



Tools for Creating and Managing Student Teams

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Abstract

Collaborative projects are a means of instruction in engineering, both to gain content specific knowledge within an engineering discipline and to master skills associated with working on and leading teams. Yet research indicates that a variety of team-management and team participation difficulties arise when using student teams – difficulties that often result in uneven learning outcomes, unsatisfying collaborative experiences and fitful facilitation headaches for the instructor. This session explores a particularly useful technique – team compacts – as a tool to overcome specific difficulties, to facilitate management of student teams and maximize learning outcomes while minimizing instructional hassle. The session is grounded in published research on the topic, the experience of the facilitators and the practice of the participants.

Background

Need: Studies reported in the **Harvard Business Review** suggest that collaborative work has increased over 50% in the last decade and many professional employees now spend up to three quarters of their day communicating with others¹. Many STEM courses require students to work in teams to complete assignments. Johns Hopkins engineering design courses, and many other courses, require collaborative work on teams; indeed, well over half the courses within the Center for Leadership Education in which the authors teach use team-based structure for some portion of the semester's work. Moreover, ABET criteria require "an ability to function on multidisciplinary teams"² as an engineering instructional outcome.

Therefore, to adequately prepare students to perform effectively both in class and the workplace, undergraduate and graduate engineering courses should offer specific instruction on team skills. Yet research indicates that a variety of team-management and team participation difficulties arise when using student teams. These problems result in uneven learning outcomes, unsatisfying collaborative experiences and fitful facilitation headaches for the instructor.

As a result, students and teachers often are less satisfied with the team modality than other teaching modalities³. Students and teachers recognize that individual and team-based difficulties affect learning success. For example, Buckenmeyer and Stein suggest that individual issues such as "social loafing" (an individual shirking work and riding the coattails of other group members), differing expectations about the desired or expected grade, and inability to manage conflict between members often disrupt student groups, create management problems, and lead to student dissatisfaction and diminished learning outcomes^{4,5}.

Other researchers have documented that team issues also may lead to ineffectiveness and management difficulties. For example, Caspersz, Skene and Wu (2005) argue that factors such as managing multiple projects each competing for time and attention, the infrequent and sporadic nature of student work group meetings, the lack of clearly assigned roles, and the lack of

knowledge of individual skill/knowledge strengths and limitations all contribute to team ineffectiveness⁶. Michaelsen argues that the success of student teams [and conversely, lack thereof sometimes] is due to high levels of group cohesion. Moreover, he argues, “the greatest inhibitors to the development of group cohesiveness are either a previously established relationship between a subset of group members ... or background factors such as nationality, culture or language”⁷.

Informal surveys about difficulties of team projects conducted by Rice and Smedick with six classes of Hopkins students, prior to initiation of the instructional design, support these and other similar findings. For example, over 80 percent of students indicated that the greatest issue with team projects was disagreement over priorities and plans for action. Other problems they found frequent and vexing included uneven distribution of workload and scheduling difficulties.

Work to date: Within the engineering education setting, several studies have demonstrated the potential and need for work on the issue. For example, Davis and Ulseth developed a curriculum for teaching teamwork skills over several years⁸. And while the topics were comprehensive, it featured normative content about roles, feedback and contracts, but without the interactive experiences that Google’s Aristotle Project found critical for developing understanding⁹.

Borrego et al. identified a set of factors in engineering education that must be addressed during training to allow engineering teams to be successful. The factors are conflict resolution, establishing trust, overcoming social loafing or unequal team member contribution, interdependence for task completion, and shared understanding of roles and responsibilities that guide team behaviors¹⁰.

Polk et al., working with professors from their School of Management developed a series of training workshops to address many of the above issues from the perspective of Tuckman’s four stages of team development as well as team evaluation. Results of the multi-session training program show improvement in team leadership skills, but again were normative exercises and left unanswered the effect on skill acquisition for all team members¹¹.

A series of studies from the Northwestern University McCormick School of Engineering and Applied Science determined two critical factors for improving team function in engineering teams. First they found that team charters, similar to the team compacts the authors use, are effective at maintaining team self-management skills. Second, they found that discussing and settling on norms of expected behavior for work teams ahead of initiating work tasks help establish norms that support psychological safety and improve group function. Among the critical factors to discuss are typical problems such as scheduling, honesty in communication and dealing effectively with conflict¹².

Instructional Design/Methods

Building on the conceptual work and findings from Google’s Project Aristotle, Lencioni’s functions of teams¹³ and Cialdini’s principles of influence,¹⁴ the presenters have developed and tested an effective and efficient instructional program that trains students in self-management skills and eliminates most of the problems that plague student work teams. The real-life exercises

draw on the lives of participants and allow them to experience in real time the issues under consideration rather than offering a normative explanation of what they should do in a hypothetical situation. The training results in the production of a team charter that members build, sign and use to guide their work.

The training for charter design and development activities emerges from the conceptual framework of Patrick Lencioni's dysfunctions of a team as illustrated in Exhibit 1: Lencioni Model of Team Dysfunction. The instruction and discussion features explicit acknowledgement of the role that trust, conflict, commitment and accountability each play in achieving productive and useful results. However, rather than simply discussing each topic, students engage in experiential activities that allow them to discover and build the elements of successful work teams that are associated with that function.

