

Extended Abstract - Implementing Team Based Learning in Freshmen Engineering Courses

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Abstract - Team Based Learning (TBL) is a specific pedagogical tool that emphasizes collaborative learning. Oftentimes TBL is confused with group activities and other active learning strategies involving student teams. TBL is distinct because it follows a prescribed sequence of individual work and group work, and includes immediate feedback as well as peer evaluation. TBL is widely used in medical, pharmacy and nursing schools and the use of TBL in engineering education is growing. The advantages of using TBL in the class room include: (1) students are held accountable for individual (pre-class) and group (in-class) work. (2) The responsibility for learning shifts from the instructor to the students, promoting lifelong learning skills. (3) The majority of class time is used for team assignments that use the course content applied to large difficult problems. (4) The students are actively engaged during class time. Furthermore, TBL is suitable for courses having as little as 12 students, but is also used in courses having up to 400 students. Therefore, TBL is an ideal tool to be used in freshman engineering courses. Implementation of TBL in an Introduction to Engineering course at the University of Alaska Anchorage in the Fall of 2013 is in preparation. In spite of all the benefits of using TBL, a possible deterrent for faculty to adopt TBL is the time intensive development of TBL modules and the lack of available support to develop and improve classroom materials. It is the intent of the authors to form a national freshmen engineering TBL support group to facilitate the implementation of TBL in freshmen engineering courses.

Index Terms – Flipped classroom, freshmen engineering, team based learning

WHAT IS TEAM BASED LEARNING

Team Based Learning (TBL) is a specific pedagogical tool that emphasizes collaborative learning. Oftentimes TBL is confused with group activities and other active learning strategies involving student teams. TBL is distinct because it follows a prescribed sequence of individual work and group work, and includes immediate feedback as well as peer evaluation. TBL effectively flips the traditional “first lecture, then homework” model used in most courses.

For each course topic or module, the following sequence is followed. First, during lecture time, the students test their knowledge of a topic assigned to study before class through the Readiness Assurance Process or RAP. Students take the RAP as an individual, (iRAP), and then they repeat the RAP as a team (tRAP). During the tRAP, each team must come to a consensus for the answers to the RAP, and they immediately check their answers using the Immediate Feedback Assessment Technique (IF-AT) form. The IF-AT form, shown in Figure 1, is a scratch off sheet in which a star is located under the correct answer.

IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)						
Name	Team 4			Test #	1	
Subject				Total	44	
SCRATCH OFF COVERING TO EXPOSE ANSWER						
	A	B	C	D	E	Score
1.			☆			5
2.	☆					5
3.				☆		1
4.		☆				3
5.				☆		5
6.	☆					5
7.		☆				5
8.					☆	5
9.				☆		5
10.			☆			5

Figure 1: IF-AT form after tRAP

Teams receive points based on the number of scratches it takes to determine the correct answer. Using the IF-AT during the tRAP is key to helping students correct misconceptions real time, and the points-scale gives the students motivation to learn to work together effectively as a team without instructor input. After all teams have completed the tRAP, students are given an opportunity to

Session F4B

submit a written appeal of RAP questions, and the instructor can give a short (10 minute) lecture clearing up any remaining confusion about the topic.

Once the Readiness Assurance Process is completed, a majority of the class time is spent doing applications. The application questions require applying the concept knowledge from the RAP to problems. Student must work together in their teams in order to come to an answer. For each application, teams report their answers to the class, the answer(s) are discussed as a whole class, and teams must defend their answer.

The final part to TBL is peer evaluation. Permanent teams of 5-7 students are formed at the beginning of the course. Two to three times during the term, students rate their team mates on their contributions to the team performance and the peer evaluation is part of the final grade.

The uniqueness of TBL is that students are held accountable for both individual work—iRAP, peer evaluations—and group work—tRAP, and applications. In addition, the responsibility for learning shifts from the instructor to the students, promoting lifelong learning skills. The majority of class time is used for team assignments that use the course content applied to larger and more difficult problems than can normally be done by individual students. Finally, the students are actively engaged during class time as opposed to passively listening to a lecture.

WHY TBL IN FRESHMEN ENGINEERING COURSES

Team Based Learning is currently used successfully nationally and internationally in professional schools such as medical, pharmacy, law, and business schools, and is gaining a foot hold in undergraduate programs in the humanities, sciences, and engineering.[2] TBL has been shown to improve the communication, team working, problem solving, critical thinking, and lifelong learning skills of students in TBL taught courses more than in traditionally taught courses.[1,2] The nature of Team Based Learning—such that the students solve problems in teams during class time, and then must report and defend their answers to the entire class—effectively gives students the opportunity to learn, practice and refine their communication, problem solving and critical thinking skills. The individual accountability for the pre-reading promotes lifelong learning skills. Since these skills are critical to being successful in industry, it is our job to give students ample opportunity to develop these skills early in their engineering student career, and using TBL as a teaching/learning technique in freshmen introductory engineering courses will do so.

