

Work-in-Progress — Use of Multiple Tools to Evaluate Student Teamwork Skills

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Abstract - Teaching students the importance and ability of working effectively on a diverse team is often one of the course goals in First-Year Engineering programs. Teamwork skills are highly valued by employers and is one of the student outcomes of ABET accreditation. One tool used to assess teamwork skills is the Comprehensive Assessment of Team Member Effectiveness (CATME). Although, there are many articles in support of using CATME, there is always a risk involved in using one tool, especially when the data is based solely on student input. The goal of this study will be to use a multi-faceted approach to assess teamwork skills and determine if there is growth in teamwork skills throughout a semester. The evaluative tools will not only include CATME, but student self-reflection, team meeting minutes and instructor observation.

Index Terms –Assessment, Soft-skills, Teamwork

are administered and hence the best experience is derived when teams are productive and functioning efficiently. Critical teamwork skills which assure team success are important to inculcate but too often, the student team experience can become problematic. Denning [2] in his publication, “Educating a New Engineer”, proffered that the engineering student need not only demonstrate the ability to think critically, act resourcefully and integrate several appropriate knowledge areas when solving realistic engineering problems. He further posited that the student needs to compliment his or her technical capability with the willingness to listen, communicate and complete the task assigned. Lingard [3] indicates that it is unwise to assume that the mere introduction of teamwork concepts will automatically translate to development of strong teamwork skills. There is a need to develop an appropriate system of monitoring the individual student’s contribution to the effective functioning of the team.

INTRODUCTION

Supported by transitions in pedagogical approaches employed in First-Year Engineering (FYE) courses, there has been a constant shift from instructivism to a more constructivist approach. Oliver [1] suggests that in constructivist pedagogy, learning takes a more personal tone where students are active in the learning process and derive meaning out of the associated experiences. Their prior knowledge then serves as the substratum for continued learning. The author further posits that the environment created, tends to require students to work with their peers on open-ended questions, share the results of their work and reflect on outcomes.

This is different from the traditional instructivist approach which assumes that all knowledge resides with the instructor who then attempts to fill the minds of his or her students. Considering this development, educators are challenged to find creative ways to focus student learning. Oliver [1] posits that course designs must incorporate student-centered team based learning pedagogy such as project-based, case-based, inquiry based and problem-based scenarios. Accordingly, the FYE courses at OSU have consistently made this transition to aid in realizing this desired outcome. Teamwork forms a critical component of the way courses

JUSTIFICATION

While reviewing the curriculum for First-Year Engineering (FYE) courses at a variety of universities, a commonality stood out: The main learning objectives were not knowledge-based, but rather skills and abilities. Additionally, ABET [4] General Criterion for Student Outcomes only two of eleven criteria (a) and (j) focus on knowledge or content. As it pertains to appropriate student development, apart from stakeholders at the university level, another important group of stakeholders are potential employers. Davis, Beyerlein and Davis [5] identify five professional behaviors that are important for professional engineers.

One set of important behaviors and roles related to communication, collaboration and achievement [6]. ABET criteria includes an ability to function in multidisciplinary teams. Therefore, it is not surprising that a common theme featured in many places, whether industry or academia, is “teamwork.” While teamwork and the skills required to be a good team member may be the focus of a considerable number of research efforts, a practical way to implement and assess teamwork in a FYE program is far less prominent in the literature.

Moreover, many of the skills needed to be an effective team member such as collaboration, communication and

others of that ilk, are skills that can aid freshmen in their transition from high school. Furthermore, the development of robust team building skills can help students from underrepresented groups in engineering, either directly, or by improving the teamwork skills of white male students.

IDENTIFICATION OF TEAMWORK SKILLS

There are a variety of stakeholders who influence the teamwork skills students learn. As a consequence, there are a variety of starting points when deciding which skills will be the focus. This study is choosing to focus on potential employers as the stakeholders, specifically Google. In a recent article [6] five characteristics of a good team member were identified by google:

- Ability to create a psychologically safe environment (TW1)
- Dependability (TW2)
- Ability to provide structure and clarity (TW3)
- Ability to find meaning of work (TW4)
- Ability to recognize the impact of work (TW4)

Note that for the purpose of simplification and to create a better balance in category weighting, the final two categories were combined. Upon examining a variety of other rubrics [7] - [11] the four remaining categories appear to be rather comprehensive.