Exhibit 1: Lencioni Model of Team Dysfunction



The activities and exercises reflect the teamwork requirements illustrated by Google researchers in Project Aristotle. That is, the exercises allow - actually require - participants to enact behaviors that Google researchers determined are the critical components that distinguish effective from both average and ineffective teams.

More specifically, activities require team members to interact with each other to discuss and decide on norms about how they will treat each other during their work together. Moreover, the exercises encourage and reinforce conversational turn-taking so that each person contributes in approximate equal amounts to the collective product. Additionally, the exercises require consciously attending to each person's verbal and non-verbal interaction patterns so that participants can begin to imagine how each other might feel in a variety of situations. Moreover, the exercises address many of the issues that typical teams encounter, such as dealing with

conflict and making decisions so that members learn to establish interactive behaviors that provide for psychological safety. Thus, members learn that they can take risks - express their position or opinion on any issue or ask for help - and will be taken seriously and considerately by the other members of the group.

Exhibit 2: Experiential Activities by Level of Lencioni Model

- Trust**
 - Please meet ____; team members interview and introduce each other
 - Discuss concepts of trust, building trust, breaking trust, and rebuilding trust
 - Characteristics of best and worst teams on which participants have worked
 - Individual stories of personal angels and heroes
 - Individual stories of events of primary emotions
 - Individual stories of events of earth, wind, water and fire
 - Face pictures and estimates of the mood and what individual is feeling
- Conflict**
 - Thomas-Kilman Conflict Mode Instrument analysis
 - Identification and discussion of typical problems on work teams
 - Indicators of when and how "you" feel heard
 - When you disagree with something I said, please say...
 - Constructive feedback exercise
 - The conflict miner exercise
- Commitment**
 - Decision-making exercise
 - What does recognition, appreciation, and thanks mean to you?

Exhibit 2: Experiential Activities by Level of Lencioni Model illustrates the exercises matched to the Lencioni Model. Exercises

require 5 to 30 minutes to complete, depending on class size. Note that there are multiple activities within each step of the model so that classes such as engineering classes that require different teams throughout the course of instruction can be reconstituted without necessarily repeating the same exercises.

Exhibit 3: Sample Activity to Build Trust presents the directions of an exercise in building safe space as each student tells a personal revealing story about themselves. The power of this activity is that the stories are true instances of members doing well or doing poorly that everyone experiences and can visualize. The result is bonding, a sense of how the storyteller feels about and reacts to life events, and a willingness to allow each other space to be wrong and to ask for help.

Exhibit 3: Sample Activity to Build Trust

As you discuss "trust" as a basis of teamwork, pass out color-coated M&Ms. Ask everyone to take several, eat as many as they wish, but save one (1) in sight on top of desk.

1. Discuss finding from Google about psychological safety
2. Explain that each person is going to tell a two (2) minutes story about themselves as a way to get to know each other better.
3. List colors of M&Ms and type of story on board
 - Blue = proud
 - Orange = failure
 - Yellow = scared
 - Green = embarrassed
 - Brown = success/accomplishment
 - Red = aspiration
4. Explain that the types of personal experiences each person tells in their true stories must correspond to the color of M&M left on their desks.
5. Tell a sample personal story to the class. Choose a self-deprecating story such as failure or embarrassment to model.
6. Allow two (2) minutes to prepare stories.
7. Work around room telling stories. (Can be adjusted to group size).

The model offers similar activities for each level of the Lencioni model, with each activity directed toward using and combining the Google findings while establishing norms of behavior. For example, the activities require addressing and practicing dealing with conflict and resolving questions of how groups can make productive decisions so groups can debate options and decide how they will deal with the issue when it arises.

The instructional design is built for close-proximity teams and is deployed in classes ranging in size from 12-35 students. Team size ranges from 3-9 students with the typical size of 5-6 students.

The exercises culminate in talking explicitly about most of the expected potential issues and norms of behavior for the semester. As each student is practicing listening and participating, the idea of the student compact is introduced. Students discuss the suggested questions and decide on agreed upon responses. They practice surfacing and considering multiple points of view, ask to hear all opinions and reach resolution that each person can follow. They enter the results of the discussions onto the team compact. The compact codifies the expected norms of behavior for the team in working with each other. Exhibit 4: Sample Team Compact presents the decisions one design team is using for their work this year. Note the detail they address.

Team members sign their compacts as a pledge to each other that they will abide by the norms and rules they have established for themselves. The signature follows on the work of Cialdini regarding the power of consistency for maintaining behavior. Not only do team members decide collectively to act in certain ways with and toward each other, and express that decision aloud with each other, but also they pledge in writing to behave in those specified ways.

Exhibit 5: Template Compact Questions illustrates the compact along with the prompt questions which student teams must explore, resolve, codify and follow for the course of instruction.

Activities from initiation to completion of the compact typically require approximately two class periods of student participation.

