILLS

To successfully move teams toward smooth functioning, group members need to address sources of conflict and learn to conduct team interaction, such as idea generation, in productive ways. Again, structured learning activities guide member interaction and provide a template for critical problem solving skills.

Facilitating a Brainstorm

Though idea generation is a phase of project design that is often overlooked, learning to postpone critical evaluation is a key skill in a group's problem solving process [6]. One reason this process may be cut short is due to the perceived risk of getting an idea shot down. There is also potential for conflict as members begin to champion different ideas and take sides against each other. Introducing a structured brainstorming activity helps teams to avoid these pitfalls. The following story has been used to introduce idea generation as it portrays the diversity of solutions to a technical problem in an engaging manner.

An examination at the University of Copenhagen contained the following question: "Describe how to determine the height of a skyscraper with a barometer."

One student replied:
"You tie a long piece of string to the neck of the barometer, then lower the barometer from the roof of the skyscraper to the ground. The length of the string plus the length of the barometer will equal the height of the building."

This highly original answer so incensed the examiner that the student was failed immediately. The student appealed on the grounds that his answer was indisputably correct, and the university appointed an independent arbiter to decide the case.

The arbiter judged that the answer was indeed correct, but did not display any noticeable knowledge of physics. To resolve the problem it was decided to call the student in and allow him six minutes in which to provide a verbal answer that showed at least a minimal familiarity with the basic principles of physics.

For five minutes the student sat in silence, forehead creased in thought. The arbiter reminded him that time was running out, to which the student replied that he had several extremely relevant answers, but couldn't make up his mind which to use. On being advised to hurry up the student replied as follows:

"Firstly, you could take the barometer up to the roof of the skyscraper, drop it over the edge, and measure the time it takes to reach the ground. The height of the building can then be worked out from the formula H = 0.5g x t squared. But bad luck on the barometer."

"Or if the sun is shining you could measure the height of the barometer, then set it on end and measure the length of its shadow. Then you measure the length of the skyscraper's shadow, and thereafter it is a simple matter of proportional arithmetic to work out the height of the skyscraper."

"But if you wanted to be highly scientific about it, you could tie a short piece of string to the barometer and swing it like a pendulum, first at ground level and then on the roof of the skyscraper. The

height is worked out by the difference in the gravitational restoring force T =2 pi sqr root (l /g)."

"Or if the skyscraper has an outside emergency staircase, it would be easier to walk up it and mark off the height of the skyscraper in barometer lengths, then add them up."

"If you merely wanted to be boring and orthodox about it, of course, you could use the barometer to measure the air pressure on the roof of the skyscraper and on the ground, and convert the difference in millibars into feet to give the height of the building."

"But since we are constantly being exhorted to exercise independence of mind and apply scientific methods, undoubtedly the best way would be to knock on the janitor's door and say to him 'If you would like a nice new barometer, I will give you this one if you tell me the height of this skyscraper'."

The student was Niels Bohr, who would go on to win the Nobel Prize for physics.

Though the above story may be apocryphal, first-year students seem to respond its youthful irreverence. Pairing this story with an experiential learning activity, such as the one shown in FIGURE 3, allows students to practice the skill of idea generation, a skill which may seem awkward at first. This activity accompanies the first graded project, which focuses on skills of estimation and report writing, where students must calculate how long it would take the trash generated at football games to fill Tennessee's Neyland stadium.

Team Activity: Brainstorming

You have heard how Niels Bohr generated many ways to solve a single technical problem. For this current project, one of the variables you will need to ascertain is the volume of trash generated by a football crowd. Your assignment is to come up with 5 different methods of calculating the volume of trash. Remember to refrain from evaluating any of the methods until you come up with at least five.

#1. _____
#2. _____
#3. _____
#4. _____
#5. _____

FIGURE 3
HANDOUT FOR BRAINSTORMING ACTIVITY.

For this activity, students came up with many different methods. Some of the more popular included calculating volume of dumpsters and charting how often they are emptied, calling the physical plant, measuring dumpsters and trash cans, finding out the yearly volume of Gameday trash, according to the number of cups/containers used per fan. The important thing isn't that the method is right, but to encourage the skill of creative thinking.