Another benefit for the students is in-depth knowledge and understanding of topics that comes from solving complex problems. Students gain an appreciation for team work and

learn to work as an effective team mate. The effectiveness of team work can also be demonstrated to the students—Michaelson et al.[1], has shown that in the past twenty years, over 99.95% of the teams have outperformed their best member by an average of almost 14%, and the worst team typically outperforms the best student in class on the RAP.

Benefits for the instructor and administrators include (1) minimal team facilitation because the groups tend to develop into self-managed learning teams. (2) TBL is cost effective since it can be used in large classes using the same instructor/TA costs as small classes. (3) There are fewer worries about students not being in class or failing to prepare for class. (4) Student-faculty interactions are more like working with colleagues when students are prepared for class and instructors have time to develop personally rewarding relationships with students.[1]

PILOT IMPLEMENTATION

Two team based learning modules (iRAP/tRAP and applications) have been implemented in the Introduction to Engineering course at the University of Alaska Anchorage in Spring 2013. This course is a one credit, student success skills orientated course using the textbook "Studying Engineering: A Road Map to a Rewarding Career" by Raymond B. Landis. Chapter 6 of this textbook was used for one of the modules that took place over two class sessions. Students were assigned to read Chapter 6 before the first class session, during which the iRAP/tRAP—ten multiple choice questions— and one application were administered. During the second class session, only applications were done and one application was combined with a technique called the gallery walk.

For the first application during the second class session, the students were given a list of barriers that prevent productive action. The students had to decide which barrier was the most difficult to overcome. The application question and possible answers are shown in the Appendix. Once the teams had determined their answer, simultaneous reporting was used. Each team had four cards labeled A through D, and all teams had to simultaneously raise the appropriate card that showed their answer. The simultaneously reporting prevents that students switch their answer, and it also allows the instructor to moderate the inter-team discussion by, e.g. ask one team why their answer is a) and not d). This approach lead to a more lively discussion than was observed the traditional group discussion approach was used earlier in the semester.

The second application—performed as a gallery walk—asked the team to come up with at least three strategies to overcome the barriers mentioned in the previous application. After deliberation, each team wrote their top three strategies on the chalk board. The instructor, together

with the whole class, erased strategies mentioned multiple times. Students were then asked to decide—as a team—to determine which were the top two strategies listed on the board. (There were about 10 strategies listed on the board.) Simultaneous voting was performed by giving each team two sticky notes, and the teams sent a representative to the front of the board to place their sticky notes next to the strategies.

Informal feedback was gathered from the students asking how they liked TBL compared to regular lecture. Ninety two percent of the students said they would prefer TBL over regular lecture. Reasons mentioned included:

- team work is more fun
- interaction with team members is stimulating
- more efficient and engaging
- ability to hear other students opinion
- practice personal skills and communication
- learned more compared to regular lecture
- gaining different perspectives about the material
- it is not just sitting and listening

Based on the positive results from the pilot implementation the Summer 2013 Introduction to Engineering course at the University of Alaska Anchorage is currently taught as a TBL only course.

FUTURE PLANS

One disadvantage of implementing TBL in course is the necessary preparation time beforehand to develop iRAP/tRAP and applications. Having a support network of faculty who use TBL in their classes would greatly reduce the preparation time for faculty interested in developing TBL courses. Applications, as well as iRAP/tRAP questions, can be exchanged and improved through faculty collaboration, resulting in better posed questions/answers and a better educational experiences for the students.

It is the intent of the authors to form a national freshmen engineering TBL support group to facilitate the implementation of TBL in freshmen engineering courses. If you want to join the freshman engineering TBL support group and/or you are interested in implementing TBL in your freshman engineering course or have general questions in regards to TBL, please do not hesitate to contact the authors. General information about TBL can be found at the Team Based Learning Collaborative website. [3]

APPENDIX

Application used in the Introduction to Engineering course:

Which of the following barriers that prevent productive action is the *most* difficult to overcome?

- a) Your current non-productive actions satisfy some want that you have
- b) You have difficulties choosing to do things you don't find easy or enjoyable
- c) You are afraid to study because if you do and still fail, it will reflect on your ability
- d) You prefer to blame your failure on people or factors external to yourself

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