A Sea of Variations: Lessons Learned from Student Feedback about the Role of Trust in First-year Design Teams

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Work in Progress: A Sea of Variations: Lessons Learned from Student Feedback about the Role of Trust in First Year Design Teams

Abstract

Teamwork is a fundamental part of the engineering profession; therefore, students majoring in engineering often work in teams. However, many dread the prospect of working on a team because they fear that their course grade will be adversely affected by the actions of other team members who cannot be trusted to support their own expectations of work product quality. This belief might have been formed through a prior experience, or may arise from suspicion about the unknown motives and actions of the other team members. While effective and appropriate team leadership is often identified by students as a major factor in team success, a more fundamental attribute of a successful team is trust among its members.

This research study will identify and explore the role of trust in the dynamics of successful first year engineering design teams at our multidisciplinary university in the eastern United States. We are using a conceptual framework for the formation of trust in a team-based environment, which has been formed by studies of successful business, technical and sports teams. Despite differences in maturity and experience, engineering students have a lot in common with these older team members, because both groups are people with common traits of human nature.

Our research questions are as follows:

- How do team members describe manifestations of trust as a key factor in team success?
- How can faculty remove barriers to the development of trust among members of student teams?

End-of-semester surveys revealed that teams that exhibited a high level of trust often stated that the choice of design project did not affect the ability of the team to be successful, while teams with a low level of trust often blamed the choice of project for their difficulties factors. Successful teams also seem to exhibit a type of "team chemistry" whereby they enjoyed socializing as well as working together. The trust reinforces this type of compatibility.

Introduction

This research study will identify and explore the role of trust in the dynamics of successful first year engineering design teams at our multidisciplinary university in the eastern United States. We are using a conceptual framework for the formation of trust in a team-based environment, combined with a second framework that informs our data collection through team-based reflective journals. Using a case study approach as our research method, we assert that, despite differences in maturity and experience, engineering students have a lot in common with case study participants from business, technical and sports teams, because all of these teams consist of people with common traits of human nature. This particular study is part of an ongoing effort to help first year student design project teams avoid or overcome difficulties in teamwork when the team is not of their own choosing, and a large part of their own final grade depends on the team's success with the design project.

Our conceptual framework is drawn from examples of successful business and sports teams, which have been studied extensively to identify the dynamics that make them successful and how their members apply their sense of human nature to behaviors that build trust.

Conceptual Framework for the Development of Team Trust

<u>What is Trust When It Comes to Teamwork?</u>

One way to define trust is to consider it as a commitment to cooperation with others without being certain of their actions [1]. While our team members "trust" one another with the expectation of honest behavior, doing so involves risk [1]. Students recognize this all too well; for example, "how can I be sure that a fellow team member will honor their commitments when my grade is at stake?" Therefore, taking the risk makes one feel vulnerable, and students already exert pressure on themselves to perform extremely well, which makes them risk-averse.

According to Larson and LaFasto [2], there has never been more of a need for collaboration in solving the world's problems, and, at the same time, less of a willingness on the part of those who could solve them to work with others to do so. Just when greater trust is needed, less is felt. These authors also identify four necessary components for the development of trust: honesty, openness, consistency and respect [2]. Curiously enough, some of these traits are also necessary for a reputation built on integrity and a strong sense of professional ethics, which one of our prior study populations identified as part of the ethical obligations of engineers [3].

<u>How Teams Relate to Concepts of Trust</u>

Another way to describe trust takes the view of "trust tokens" in team dynamics, as described by Morita and Burns [4]. These "tokens" are perceived expertise, recommendations, social capital, willingness to help and validation of information [4]. Perceived expertise refers to the ways in which team members regard the abilities of each other and expect everyone to use their expertise (as a combination of ability and experience) to complete project tasks on time and with high quality. Recommendations and social capital, as contributed by an authority figure (such as an instructor in the case of student teams) about a certain team member's performance (e.g., through high grades) lends credibility to that team member's contributions [4].

