Looking Ahead: Fostering Effective Team Dynamics in the Engineering Classroom and Beyond

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ABSTRACT

The Effective Team Dynamics (ETD) Initiative at Georgia Tech developed curriculum to improve function of student teams. ETD uses the language of CliftonStrengths® to help students identify the areas in which they are the strongest and to apply those strengths to interpersonal contexts. ETD has developed curriculum for five "Touchpoints," or units, beginning with first-year seminar and ending with capstone senior design. Each Touchpoint is modular, and instructors can flexibly integrate the materials drawing on the expertise of ETD's trained facilitators. Next, ETD will study the effects of team training on students' persistence in their intended college major, focusing on the persistence of underrepresented minority students.

Key words: Team dynamics; Strengths-based training; Underrepresented students

INTRODUCTION

Team dynamics form an integral part of project-based learning in the engineering classroom. However, while the benefits of asking students to collaborate around a real-world problem are well documented, the best practices for encouraging productive teamwork are less clearly understood. Scholars have found that students are often required to work in groups without adequate preparation and guidelines for such interpersonal interactions (Gasiewski et al 2012; Gillespie et al, 2006; Sandlin et. al, 2018; Tennant 2006). This lack of "collaboration readiness," or the preparedness of students to engage in teamwork, means that teams often do not reach their full potential (Balasooriya et al 2013; Castner, 2012; Morgan, Glickman, Woodard, Blaiwes, & Salas 1986; Rosas & Camarinha-Matos 2009).

To address the question of collaboration readiness, The Effective Team Dynamics (ETD) Initiative at Georgia Tech developed a curriculum based on research-driven methods of improving team

dynamics, focusing on reflective evaluation of students' own habits, skills, knowledge, and abilities.[1] The curriculum includes specific assignment requirements to explore the unique dynamics present in each new team. Using the language of CliftonStrengths®, our program helps students identify their patterns of thought and behavior in a team, name and build on their strengths, identify the diverse strengths of any team, and interpret behaviors of their team members in productive ways. By teaching both faculty and students how to approach defining expectations within a team, how to have "Crucial Conversations" (Patterson et al, 2011) when issues arise within a group, and how to give useful feedback on teamwork skills, ETD provides supportive structure and a set of tools that can help students "figure out" their individualized approach to working in teams.

The ETD initiative was originally funded as part of a broader effort on the part of its PI, Mary Lynn Realff, and others in the College of Engineering, to meet the institute's strategic goals. The initiative now involves faculty and students across the university and does not have a single institutional home. Faculty partner voluntarily with ETD with support from their Associate Chairs, which allows us to reach a variety of classrooms. These faculty incorporate grade-level specific activities within their courses but are not required to be the "expert" in team dynamics, since ETD facilitators come to classes. This approach makes faculty more willing to welcome team training into their courses. When surveyed, 92.3% of instructors agreed that "The ETD/Strengths activities were useful to my students as they worked in teams last semester."

The Effective Team Dynamics Initiative comprises both an undergraduate program and an NSF-funded graduate workshop (iCOGS) program. In both, we applied the insights from the Science of Team Science, positive psychology, and recent educational research to the question of fostering effective teams in engineering courses (Bennet et al 2010, Lotrecchiano 2013, Hall et al 2012, National Research Council 2015) and in interdisciplinary graduate research teams. Our curriculum changes target classes with a project-based learning component. These courses ranged from first-year composition offered by faculty in the School of Literature, Media, and Communication, to sophomore and senior design courses with faculty in the College of Engineering and beyond. We seek to circumvent common sources of group dysfunction. In the undergraduate curriculum, we propose that using strengths-based language to answer the questions, shown in Figure 1, "Who am I?", "How do I team?", and "How do we team?", and "How do you team?" will strengthen student teams' final products as well as enhance collaboration and inclusivity at an institutional level. Specifically, our curriculum promotes students' ability to fulfill the following learning objectives:

1. Leverage their knowledge, skills, strengths and diversity, and those of their teammates to develop innovative and inclusive approaches to global challenges.

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[1] ETD builds on a larger academic movement to apply teams literature to university education. See Borrego, Karlin, McNair, and Beddoes (2013); Cooke and Hilton (2015); M'Randa, Price, and Perez (2018) for examples of this approach.