In an effort to consolidate information from the various rubrics together, the four major characteristics above are clarified by describing the necessary sub-skills.

Ability to create a psychologically safe environment involves team members feeling the comfortable enough to take risks while also allowing others to safely take risks. Other important traits include being polite, maintaining a positive tone, and respectfully listening. Ultimately, these traits lead to building upon and synthesizing each other's contributions.

Dependability can be articulated by high quality work completed by the required deadlines. A dependable teammate not only remains committed to following through on tasks without reminders, but aids teammates that are struggling to complete their tasks by the required deadline.

The ability to provide structure and clarity includes being able to define goals clearly. Creating clear roles for team members and knowing everybody's roles on their team. Team members will articulate plans clearly and use common time efficiently.

Lastly, team members should believe their work matters. The task needs to be important to each member and the diverse opinions of team members should be valued.

ASSESSMENT RESOURCES

In order for the assessment of teamwork skills to be effective, it must not only be valid but in a format that does not create heavy additional workload on the instructor. This

goal can be achieved by using current classroom practices more efficiently, as well as adding measures that do not require a heavy time commitment.

Currently, the comprehensive assessment of team member effectiveness (CATME) is being used to create teams and allow team members to evaluate others. Further examination shows that CATME can support evaluation for all four teamwork characteristics.

Another current measure already being implemented are class grades for labs. Although these grades can help measure whether the work produced is of high quality or not (TW2), there is little individual accountability. One solution to this issue is to have students insert their draft work in the appendix of lab reports with the student responsible for the section clearly noted.

Team Meeting Minutes were recently added to the second semester of the FYE program. These will now be incorporated in both semesters, and the format for these will be modified to provide additional support in evaluating TW1, TW2 and TW3.

Students regularly complete journals that provide feedback for the instructors. The plan is to collect additional information from students on their opinions regarding the benefits and drawbacks of working in teams to gather information regarding TW4.

The only procedure not currently being utilized is a Classroom Observation instrument. The complete transition to a new mode of instructional team management, where the GTAs have responsibility for leading lab instruction, affords time for instructors to observe each team member as they work in the team context and document teamwork behaviors.

CONCEPT SCREENING AND SCORING

Once the four characteristics of teamwork (TW1-TW4) and how they were measured were established, there was a need to decide how to weight the categories through a concept screening and scoring procedure. First the criteria were established by recalling past experience and listing common reasons for team breakdown. Both researchers independently ranked each of the four characteristics (TW1-TW4) by which character would be most likely to prevent a particular issue. After independently ranking them, TW3 (Structure and Clarity) was decided to be the most important and TW4 (Meaning and Impact of Work) was decided to be the least important. Characteristics were decided to be weighted as follows: TW1 – 25%, TW2 – 25%, TW3 – 35% and TW4 – 15%. Additionally, it was decided that when possible CATME, Team Meeting Minutes, and Classroom Observations/Journals would be equally weighted for each character (Gradebook scores would be used to corroborate Team Meeting Minutes). Relying too heavily on CATME could lead to emphasizing student bias too much. Conversely, relying too heavily on instructor observations could lead to magnifying an error due to instructor bias.

DATA COLLECTION

Data will be collected throughout the semester, with teamwork scores being compiled every 5-weeks (or three times a semester). CATME evaluations will occur in weeks 5, 10 and 16.

Team Meeting Minutes will be analyzed every week beginning in week two. Each 5-week period will be assessed holistically as not every meeting is likely to address every teamwork skill.

Classroom observations will only be made on eleven occasions as some weeks there is no lab due to breaks, exams or classroom presentations. Every attempt will be made to have two observations per student in the 80-minute lab to ensure a fair snapshot of student activity. Also, the starting point will vary to ensure each student/team is not always observed during the same time in a lab period.

Lastly, one Journal question will be devoted to TW4 in each of the three 5-week periods.

ACKNOWLEDGMENT

We would like to thank the faculty and leadership of the newly formed Department of Engineering Education at The Ohio State University.

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