

Teams and Team Building at Baylor University: Why Should We Do This and Where Should It Occur in the Curriculum?

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Abstract

Experience with teams is a desirable outcome with employers. Academic programs often have student teams accomplish course, design, and lab projects starting with the freshmen introductory courses and culminating with capstone senior design. Where do students learn about teams in the curriculum? How do they learn to be good team members? It seems the most pervasive approach to teams in higher education is a “sink or swim” attitude where teams are allowed to form on their own and work out any issues that arise. Little, if any, formal instruction on being a team member is given throughout the curriculum. Even less instruction is given on team leadership. This paper will discuss the rationale for teams in the academic environment and the use of teams at Baylor University. Also, the paper will examine how students view teams and approach the accomplishment of team projects. This will be contrasted with the view of teams held by faculty. Some suggestions will be made to make the team experience more manageable for faculty.

Introduction

Teams have become a common feature of engineering programs as businesses describe functioning on a team as a desirable learning outcome. This outcome is highlighted by the Accreditation Board of Engineering and Technology (ABET) in their student outcome 3d which states that students should have “an ability to function on multidisciplinary teams.”¹ In the business environment, a team can be defined as:

“A group of people with a full set of complementary skills required to complete a task, job, or project. Team members (1) operate with a high degree of interdependence, (2) share authority and responsibility for self-management, (3) are accountable for the collective performance, and (4) work toward a common goal and shared rewards(s). A team becomes more than just a collection of people when a strong sense of mutual commitment creates synergy, thus generating performance greater than the sum of the performance of its individual members.”²

Thus, the purpose of a team is to accomplish a task that, in the end, results in a better, more complete solution for having been accomplished on a team and accomplished in a timely fashion. While the team is important, it is only as good as the team members and the skills they bring to the team. Being interdisciplinary and diverse is seen as favorable environment within which to generate ideas.

Important Team Topics

To improve student understanding of teams, the students should be exposed to topics related to team building, such as team and team member types. Examples of the material that might be in these two topics are given below.

Team Types

A large body of literature exists on team types and team formation, especially from the business world. There are a number of recognized team types depending on the source and definition. All have a place in the business environment and students need exposure to these team types as part of their education. Students in our programs should have an awareness of the types of teams and how they function in an organization. Common team types found in the literature are:

Functional teams perform specific functions in an organization. Sometimes they are called department teams. These teams have members from the same department or work area who meet regularly. Individuals relate to a specialty or focus he or she has mastered, with everyone working toward achieving goals outlined in the company's mission statement. A manager holds the primary responsibility, with subordinates reporting to this person. Often, these are permanent teams.^{3,4}

Cross-functional teams are when members come from across functions, or specialties, of the organization to become a team. Expert people with separate areas of specialization work together. These members are usually at about the same level, come from different departments, and often make decisions without management. Often, these are temporary teams assembled for a specific purpose.³

Leadership teams are made up of leaders from different departments to take a strategic role in guiding business decisions. The goals are aligned with the mission and vision of the company.³

Virtual teams are made up of members who are not located at the same location and may be in other cities, states, or countries. Technology is used to connect these members. These types of teams tend to be more project/task oriented. Teams can be built on strengths and weaknesses rather than geography.³

Quality circles are individuals who become aware of, analyze, and address problems that arise from the workflow of the company. The goal is to improve performance and inform management of any issues that might arise. Often these are tied to quality improvement initiatives.³

Task Forces, or problem-solving teams, are teams of experts, typically a cross-section of people, who come together to solve a well-defined and temporary challenge. They have a sense of autonomy and do not need to constantly consult superiors to get things done.³

Self-directed/managed teams are the most empowered. These teams have power to make decisions. Each team member has a particular skill that is essential to the team seeking to make informed decisions, complete assignments, or deliver services for customers. Companies that use self-managed teams give employees a feeling of ownership of the project.⁴

Team Member Types

A team is made up of team members. Team members can fall into a number of types/categories, depending again on the source being quoted. Ngo quotes Parker and lists four types of team members: the contributor, the collaborator, the communicator, and the challenger.⁵ Sussex further lists seven personality types that make a well-rounded team.⁶ They are: leader, team player, researcher, expert, planner, creative, and communicator. Our students need to become aware of their team member type and how this impacts the team in order to be more productive to a potential employer. At Baylor University, neither team types nor team member types are covered anywhere in the curriculum.