Figure 1. ETD Questions.
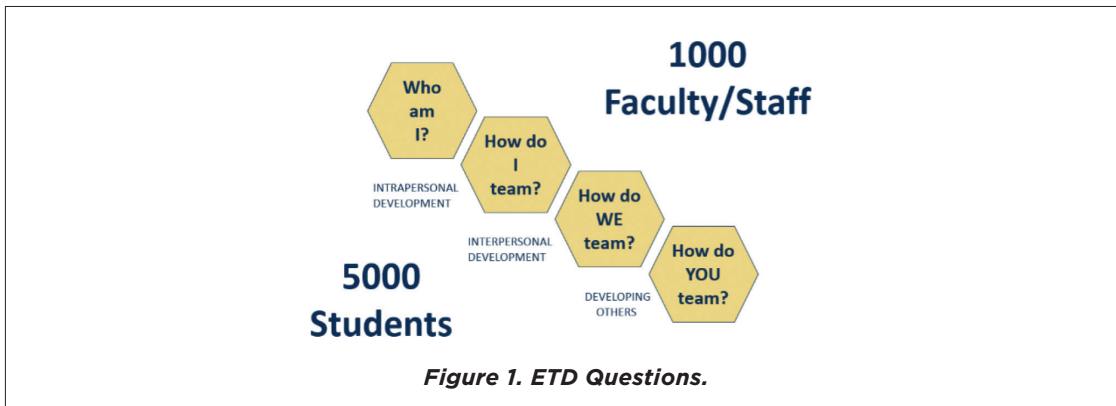
2. Deploy effective communication strategies to manage collaboration and conflict within their team.

3. Devise a plan that manages team dynamics towards completing the work that includes workload, responsibilities, quality of work, and timeline.

4. Observe and assess their behaviors that contribute to team challenges, successes, and failures and those of their teammates. Compare and contrast their own assessment and that of their teammates to modify their own and the team's strategy.

Within the curriculum, a set of activities constitutes a complete unit, which is called a Touchpoint. Each is designed to be delivered to students in various courses where they are working in teams throughout their college career. Each Touchpoint unit can be incorporated independently in a course, furthering teamwork skills and build on previous teamwork success throughout the student's college career. Figure 2 shows the pathway through the five different Touchpoints as developed and implemented at Georgia Tech, starting with the first-year seminar course and ending with the capstone design course.

Figure 2. Student Pathway through ETD Curriculum at Georgia Tech.

Figure 3. Implementation and Research Cycle.
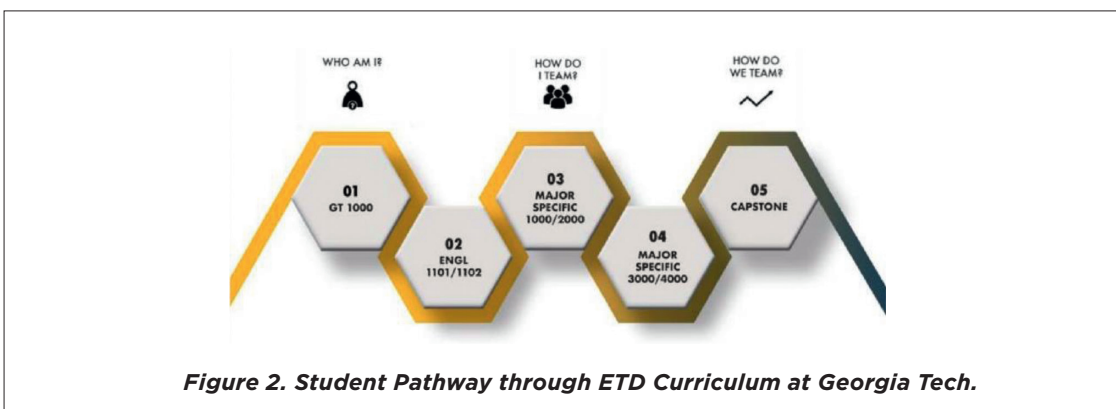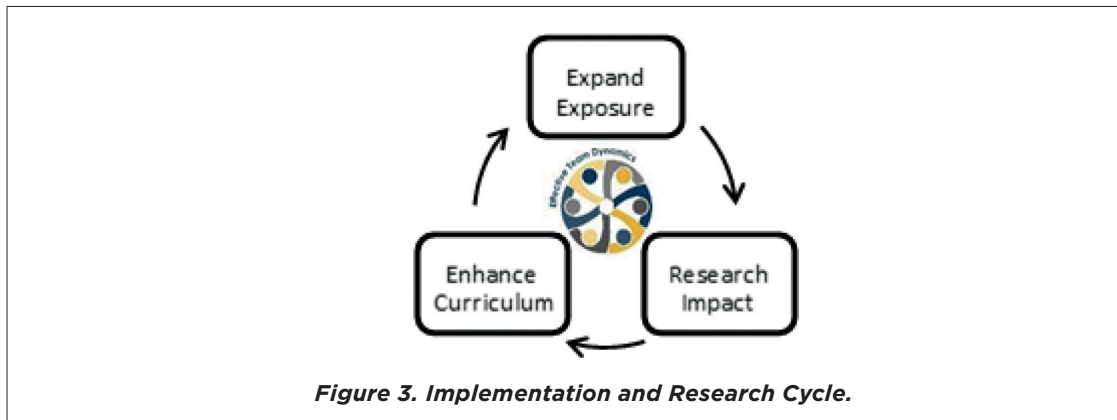
METHODS

