



Team-based Learning: Creating Effective Teams with Student Accountability

MATT ZACHRESON *Department of Physics*

TODD KELSON *Department of Biology*

In speaking to the Corinthians, Paul taught of the spiritual gifts we have all received, likening these gifts to the diversity of body parts, be it the foot, ear, or eye. All parts are different, yet all are of the same body (1 Corinthians 12:12-27). We can liken this to the myriad learning styles among individuals. As educators, we enter the classroom with a desire to teach all of our students at the level of their own understanding. We are all too familiar with the traditional classroom way of teaching where a lecturer stands at the front and spends the hour talking (talk-and-chalk). On the opposite end of the teaching spectrum, we find active learning where the instructor guides students in the discovery process and students learn on their own with the instructor more as a mentor (active learning). Discipline-based research has produced evidence showing that students retain very little information when taught by lecture (Lightner, 2007); however, mentored learning enhances student retention (Freeman et al., 2014). Research studies demonstrate significant gains in learning as well as student confidence using these active learning techniques

in the college STEM classroom (Armbruster et al., 2009; Bowen, 2000; Deslauriers et al., 2011).

Let's begin by defining what exactly is active learning. For the purpose of this article, we will define active learning as the process whereby students prepare in advance of class time by reading the textbook, watching online lectures, and completing reading comprehension questions. The classroom then becomes a laboratory of large group learning where students work in teams to engage in learning activities that promote higher-order thinking (apply, analyze, evaluate). Active learning focuses on students gaining skills and not just content; therefore, the classroom becomes a preparation for life skills and content knowledge.

We, the authors, teach our science courses using a modification of active learning known as Team-based Learning. Team-based Learning (teambasedlearning.org) consists of students completing preparatory materials outside of class using textbooks or online materials. To hold them accountable for their own learning prior

to coming to class, they take an individual readiness assurance test as soon as class begins. After submitting their individual answers, they take the same test with their team members. The team submits one answer sheet, and each student's grade is based on their individual as well as on their team answers. After the quiz has finished, student teams work together for the remainder of the class period to solve in-class activities based on real world problems. The instructor now becomes a mentor, instead of a lecturer.

Building Good Student Teams

Learning is maximized when students are organized into a high-functioning team. Larry Michaelson (Michaelson and Richards, 2005) gives several research-based guidelines, which are summarized below:

THE OPTIMAL TEAM SIZE IS 5-7 STUDENTS. Fewer than five leads to a lack of diversity in perspective. In order to be as comprehensive as possible in answering in-class problems, there need to be as many different opinions as possible. Students discuss their different viewpoints, and then work to compromise in finding an answer that all can agree on. More than seven leads to some students being left out of the discussion or to student stragglers; they appear to be involved but in fact are social loafers.

IT IS BEST TO KEEP TEAMS TOGETHER THROUGH-OUT THE ENTIRE COURSE. Team development of interpersonal skills and collaboration requires time, and students need as much time as possible to develop their social feet and learn the power of compromise in a team.

TEAMS WORK BEST WHEN THEIR MEMBERS HAVE DIVERSE BACKGROUNDS/ABILITIES. The best teams have a mix of high and low ability students. Additionally, one should also consider gender, college major, age, and ethnicity when forming teams. Our experience is that when it comes to gender, one should not put a person of one gender in a team with only members of the opposite gender (one female in a group of all males or one male in a group of all females). This can lead to objectifying and marginalizing that single gender. We find that it is OK to have teams that are all male or all female in classes that don't have enough of a gender to have a mix in all teams.

Matt uses the questions below to devise teams in a freshman-level Physics course:

- 1 How much do you agree/disagree with this statement: I've always loved Science.
- 2 What's the highest level of math that you've taken?



- 3 How much do you agree/disagree with this statement: Math has always come easy to me?
- 4 How confident do you feel in your abilities to perform well in physics?

Students respond to these 4 questions during the first week of class, and teams are formed with a mix of comfort levels and mathematical abilities. In major's courses, the students are sorted based on their prior physics knowledge. Additionally, catme.org offers their own team maker based on these same guidelines, with some customization options available to the instructor.

In summary, forming teams made up of diverse members can help students learn conflict resolution and how to build cohesiveness - skills that will come in handy in marriage, church work, and employment. Students learn to build unity when they can evaluate one another in a safe environment. Peer evaluation is an important tool to build this unity.

The Importance of Team Evaluations

When students are aware of their weaknesses in teamwork, they are better able to address these issues and improve, leading to deeper learning for the whole team. However, many students (especially LDS students) have a difficult time addressing conflicts (Stevens, 2013). Therefore, peer evaluations become an important part of the team activity, and students are expected to evaluate one another. Since the evaluated students receive their feedback anonymously, it makes it easier to bring up and resolve conflict.

As mentioned previously, students learn more deeply when they are expected to teach one another (BYU-Idaho Learning Model). The evaluations give team members a chance to rate how much each team member contributes to the overall team effectiveness. Since the evaluations give a measure of how much each student contributes, their overall grade is dependent on the evaluations they give and receive.