Why Work on Teams?

There are distinct advantages to working in and on teams. West lists a number of advantages, a few of which are listed below:⁷

1. Teams are the best way to enact organizational strategies.
2. Teams enable organizations to develop and deliver products and services quickly and cost effectively.
3. Teams enable organizations to learn more effectively.
4. Cross-functional teams promote improved quality management.
5. Cross-functional design teams can undertake radical change.
6. Time is saved if activities, formally performed sequentially by individuals, can be performed concurrently by people working in teams.
7. Innovation is promoted because of cross-fertilization of ideas.
8. Teams can integrate and link in ways that individuals cannot to ensure that information is processed effectively in complex structures.
9. Creativity and innovation are promoted within team based organizations through cross-fertilization of ideas.

It is important for faculty and students to understand the significance and function of teams in the workplace to add credibility to the team experience in academic programs. Teamwork can be effective and evaluating effectiveness is dependent on results and assessment.⁸ Achieving goals depends on the ability of the team to function. Teams must be assessed in order to make a judgement about the team's function and realize improvement for the next team task. So, teams are important for the workplace because, in teams, all members are working towards a shared purpose and common goal. In doing so they are also sharing their varied skills in complementary roles and in cooperation with each other.⁹ Because teams are important for the workplace, teams should be important in our academic programs.

Why Do Companies Want Good Team Members/Teams?

Lisa McGrath states that in a recent survey, teamwork and communication skills ranked among the top five qualities sought by employers. This is significant and shows the importance of teamwork to companies in their daily operations. It seems that companies are now using team building as a way to differentiate themselves from their competitors. The belief is that teams and

team building will positively impact their bottom line. This is especially true for companies such as Google, Amazon and Facebook. As McGrath states, “They recognize that team work brings about synergy - “the sum of the parts being greater than the whole” and if implemented correctly, teambuilding can make a company more productive, increase staff morale and foster innovation.”¹⁰ The bottom line is that business sees improved morale, greater flexibility and increased innovation as a result of teams.¹¹ There are any number of resources, mostly from business, that can be useful in developing teams and team skills in an academic engineering program. One particularly noteworthy resource is Patrick Lencioni who has written extensively on teams and team function/dysfunction.¹²⁻¹⁵ If our students are to be competitive, then they must learn to be good team members and display qualities such as open and honest communication, reliability, a positive mindset, flexibility, being fully engaged, and an ability to solve problems. Having these qualities and being able to demonstrate them is essential when operating on a team. Examples of successful team involvement are also important to highlight when interviewing for employment. Not just that the student was on a team but what skills did the student contribute to the success of the team. So where should teams occur in the academic environment and what training should be given to our students to make them “good” team members?

Nature of Teams in the Academic Environment

From the ASEE Conference proceedings website, there are 4,985 papers that use the words “Team” or “Teamwork,” thus, the conclusion that much has been written about teams in the engineering academic environment. As a result of the ABET requirement for teamwork, teams are found at nearly every level of the curriculum and rightly so. If we want our students to be proficient in team work we should give them opportunities to work on teams. The literature mostly deals with specific instances of teams in a course or curriculum. The literature tends to focus on how to assess teams with little consensus on the method to accomplish assessment or its effectiveness.¹⁶⁻¹⁹ A comprehensive approach to teams and team training throughout the curriculum was not readily apparent in the literature. Sheppard et al. have proposed developing teamwork through a core design thread starting in the freshman year and continuing through the senior year.²⁰ An assessment is done at each level to document student progress. While their design thread was not completely implemented at the time their paper was published, this does speak to the need for integrating teamwork throughout the curriculum. Edmonson and Summers have also recognized the lack of student preparation in teaming skills and have proposed an integrated approach which also spans the curriculum.²¹ They list eight courses in their curriculum which involve teamwork but do not give details on the teams themselves. What is of interest is a project management course taught to freshmen where students can learn skills for functioning on a team, such as understanding people, negotiating, time management, and conducting effective meetings. Needed is a more comprehensive approach to teams and team development in the curriculum. This should occur at all levels. Students must have some instruction on how to be a good team member and what being a good team member means for the success of the team.