Our implementation of a strengths-based approach in team training is based on a growing body of anti-deficit research, which highlights teammates' strengths as opposed to discovering and correcting errors or perceived deficiencies (Apfelbaum 2014; Gasman et al 2017; Harper 2010). We measure the impact of an asset-based approach on team performance using mixed methods, including quantitative and qualitative analysis. We then apply the lessons learned to curriculum development.

Qualitative data, drawn from student and faculty interviews using protocols created by our re-search team, follows the data analysis steps described by Merriam (2014) to analytically code data and categorize themes as patterns emerge. Quantitative data is collected through student and faculty surveys and tracking data. Faculty surveys of team trainings assessed faculty attitudes about team skills and their own sense of readiness to implement team training in their classes. Additionally, a series of surveys were developed and administered to assess Graduate Research Teams' training regarding participants' confidence in specific module learning objectives. Follow-up surveys were also sent to the graduate student participants to understand whether or not they were able to use the team skills they learned at the workshops.

In the future, we plan to measure "collaboration readiness" with more precision, as it is chal-lenging to objectively measure team performance across a variety of faculty expectations for what constitutes team dysfunction. The peer review materials that we have collected from students will guide the development of such a tool. Course grades vary widely based on the professor's expectations and rubrics used. Thus, we have decided against using team project grades as part of our assessment tool, since the final score does not always correlate to the team's success at collaborating.

PRELIMINARY RESULTS

A research team comprised of Georgia Tech faculty, educational researchers, and undergraduate researchers analyzed the faculty and student data. The faculty survey results suggest that while faculty believe team competencies should be emphasized in their courses, the faculty themselves may not be best suited to implement team training in their classes without external resources. The student survey data indicates that students recognize the importance of teamwork. Students surveyed believe interdisciplinary research is important and enriching. However, students have doubts about their ability to identify their own weaknesses and strengths. This supports our understanding of CliftonStrengths® as a valuable classroom intervention.

The results of graduate students' trainings showed that, on average, participants felt confident in their abilities related to understanding the importance of working in teams, the value of team diversity, and navigation of communication issues and resolution of conflict in team settings. Additionally, the follow up survey results showed that the conflict management skill that they gained through the trainings was the most utilized skill in their own team environment. Through the Effective Team Dynamics Initiative, we have already developed modular, flexible curriculum materials that train students on transportable team science competencies. We have conducted formative assessment to inform curriculum development process and further implementation. Our undergraduate curriculum is in its fourth year and has involved 1000 faculty and staff members throughout all six colleges of the Georgia Tech community. We have helped over 5000 undergraduate and graduate students who work in teams in courses or in research contexts.

NEXT STEPS

Looking ahead, we hope to study the effects of our team training on students' persistence in their intended college major, focusing on the persistence of underrepresented minority students in STEM. By training non-URM and URM students alike in healthy, professional approaches to the group work encountered in their courses, we aim to create a more equitable campus environment. Research shows that persistence in college is strongly influenced by the student's ability to develop academic and social networks (Pascarella and Terenzini, 1991; Tinto 1987 & 1993). While universities have little direct influence over the social networks that students develop, they do have more control over academic networks. Bringing team training into classes from every student's first semester on campus could build resilience and persistence in at-risk students. We plan to triangulate different data sources such as in-major persistence numbers collected by Georgia Tech, interviews, and surveys to assess the impact of teamwork training on their persistence at the time of graduation.

Our curriculum encourages faculty to shift from an instructor-based approach to a student-centered approach in their pedagogical practices through an emphasis on each student's unique strengths. The strengths insight will provide faculty an opportunity to build social networks through the course by utilizing the activities and assignments. These networks are more important than ever during the COVID pandemic. We have continued our work through online workshops for students and video lessons to support faculty. Through our team training, faculty could share in the academic support of a student's social network within the team, thus increasing persistence in STEM fields.

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