Matt has tracked his teams' performances over the two years that he has used Team-based learning. The teams that perform well quantitatively (on test scores and learning gains) are ones that exhibit the following qualities:

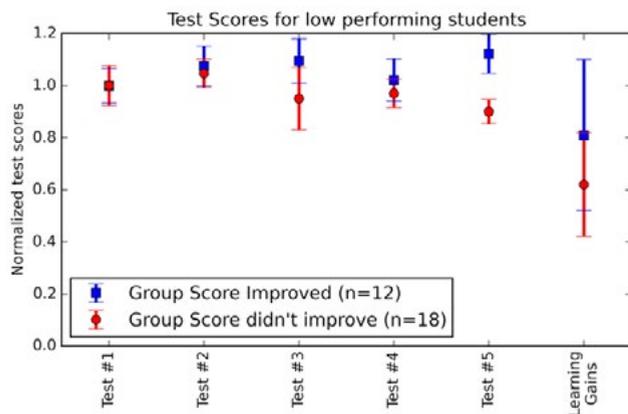
TEAMMATES HAVE GENUINE CONCERN FOR EACH OTHER'S WELL-BEING. When a teammate feels cared for, they are more likely to be well-prepared so that they don't let their teammates down. Additionally, the genuine concern lets the team debate with and challenge each other's solutions without animosity.

THE TEAM MOVES AT THE PACE OF THE SLOWEST MEMBER. As the best teams try to find solutions, they will move at a pace so that every team member is on track and understands what is going on. This requires that the team members who really understand the content remain aware of the needs of those that are struggling, and that the team has developed a rapport such that the struggling students have no qualms asking questions.

THE TEAM IS USUALLY (BUT NOT ALWAYS) ON TASK. Team members often get distracted from the teamwork, especially as the semester drags on. The best teams are the ones that can generally stay on task, but still occasionally drift off topic, allowing for some team bonding time.

In addition to observing the behaviors of high-performing teams, poring through team performance data led Matt to discover another benefit of team evaluations: they can help underperforming students perform better.

Matt selected a subset of students (n=30) who both performed badly on their first exam, and were the lowest-ranked member of their team. He then subdivided them into two groups: those whose group scores improved (n=12) and those whose group scores did not (n=18). This graph shows their test scores through the remainder of the semester:



The scores for Tests #1-5 are normalized to the students' first test score. The learning gains were calculated from students' performance on nationally recognized physics concept tests and are normalized to the class average. The data shows that the poor-performing students, who listened to and improved based on their team evaluations, did better on subsequent tests and learned more than the poor-performing students who did not improve.

Team Evaluation Methods

We can benefit by telling others how their behavior is affecting us and those around them. Feedback can be destructive to a relationship if given inappropriately. Giving the right kind of feedback at the right time is a skill that all should develop. Most of us like to receive praise for work done well as well as feedback on how we can improve.

Team evaluations give students a chance to give this feedback to their peers. Each team evaluation has two major parts. First, the students are either asked to rank their teammates or divide among them a set number of points. Secondly, students compliment their peers on work done well on the team and evaluate their peers on what they can do to improve the learning environment in the classroom.

Students have made the following comments to Todd when asked what their opinion was of peer evaluations:

I was told that I could and should speak up more in the group, which helped me to learn to say what I think and any questions that I have.

It helped me work with others better, and how to contribute as a group member.

I didn't realize at first that I appeared as being bossy or that others felt I was annoyed when we were getting low grades; they helped me a great deal to find my role with them and by the end, we really were efficient as a team.

Team evaluations work best when students can get frequent and prompt feedback, ideally at least three times a semester. To help speed up the process, and reduce the instructor load involved, Matt developed a Qualtrics survey

that, with a few clicks and a link in I-learn, will gather each team's evaluations and compile each student's scores and feedback automatically. You can find the survey and

Learning is maximized when students are organized into a high-functioning team.

instructions on how to use it at this link, or by searching for "How Do I Create a Peer Evaluation Survey" in the FRC's i-learn help guides.

In conclusion, we have successfully implemented team-based learning in our STEM courses. That is, we organize student teams that work together the entire semester. They come to class prepared and work effectively with team members to accomplish in-class activities. Our end-of-semester evaluations show that students appreciate feedback from their peers and they reach to new heights in their classroom attitudes based on these evaluations. They recognize their different strengths and weaknesses and work alongside one another to develop into lifelong learners. ❖

References:

- Armbruster, P. et al. Active learning and student-centered pedagogy improve student attitudes and performance in introductory biology. *Education* (2009) 8:203-213.
- Bowen, C. W. A quantitative literature review of cooperative learning effects on high school and college chemistry achievement. *Journal of Chemical Education* (2000) 77:116.
- Deslauriers, L. et al. Improved learning in a large-enrollment physics class. *Science* (New York, N.Y.), (2011) 332:862-4.
- Freeman, S. et al., Active Learning Increases Student Performance in Science, Engineering, and Mathematics. *Proc. Natl Acad. Sci. USA* (2014) 111:8410-8415. (doi: 10.1073/pnas.1319030111)
- Lightner, S. et al., Team-Based Activities to Promote Engaged Learning. *College Teaching* (2007) 55:5-18.
- Michaelson, Larry and Boyd Richards, Drawing Conclusions from the Team-Learning Literature in Health-Sciences Education: A Commentary. *Teaching and Learning in Medicine* (2005) 17:85-88.
- Stevens, MJ, Passive-aggression among the Latter-day Saints. *Sunstone magazine* (2013) 171:7-13.