Extended Abstract - Assessing Teamwork in a First-year Engineering Studio Course

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***Abstract* - This presentation describes findings from a long-term project to develop teamwork among first-year engineering students at a major research university. Findings to date from 1,834 teamwork assessments(Goodman, 2013) have identified four top factors that contribute to team success and four top factors that contribute to failure, as well as essential development opportunities for individual students and teams. Additional findings examine motivational factors, receptivity to peer feedback, and the importance of introducing students to a basic team vocabulary.**

Index Terms – Teamwork, Leadership, assessment

Courses that assign a real-world engineering challenge to student teams are an increasingly common feature of engineering education(Jeffrey E. Froyd, 2012). These courses often introduce students to the design process, fundamental engineering concepts, and how to communicate with the non-engineer(s) who will use the final product. Northwestern University helped pioneer these types of courses and all of our students are placed in four-person teams for two quarters during their freshman year. Students can also take a senior year capstone course that uses a similar methodology.

In 2011, the freshman courses adopted a new web-based teamwork assessment(Adam Goodman, 2011) that introduces students to concepts that are commonly found in industry: learning from past team experiences, guiding work through a team charter (and project plan), assessing high- and low-functioning behaviors, identifying and assessing individual and team learning goals, and separating process from product work to better identify member contributions in each area. Since then, approximately 40 faculty members have worked with students to conduct 1,134 assessments.

Using text analysis and grouping common themes from students' written responses, we have identified factors that students believe most contribute to or inhibit team success; the types of work that students report as being most important to them; and, student perceptions of their teamwork ability. These findings point the way to two issues for improving student learning.

First, we need to find effective pedagogies that account for students having a primary orientation toward task completion. An intangible asset like teamwork struggles for students' attention. How do we, as educators, help students assign value to these unseen, yet very real, factors that directly affect engineering success and failure?

Second, students need a vocabulary for teamwork so that they can properly and accurately identify high- and low-functioning behaviors. For example, our results show that "commitment," "communication," and "conflict" are major problems, yet students are unable to specifically describe the type of problem confronting them.

For the purposes of this analysis, we compared our findings with Patrick Lencioni's "Five Dysfunctions of a Team"(Lencioni, 2002), one of the most used texts on the subject of teamwork. In summary the dysfunctions are absence of trust, fear of conflict, lack of commitment, avoidance of accountability, and inattention to results. It is also important to note that overcoming these dysfunctions requires teams to build in order, beginning with trust and ending with attention to results.

Returning to how we reached these conclusions, results to date have identified four top factors that students report as most contributing to team success:

The most common factor is mutual commitment and dedication and is consistent with the third element of Lencioni's model. Students understand that, when all team members are relatively equally committed to their project, team effectiveness is increased. They also understand that variable commitment, such as a disengaged team member or an overly controlling team member, causes dysfunction. As we continue to analyze the data, we hope to learn more about students' awareness for how they build and sustain each team member's commitment and how they respond (or fail to respond) to this when commitment varies or dedication is unclear.

Second, students report that communication among team members about the project plan, goals, decisions made, and similar task-oriented behaviors aid success. This is consistent with prior research(Ashleah C. Troth, 2012) and with Lencioni's teamwork expectations for commitment, accountability and results. Students understand that "when communication is good" the project is likely proceeding well. However, they don't provide precise descriptions for

the type of communication that is working. Similarly, and perhaps more troubling, students attribute a host of problems to poor communication but they are unable to be specific about the type of dysfunction because they simply report that the group, or an individual, has "communication problems."

Third, students report that the adoption of shared goals and a commitment to achieving those goals aids team success, a finding which is, again, consistent with Lencioni's model that teams have a result-driven orientation. Our teamwork assessment requires students to consider this topic at the beginning, middle and end of the team's work. Accordingly, students may identify this factor as being important because of the curricular emphasis we give it. Also, it is interesting to note that students primarily report this as a factor that positively affects their work; they do not typically associate the absence of shared goals as inhibiting team success.

Fourth, students report that honest and open dialogue about conflict also enables team success and is also consistent with Lencioni's behavioral expectation for embracing healthy conflict. Students recognize when conflict happens and they understand that solving conflict is effective. However, this does not mean that students are equipped to see productive conflict as useful or to address and solve conflict in productive ways. Instead, teams typically identified a need for honest and open dialogue about conflict because, in hindsight, they reported that their failure to do so negatively affected their success. In sum, students typically report that, while they recognize the problem, they failed to address it.

Similarly, there are four top factors that students find most contribute to team dysfunction: a lack of communication/miscommunication; absence of trust; lack of commitment/sustained motivation; and relational conflict. Each of these are central to Lencioni's model. These factors relate to the top factors for team success. In particular, students see commitment, communication and conflict as essential for effective teamwork and, when poorly addressed, as major culprits for a team's dysfunction.

A central feature of the teamwork assessment is for students to identify individual and team learning goals that improve each student's and the team's performance. Regarding individuals, students most often choose to improve their communication skills. The most common team-wide development goal is to improve aspects of team meetings: agenda setting and following, time management, quantity of meetings, timeliness, and following through on commitments.

In addition, when looking at motivation we found that students are primarily driven by a strong orientation to complete the assigned project. Others have found a similar orientation among teams(Jos Fransen, 2011). Project work is more highly valued than process contributions such as facilitation, project planning or effective teamwork. For example, when students are asked to identify significant contributions to their project team, the most frequently cited contributions are task-specific (e.g., design, building, documentation). Students also emphasize these types of tasks over building effective relationships among the team or with other individual team members.

These results support the finding that students are able to use specific concepts when task-focused, but they are unable to be specific about the behavioral aspects of effective teamwork (e.g., commitment, communication, conflict).

Interestingly, students are overconfident in their ability to handle teamwork dynamics. For example, they can see themselves as having an effective team until a significant dysfunction, while present for some time, finally derails progress.

The implication of these findings is that, while students see the importance of communication (and other behaviors) as being essential for team success, they associate productive work with getting the job done. A related finding may point to how engineering students can close the gap on behavioral skills. In general, students lack a teamwork vocabulary. Students express ideas related to concepts such as trust, motivation, conflict and commitment. However, they don't use these terms. Relatedly, "communication" is important because of its plurality use and students' inability to be more precise about what they intend by this broad term. Introducing students to common behavioral traps and high functioning behaviors in the form of a concise and specific vocabulary should give students the language they need to better identify, address and support high- and low-functioning behaviors.

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