The willingness to help one's fellow team members fosters trust by demonstrating that they are approachable when others need help. Past helpful behavior matters considerably in this regard [4]. Finally, validation of information also depends on a series of past behaviors in which a team member who delivered true and useful information in the past is assumed to continue to do so. In this way, validation also reinforces the perception of expertise [4]. All five of these tokens are also related to a description of trust as consisting of both cognitive and affective components [5]. Cognitive components consist of confidence in others' ability and is related to perceived expertise, social capital and validation [4], and the affective components include the assumption of the trustworthy intentions of others, which is related to recommendations and willingness to help [4] [5]. A large number of researchers have been identified as exploring these aspects of this multifaceted and complex construct [5].

Hakanen, Hakkinen and Soudunsaari mention the role of communication repeatedly in building trust through the promotion of a genuine interest in the lives of fellow team members and the sharing of goals and norms [1]. Many student teams in our experience have expressed the importance of effective communication among team members, and develop an agreed-upon method for communication readily. A team member who does not communicate well with the others causes doubt about their openness, commitment to the team's goals and even honesty/integrity. Consistency in team member behavior provides evidence of honesty, integrity and commitment, which also engenders respect and trust. Another irony surrounding trust is that it takes a long time to build, yet can be easily broken [1]. Part of the reason for this fact is that team members need to be willing to get to know other team members, and to accept their interests and motives, in order to trust them [1]. The components identified by Larson and LaFasto [2] are all necessary to build any level of trust, but the erosion of just one them can hinder the process of building trust considerably.

When our students record their impressions of the role of trust in their team's progress reports, they are reflecting on their current experience on the team and their observations and impressions of the actions of fellow team members. Reflection provides both "deep lessons" and "new understandings" that students would add to their own accumulated knowledge and experience [6] [7].

Since our study takes place under conditions where the instructor-researcher has frequent contact with students-participants and will collect data through multiple sources, we also need to recognize that the meaning of the results will be influenced by the researcher as well as the participants [8]. Our dual role makes this a challenge, as we strive to be objective in identifying and interpreting our results. It is too easy to expect that our students' views about trust would match our own, when they might be different.

Objectives for This Study

Our research questions are as follows:

- How do team members describe manifestations of trust as a key factor in team success?
- How can faculty remove barriers to the development of trust among members of student teams?

The first question seeks to identify the behaviors which engender trust among members of first year student teams in terms of how these behaviors resulted in team success. For the second question, the results of our study may provide clues for faculty to assist student teams with effective team building through the development of trust by removing barriers to trust that are within their control.

Research Methods

Our introductory engineering design course provides both technical skill development and an introduction to engineering design through a semester-long team project, which is pursued by five-member student teams. Students were assigned to project teams using the CATME™ team formation instrument. Our case study consisted of six teams of five students each, where three

teams contained all men and the other three teams contained both men and women. Unfortunately, we did not have any teams containing only women in our study, and our number of teams was limited to those where all team members had consented to having their data used for this study. The students were asked to describe their experiences on their team through peer evaluations and other surveys that were given during the course, as well as 12 weekly team-based reflective learning assignments asking them to describe how, as a team, they had built trust and respect among their members. There was also an assignment to reflect on their team and project over the course of the entire semester.

While engineering students have been described more as active rather than reflective learners [9], we chose to incorporate both individual and team-based written reflective learning assignments throughout the duration of our course, so that the students could develop a retentive recognition of what they had learned and what it meant to them. The team-based reflective learning assignments provided most of the data relating to the development of trust among team members.

Specifically, teams were asked this question: *what did team members do to build trust and/or respect within your team?* Additional questions about design project progress during the week provided a context for responses using evidence of specific actions taken by team members resulting in greater trust in the value of their contributions.

In addition to the weekly project status and reflective updates, team performance was monitored through peer evaluations and classroom observations. These data provided evidence that reinforced the themes identified in the weekly updates, as well as early warning signs that teams who were struggling with project task completion also struggled with teambuilding through the development of trust and respect among team members.