Findings

Instructor and student responses to use of the guided instruction activities and creation/use of student compacts have been positive and revealing. In the last four years, student complaints about group process activities from teamwork projects has vanished from end of term course evaluation comments. The number of times instructors have had to intervene or settle issues between team members has changed from 2-3 times per semester to zero. Achievement scores on team-based assignments have improved from a pattern of one A, several A-'s, several B's and a C to all A or A-s, even as the workload on student teams has increased. No students have been "fired" from teams by other team members although at least one team used that potential sanction as a consequence to encourage equal participation from the offending team member.

Teams have reported that sometimes they refer to their training and decisions as codified in their compacts when they work with each other and as they settle the inevitable disagreements that occur during a term. But perhaps more importantly, most teams have reported that setting behavioral norms ahead of time usually preempted the need to even refer to the document; they simply act on the decisions they have already agreed to follow. And the ideal team size seems to be 4-5 members for involvement and discussion.

An additional an unexpected finding is behavior after graduation. Both instructors have received requests for copies of the guided exercises and compact questions from students who had been

Exhibit 4: Sample Team Compact

Describe how you will deal with scheduling meetings:

- Share team schedule and use team Google calendar
- Individuals can suggest adding more meetings, if necessary, one week before meeting time
- Meeting agendas/stakeholder interview questions should be prepared beforehand

State time and condition for how long before a deadline our individual work will be completed and added to the team's electronic file.

- Depends on the work for written materials
- Presentations hold high precedence, and at least 4 hours before deadline

Describe the process we will use to make decisions

- In certain situations, a majority vote might be necessary and then have a discussion about it afterwards to make a consensus
- If discussed ad nauseam, you can flip a coin to decide and we will live with the result
- Not everyone needs to be involved in every decision- defer to expertise

How will we deal with a team member who is not holding up his/her "part of the bargain" in terms of quality amount of work, timing, and/or communication?

- Have one team designated person talk to that individual (if the whole group comes to them they might see it as a personal attack)
- Go at it from a more compassionate standpoint ("Is everything alright?") instead of just saying, "You're not doing your work, why?"

How will we deal with conflict and disagreement?

- Be able to take constructive criticism (about the idea, not the person)
- Ask a person for their opinion often if they are being quiet
- Allow each other to say "ouch" and know what it means

What specific rules of engagement (communication) do we pledge to follow in working with each other on this project?

- Maintaining equal talking time... stop and ask
- Punctuality in person and in paper... punctuality is on time and night before for paper
- Set agendas for group meetings and follow them
- Make sure we stay on topic
- Blocking out time on weekly basis
- Don't talk over people and maintain active listening
- Maintain confidentiality
- Keeping everyone up to speed so share new information each week

team members in class after their graduation. These former students are now incorporating the practice of compacts into their work environments outside the academy.

Conclusion and Discussion

Creating an atmosphere of trust, openness and equal participation clearly makes a difference in the successful functioning of work teams, both in the workplace and the academy. Anecdotally collected evidence points to better learning outcomes, less instructor conflict involvement and management, more equitable student participation, and fewer student complaints when team compacts together with guided instruction are used to introduce and accompany team-based tasks. Yet many questions about the practices remain unanswered. For example, the anecdotal findings indicate that the design is effective for close proximity teams. However, it is yet to be tested in a study with matched treatment and control groups to move findings beyond collected anecdotes. So too, the design has yet to be tested in virtual teams, a structure used increasingly in private industry.

However, the evidence to date is compelling and suggests that other questions also deserve attention. Chief among these questions are the following:

- How and under what circumstances do the compacts work effectively for virtual teams?
- How does the use of compacts compare between virtual and close-proximity teams?
- What are effective methods of building trust on virtual teams?
- What are effective methods for resolving conflict on virtual teams?
- What difference does task duration make on the effectiveness of contracts?
- What are the strengths and limitations across software applications for scheduling and time management for team activity?
- Which potential team problems are more frequent, more intractable and more debilitating? What techniques prove effective in dealing with them?
- What techniques are available for rebuilding trust, if it is broken?

Exhibit 5: Template Compact Questions

Project Goals: What specific objectives must we achieve to be successful?

- 1.
- 2.
- 3.

Resources: What resources (people, time, money, equipment) do we need?

- 1.
- 2.
- 3.

Decisions: How will we make decisions? What process under what circumstances?

- 1.
- 2.
- 3.

Conflict: How will we deal, value, and process conflict and disagreements? How will signal disagreement with an idea? How will we separate the idea and the personality?

Team Logistics and Process:

- Describe how we will schedule meetings
- Describe what we mean by “psychological safety”
- State time and condition for how long before a deadline our individual work will be completed and added to the team’s electronic file
- Describe how we will ask for help, when needed
- Describe how we will correspond with each other outside of meetings
- Discuss how we define quality communication
- Describe how we will decide on task delegation
- Describe specific rules for communication/engagement we pledge to follow when working with each other for each of the following items:
 - Listening
 - Asking questions
 - Assuring everyone is heard
 - Building an idea
 - Disagreeing or offering an alternative idea

Pledged by: _____

Date: _____

- Can trust be rebuilt on virtual teams?
- What techniques build commitment for virtual teams?

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