Conflict Management and Feedback

After work groups have completed a couple of graded projects, it often becomes clear that group members have differences in interpersonal and problem solving style. Because disagreements can be quite frustrating, it helps to talk about conflict management and reframe these differences as a group asset. The benefits of group conflict are many: 1) it keeps members from prematurely agreeing on solutions, 2) it helps to generate more creative solutions, 3) it increases the likelihood of effective problem solving, 4) people become more engaged and learn from other's ways of doing things, and 5) successful navigation of differences increases group unity.

Corrective feedback is a method of conflict management introduced to avoid personality disputes that can hinder collaborative problem solving. As feedback can have a negative connotation, it is helpful to reframe it as a corrective mechanism essential in the team environment. Examples as beta-testing for computer software and fly-by-wire systems from aerospace can demonstrate its utility.

Teamwork skills are behaviors, not the usual cognitive processes of the typical engineering course. Instructors of the *engage* program have incorporated a peer-rating process into the curriculum, as the persons in the best position to evaluate team skills are fellow team members [7]. The *engage* program employs Team Developer [8], a software program that allows team members to rate themselves and other team members on teamwork behaviors. The instrument is simple and uses descriptors for behaviors in common language, such as *Listens attentively to others without interrupting*. This implicit focus on behaviors allows students to formulate an action plan for changing harmful team behaviors rated by teammates, such as *Accepts criticism openly and non-defensively*.

ENHANCING WORK GROUP PERFORMANCE

As students gain groupwork skills and become familiar with the project design cycle, the once novel team environment becomes routine. Groups tend to become more cohesive and develop their own methods for project completion as the semester progresses. While one group may do most of the work in class due to the presence of a non-traditional student who lives far from campus, the team at the next table may do their best work at night because all members live in the same residence hall. These patterns, or norms, bring stability to team interaction and make project completion a predictable cycle of events.

Examining Norms

Examining team norms is a great way of raising team awareness of ongoing patterns of team behavior that affect performance. To get maximum benefit out of the diversity of team member viewpoints, students are encouraged to examine the norms that have developed within their team, as shown in the handout, FIGURE 4.

For this activity to be successful, it is imperative that every member fills out the sheet without input of teammates. This helps students become more fully aware of the diversity of thoughts and viewpoints that itself is a strength of the team environment. It also makes space for all viewpoints to be considered and prevents a dominant group member from

filling out the sheet with only nodding assent of others. In fact, dominance of team interaction by one member is a norm occasionally pointed out by a more introverted individual who has not yet expressed his or her viewpoint.

Team Activity: Talking About Team Norms

Background: Unwritten rules of behavior exist for all social situations. These rules, also known as norms, strongly influence how people act in groups. Some norms are obvious, such as "Don't talk loud during a movie." Some are subtler such as "Make eye contact when greeting someone." Often, you can identify norms by individuals getting sanctioned when they are broken. One way to improve team performance is to become more aware of these unique patterns of interaction that have developed within your team.

Activity: As with all team behavior, these norms will affect how you go about all phases of project design, from idea generation to report writing. Drawing upon your reserves of insight and creativity, try to come up with norms that reflect what really goes on under the surface of your team. Write three positive and one harmful norm below.

Three team norms that help my team function well are:
#1. _____
#2. _____
#3. _____

One norm that hinders my group performance is:
#1. _____

FIGURE 4
HANDOUT FOR TEAM NORMS ACTIVITY

One of the goals of facilitating work groups is to heighten their awareness of what they are doing right so that they can consciously do more of it in the future. Focusing on positive norms makes this activity a success in the larger project design lab, as team members can learn a great deal from listening to the experience of others. After all of the teams have finished, it is useful to have each of the groups choose one norm that they think may help other teams and write it on a whiteboard. A typical result of this last step, culled from past activity sheets, is as follows:

- Openly listen to everyone's ideas.
- Whoever has not yet written a report, writes it.
- We divide the projects up into sections.
- Try to accept constructive criticism.
- Use members strengths – Seth is good at Matlab.
- Most work is done in residence hall study room.

Leading a brief discussion on how each of these norms helps toward project completion can give other teams useful ideas. Students seem receptive to suggestions and advice developed through this format, because it is coming directly from their peers.

As with most exercises in the team room, it seems more fruitful to focus on what the teams are doing well. Discussion of norms that impede group process is best saved for solution-focused facilitation with individual teams. This allows the instructor to spend more time assessing the situation and help the team slow down and shift its focus to exploring possible alternatives.