Data Collection

Each team entered their answers to the weekly question in the blank spaces provided in the assignment form, during the week immediately following the designated week. This time delay enabled teams to reflect on an entire week's activity when reporting. The same form was used for the duration of the semester, so that responses for each week could be compared easily by students and faculty for progress as a succession of steps, whether positive or negative, in chronological order. The potential problem of repeating the same response over successive weeks was not present in this case study.

Data Analysis

We were interested in the pattern of themes in the responses for the all-men vs. the mixed gender team over the course of the semester, as well as themes over which faculty, through their methods, could have some measure of influence on team members' sense of trust in fellow team members, whether positive or negative. These responses consisted of short paragraphs containing between 2 and 4 sentences. All data were de-identified except for team gender mix (i.e., all men team or mixed gender team).

A total of 14 responses, of which 13 were weekly and one was cumulative, was compiled for each team using open-coding by one coder for the identification of themes. Unfortunately, we were not able to employ multiple coders. Codes were chosen from attributes of trust identified or implied by Hakanen, Hakkinen and Soudandaari [1] and Larson and LaFasto [2] and can be grouped as either individual or interactive attributes as follows:

- Individual attributes (ID): commitment, consistency, honesty, integrity, openness, reliability, responsibility, sacrifice
- Interactive attributes (IN): accountability, collaboration, cooperation, helping others, respect, risk, social interaction

The individual attributes are those that a team member exhibits through their own personality, outlook, moral code and actions. Interactive attributes involve ways in which a team member acts with or is regarded by other team members, or is affected by their actions. What makes the term, "risk" an interactive one is a team member's decision to depend on another one or more members for their own success, which is not guaranteed.

Results

The codes for each weekly response and cumulative response for each team are shown in Table 1 below, along with the frequency of individual and interactive codes in Table 2:

Table 1: Codes for Team Reflective Responses about Trust and/or Respect on Their Team

Week No.	Codes for All-Men Team	Codes for Mixed-Gender Team
2	integrity, social interaction	collaboration, cooperation, openness, respect
3	commitment, responsibility, risk	commitment
4	commitment, consistency, cooperation, openness, reliability	commitment, consistency, helping others, honesty, responsibility
5	collaboration, respect	collaboration, commitment
6	consistency, sacrifice	accountability, responsibility
7	cooperation, helping others	accountability, reliability
8	cooperation, integrity, helping others	accountability, openness, reliability, risk
9	commitment, respect, social interaction	accountability, cooperation, responsibility
10	cooperation, integrity, helping others	consistency, cooperation, openness, respect
11	collaboration, responsibility, sacrifice	accountability, collaboration, commitment, consistency, openness
12	cooperation, honesty, integrity, reliability	Sacrifice, risk, cooperation
13	honesty, integrity	collaboration, commitment, consistency integrity
14	commitment, integrity, responsibility sacrifice	collaboration, cooperation
Cumulative	helping others, social interaction	helping others, collaboration, cooperation, social interaction

Table 2: Coding Frequency Between All-Men and Mixed Gender Teams

Code	ID/IN	All-Men Teams	Mixed Gender Teams
Commitment	ID	4	5
Consistency	ID	2	4
Honesty	ID	2	1
Integrity	ID	6	1
Openness	ID	1	4
Reliability	ID	2	2
Responsibility	ID	3	3
Sacrifice	ID	3	2
Accountability	IN	0	5
Helping Others	IN	4	1
Collaboration	IN	2	6
Cooperation	IN	5	6
Respect	IN	2	2
Risk	IN	1	2
Social Interaction	IN	3	1

Discussion

Both teams placed ***commitment*** as an important factor in promoting trust by recognizing certain team members' commitment to meeting the team's and project's goals, along with ***reliability, responsibility*** and ***sacrifice***. These individual attributes also promote ***respect***, an interactive attribute, and encourage ***openness, collaboration*** and ***cooperation***, even in the face of uncertainty. [1] A curious aspect of ***collaboration*** is that it may have been staged in the Week #2 in-class team building exercise, but was voluntarily indicated in the development of trust by both teams during Week #5 and later.