Implementation of Teams in the School of Engineering & Computer Science

At Baylor University’s School of Engineering and Computer Science, the faculty were surveyed to determine where in the curricula, and to what extent, teams were used as a learning paradigm. In both the mechanical engineering department and the electrical and computer engineering

department, teams are used in the freshman, junior, and senior years. In the freshman year, a group project is used to integrate and synthesize the content taught in both the “Introduction to Engineering” and “Introduction to Engineering Analysis” courses, which is required of all engineering majors. In the junior year, all engineering students participate in “Engineering Design I,” where the engineering design process is conveyed via team-based projects encompassing the design, construction, and testing of an engineering device or system. In the senior year, all seniors are required to take “Engineering Design II,” where all engineering disciplines and tracks work together in teams to accomplish a variety of projects, many of which are sponsored by industry. In addition to design courses, there are nine junior- and senior-level courses in both mechanical engineering and electrical and computer engineering that require group projects.

In the computer science department, group project teams are used in all four years. All computer science and bioinformatics students are required to take seven courses, all of which require group projects in partial fulfillment of course requirements. In addition, each track in computer science (computer science, gaming, and software engineering) and in bioinformatics, have a senior capstone course required that is comprised of the application of the curricula in the design and development of a group project. Four upper-level electives in the various tracks in computer science also include a group project as part of the course requirements.

Faculty Survey on Group Project Teams

The faculty in ECS were asked to complete a survey on developing teams and team members. Each faculty were asked to respond to the following questions:

1. Do you use teams in your courses, if so, which ones and in what capacity?
2. How do you select teams?
3. Do you give any guidance?
4. How do you assess teams?

The faculty responding to the survey include a variety of team selection mechanisms, shown in order of use (Figure 1):

- Self-selection
- Interests, motivations, availability
- Ability
- Random

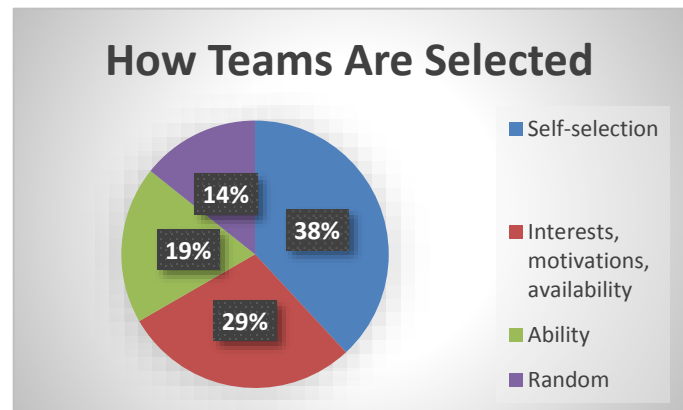


Figure 1 How Teams are Selected

The faculty responding to the survey indicated the following types of guidance provided, again, in order of use (Figure 2):

- Team leader meetings (routinely or as needed)
- Team training (lecture)
- Minimal
- No training
- Weekly meeting with feedback

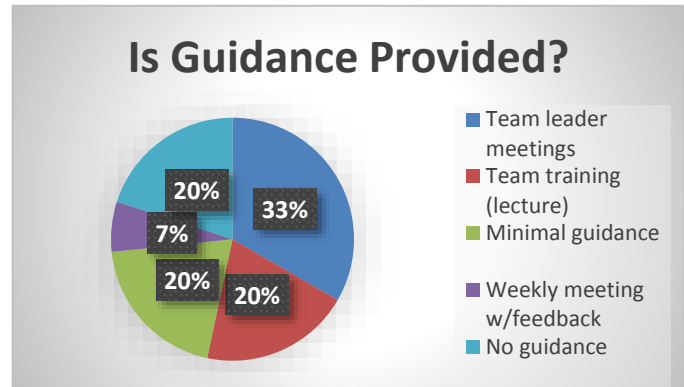


Figure 2 Is Guidance Provided?

The faculty responding to the survey indicated a variety of methods used to assess teamwork (Figure 3):

- Formative (1 or more) / Summative Peer Assessment
- Combination of individual and group evaluation
- Per team assessment by instructor
- No assessment
- Self evaluation