Progress Check-up

When group members have a fair amount of experience with each other and get to know each other's strengths and weaknesses, the group's attention becomes focused squarely on project completion. At this stage it is still important to get the students to slow down and reflect on group work habits, as process factors strongly impact project completion. With deadlines approaching, activities that do not relate directly to project completion are seen as frivolous and are not well received. The activity below, as shown in FIGURE 5, is a brief and focused way to examine group process issues that affect team performance and project design.

Team Activity: Progress Check-up

As mentioned in the Team Developer survey, effective teams monitor progress to ensure that goals are met, create action plans and timetables, define task priorities for work sessions, use meeting time efficiently, and encourage input from all team members. With this in mind, write a few sentences to answer each of the questions below AS A TEAM.

1. The biggest strength of our design is…
2. The hardest part about this project is…
3. As a *team*, what we do best is…
4. As a *team*, we need to improve upon…
5. Our goal for today's work period is…
6. At this point, our project is about ___ % complete.

FIGURE 5
HANDOUT FOR TEAM PROGRESS CHECK-UP ACTIVITY

This activity encourages teams to reflect on workgroup process variables that affect team progress. It is also another chance for the instructor to raise member awareness of functional team behaviors. By walking around and spending time at each team table, the instructor can use completed sheets to evaluate team progress and gain insight into team dynamics, as this process uses consensual agreement among all team members.

DEALING WITH OUTLIERS

The activities presented in this paper are useful in incorporating a focus on team process into project design courses. From student report, these activities appear to help them gain team skills necessary to successfully complete project design requirements. It has been the experience of team room instructors that most teams will progress into cohesive functioning and successful project completion.

However, some teams seem to have trouble developing functional patterns of behavior and experience significant difficulty in timely completion of projects. Often extra support and facilitation techniques such as timeline scheduling offer help for these teams that struggle.

Engineering educators interested in implementing a team component should be aware that dysfunctional teams are often the result of one difficult member. Though most first year students have the maturity, responsibility, and basic social skills to be a productive member of a self-directed work team, there is an occasional outlier who needs individual attention. With approximately 400 students entering the *engage* program every year, experience has shown that there are bound to be certain persons who will create difficulty on any team in which they are placed. The *engage* program has addressed this by placing a Team Development Teaching Assistant in the project room during all class sessions. These TAs are all from the counseling psychology program and have training in assessing and managing individuals who need more guidance and specialized intervention due to personality factors.

The single biggest problem is lack of attendance and participation. Missing just a few classes can alienate a team member and problems are sure to arise when there is an unequal distribution of labor. Though it is a stated expectation that members show up to all class sessions and the majority of out of class project meetings, enough students have shown lack of commitment to necessitate the following standard email:

Jeff,

I noticed you were absent from the team room today. I went by your table and talked to your teammates. They feel you are not here often enough to contribute in a meaningful way to your team.

Part of the learning that is integrated into the first year engage curriculum is the process of being on a team. Passing this course indicates that teamwork learning skills have been integrated into your course of study. Course requirements include consistent class attendance and putting in time toward successful project completion.

If this expectation is not consistently met, your team grade will be adjusted downward in proportion with your lack of participation. Please see me during team time so that we can discuss this matter.

Mark,
Team Development GTA

Experience has shown that some students may need to be asked to report in their attendance or provide extra evidence of their participation. Being singled out often gets a student's attention that their interpersonal skills and participation do matter. Individualized discussion usually works in getting the student to be accountable to his or her team; however, it occasionally brings up deeper team issues. There are always two sides to every story, and on occasion a team has unfairly scapegoated or sanctioned a member, making the team environment a hostile place. This is an issue that needs to be facilitated and monitored, with the TA taking the lead in ensuring the team environment is a fair and safe atmosphere for all members.

Difficulties may also arise due to project work times in casual environments such as students' homes and residence halls. Some teams like this laid back environment because it provides a place where college students can get much done. However, there is the rare report of drinking, sexual innuendo, or other inappropriate behavior that warrants discussion. If one of these situations occurs, it is best to refer these cases to persons in the university environment who have expertise in handling inquiries into student behavior and can take disciplinary action.

These last few caveats requiring close monitoring are the exception to the rule as most students seem pleased with their team experience. End of term feedback indicates that most students enjoy the hands-on approach used in the project design room and report working on a team as a distinctly positive experience.

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