Social interaction occurred when teams decided to take a break from working and go to the gym or local snack shop together. Both teams mentioned that these interactions helped to build trust by giving team members an opportunity to become better acquainted. Whether by schedule or by preference, ***social interactions*** were reported during the last several weeks of the semester rather than earlier, as a certain level of familiarity was necessary before the team could socialize, as well as find a block of time that was convenient for everyone. The all-men team mentioned social outings more often that the mixed-gender team as a means of building trust; it is possible that the mixed-gender team also enjoyed ***social interaction***, but did not mention it in terms of specific social activities.

Notable differences also existed between the all-men and mixed-gender teams for the attributes of ***consistency, integrity, openness*** (all individual) and ***accountability***, ***helping others*** and ***collaboration*** (interactive). The mixed-gender team placed slightly greater importance on ***consistency*** as a factor in trust, indicating that a repeated positive action or behavior was more meaningful to them than it was to the all-men team. Similarly, ***accountability*** was mentioned often by the mixed-gender team, but not at all by the all-men team, who, instead, gave numerous examples of how ***integrity*** influenced team members' assessment of value to themselves and to the team. ***Openness*** was more often described in building trust by the mixed-gender team, which also valued ***collaboration*** more strongly than the all-men team. In terms of overall team behavior, we can conclude that, while both teams divided the work load equitably among team members, all-men teams were less likely to work on tasks together than the mixed-gender teams.

Conclusions and Recommendations

Since both teams showed general agreement about ***commitment, reliability, responsibility*** and ***sacrifice*** as important factors in building trust among their members, faculty could share these findings with their students as examples of how to build trust on a team. While trust cannot be forced on anyone, but must come from within, students can be encouraged to promote an atmosphere of openness and acceptance of all team members for what their value to the team, even if it is not apparent at first. An important part of project-based learning is the opportunity for students to figure out what they need to know and do, but faculty can help by providing realistic examples of successful and unsuccessful teams who exhibit these attributes, or fail to.

Given the differences between the all-men and mixed-gender teams in the areas of ***consistency, integrity, openness, accountability, helping others*** and ***collaboration***, we recommend that different guiding or mentoring techniques be used with each type of team. For example, working

together on a task may be beneficial in building trust on a mixed-gender team, but may actually be detrimental to an all-men team, depending on the type of task at hand. Two instances of production vs. counter-production could be building a model at one sitting in one location, or writing a report for which some or all team members need to be able to organize their thoughts on their own, first, because doing so in a group setting would be too distracting for them.

In our course, containing both project-based and skill-based course content, asking fellow team members for help with skill-based homework problems was more prevalent on the all-men team, although this could have been due to a difference in individual skill sets and the ability to learn a new skill quickly. Asking a team member for help is a sign of *openness* to both helping and being helped. Both are potentially vulnerable situations which, instead, promote trust between those involved that can influence their future interactions when a sense of trust is necessary in place of individual control. Faculty should, therefore, encourage a team to recognize who needs help with particular skills by suggesting ways in which they might work together, one teaching and the other learning, to reinforce the former's skills and strengthen those of the latter. No team can expect to work smoothly all of the time, but an awareness by faculty of what factors influence trust can make the circumstances of serving on a project team more rewarding for students.

Asking additional faculty to code the teams' written responses in the project status and reflective updates would provide inter-rater reliability and strengthen our arguments for specific themes in the identification of the attributes of trust and respect, as well as prevent instructor bias. This study will also be expanded to include a larger number of teams in the future. Finally, suggestions have been made to poll students at the beginning of the design course about their prior team experience, along with existing self-assessments of technical and communications skills. Additional observations of team engagement, or a lack of it, during in-class activities, beginning early in the semester, could also be compared to student feedback about team performance in their project status and reflective updates, which begin with Weeks 3 and 4.

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