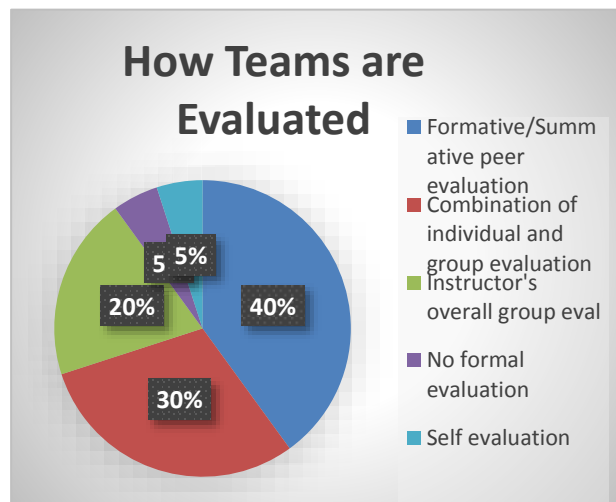


Figure 3 How Teams are Evaluated

Student Survey on Group Project Teams

In a fashion similar to that provided for faculty, the students involved in some of these project-based courses responded to a survey that included the following questions:

1. In what classes have you used teams? For what purpose?
2. How were the teams selected?
3. How was the team organized / how was the team to function?
4. How did you make sure everyone on the team learned the material?
5. How do you think teams should be formed?
6. How do you think students should be organized on academic teams?

As might be expected, the student responses to questions 1 and 2 closely followed those provided by the faculty. In other areas, we discovered based on this survey, that the student perspective differed from the faculty to varying degrees.

When the students were asked how they thought teams should be organized, the overwhelming two choices were (1) by the professor or by established roles, and (2) no formal organization, where de facto roles are allowed to emerge. There were also several indications that student roles should rotate periodically, to ensure on-the-job training for all members.

When students responded to how team members should be held accountable, a variety of methods were proposed (shown in order of selection):

- Team Leader
- Equal preparation by all team members
- No formal accountability method
- Ability to meet scheduled milestones

When students were asked about how their teams should be formed, their responses varied widely (again, shown in order of selection):

- Diversity of interests and abilities
- Student preferences
- Schedule / availability
- Random formation
- By professor

Finally, when students were asked about how their teams should be organized, their responses varied widely (shown in order of selection):

- Academically balanced
- No organization – all members help equally
- Schedule / availability
- Diversity of interests
- Knowledge of teammates' personality / abilities
- By specific roles (determined by faculty)
- Personality traits

Team Training

The best place for students to begin team training seems to be in the freshman year.^{22,23} This is the student's first exposure to engineering. It is the time to develop good habits and to state the expectations of being a good team member. At the other end of the spectrum are the capstone design classes.²⁴⁻²⁶ Senior year is where the most intensive team experiences take place in the capstone design classes. To wait until a student is a senior is too late. Thus, training on teams should take place early in the curriculum and should be reinforced often throughout the program. Sheppard et al. and Edmonds and Summers are on the correct path to look at integrating this thought the curriculum over the four (or more) years in the program. The challenge is getting faculty to work together to accomplish this goal.

While many faculty use teams, the majority often let the students self-select and then the faculty do not assess student participation in teams because of the difficulty and workload involved. It has been observed that at Baylor University, team sizes have grown from two, to three to now up to five students because of the large class sizes. Use of software, such as CATME, has helped faculty with the burdensome task of team selection and peer assessment.^{27,28} There are many questions still to be asked concerning teams and teamwork. What is the best team size? How often should teams be assessed and how should that be done? Where and how much should teams be instructed on how a team should operate? How does one show progress as a team member and what should a functioning team member look like when graduating? Thus, there are many issues with teams still to explore. What is certain is that more needs to be done to help our students be better prepared to operate on teams at their first employment. This study needs to be expanded to determine if the experience at Baylor University is typical of other universities. More importantly, a comprehensive approach to teams and team building must be developed to insure our students are competitive in the work environment.

Conclusion

Teams continue to be an important part of the engineering toolbox and team experiences are important to perspective employers. Students are required to operate on teams however; they do not receive, in general, adequate training on how to be an effective team member. Students should understand team and personality types to understand how they would contribute to a team. Training about teams and team functions would ideally start at the freshman year and continue through the senior capstone design course. Such training could go a long way to helping teams be functional. Faculty have a wide variety of team selection and evaluation processes. A comparison of student and faculty perceptions shows that they both are in agreement on some issues, such as the purpose and usefulness of teams, and have different perceptions on others, such as team organization and accountability. Responses showed faculty use a variety of approaches to pick teams. The same variety is seen in assessments. Survey responses were insightful but need more input to determine if these results were representative of faculty in general. In the end, a more comprehensive program of team development and assessment is needed for academic programs. According to the literature, no such programs exists at this time.

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