TEAM-BASED LEARNING TO ENHANCE CRITICAL THINKING SKILLS IN ENTREPRENEURSHIP EDUCATION

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ABSTRACT

An adaptation of Team-Based Learning (TBL) to the teaching of an introductory course in engineering entrepreneurship has been surprisingly transformative. TBL has three outcomes of particular interest to our entrepreneurship course design. First, TBL teaching is not didactic (learn-recite) but dialectic (reasoning oriented) with activities that revolve around the essential components of critical thinking skills. Second, the small-group peer learning structure dramatically increased student participation in class discussions (we have seen participation rise from 20% to as high as 70% on TBL class days). Third, the immediate (real-time) feedback associated with the TBL technique enhances real-time learning that appears to positively impact subject retention. This paper explores the "strides and stumbles" with a two-year experience teaching entrepreneurship, with and without TBL techniques.

BACKGROUND

Team-based learning (TBL) is an instructional strategy that has differences and similarities with problem-based learning (PBL). TBL and PBL are similar in the objective to promote high levels of student interaction in the class learning setting. Further, both methods require (or, work best) when students adequately read and consider subject facts and concepts in advance of class – that is, that the mind-set of the student is to *know* concepts and then use class time to *appl*y concepts. Class activities are designed less around learning facts and more on application of information. PBL and TBL use case studies to some extent as a focus of discussion to link the class to real-world problems. Differences between PBL and TBL can be summarized in two ways:

- PBL involves a small-group activity over several days that is decoupled from and does not typically require interaction with other groups in the large-group setting. In contrast, the TBL framework involves multiple group-to-group interactions within a single class period, for which instantaneous feedback on decisions and performance occurs; every group sees the outcomes of decisions by other groups in real-time at the same time. This framework draws on instructor skills in different ways, as highlighted in our second bullet-point.
- The TBL framework places different demands on the instructor. As opposed to being the so-called "sage on the stage" the teacher-centered didactic approach gives way to the instructor role as a facilitator (so-called "guide on the side"). And, while PBL and TBL do require more work in advance by the instructor, there may be required new facilitator skills within TBL to successfully manage multiple groups and their interactions in the large-group setting. The instructor must be both an expert *and* a facilitator.

Books by Michaelson *et. al* (1984, 2008) outline the theory and use of TBL in several settings (engineering, finance, social sciences). Numerous examples in medical education arose in our literature search, including a two-year observational study on TBL effectiveness at ten medical schools (Thompson et. al, 2007). No studies on the use of TBL in entrepreneurship education were found, so the present work intended to highlight key features and outcomes of TBL as implemented at the Institute for Management and Engineering at Case Western Reserve University (CWRU). A complete description of the TBL can be found elsewhere (Michaelson *et. al*, 1984), so here we simply prove a brief overview of the method as applied at CWRU. For brevity, the narrative to follow blends a description of each TBL step with additional comments pertaining to the CWRU process implementation. Overall there were seven major components to our TBL process:

1. Students study assigned readings outside of class.
2. A 30 – 45 minute "mini-lecture" is provided by the instructor at the beginning of class to answer any questions on the assigned reading and to highlight important concepts.
3. The in-class TBL process is then launched with each student individually taking a 5 to10 question multiple choice exam, the "Individual Readiness Assessment" (IRA). After 10-15 minutes the exam session is concluded and the exam submitted to the instructor.
4. Immediately upon completion of the IRA, students gather in pre-assigned groups to retake the same multiple-choice exam, this time the team deciding (or just coming to a consensus) on the correct choice. A folder is provided to each team with an immediate feedback form (IFF) so they can self-assess performance in "real-time"; this is the "Group Readiness Assessment" (GRA). Figure 1 provides an example of the IFF developed by Epstein (2009) and used in the CWRU implementation. The class reconvenes "as a whole" after the IFF and a representative from each team shares with the class their answer choice and any issues with the class. The instructor facilitates the Q&A from each group and records GRA test results on the board for all groups to see each others' results.

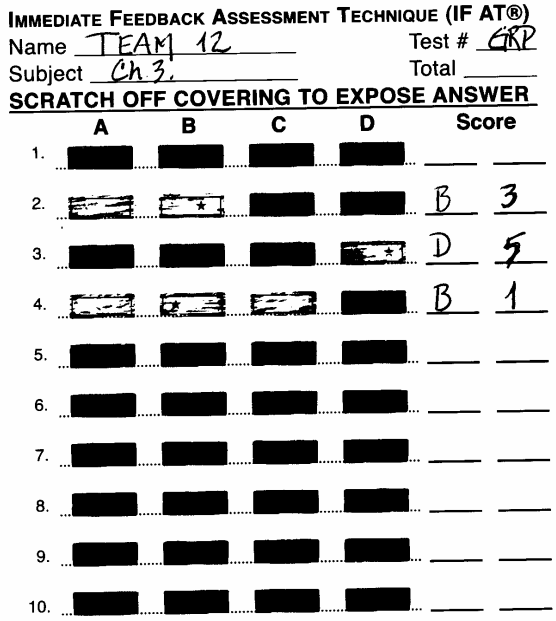

Figure 1. Immediate Feedback Form (Epstein, 2009)

5. After the instructor has a sense that critical concepts have been mastered, the students remain in their groups and proceed to the "Grand Challenge" (GC). The GC is a case application of entrepreneurship concepts in the "real-world" typically involving a mix of ethics, organizational development, finance, technology, etc. Most important is that the GC is based on actual situations with known outcomes; this is important since there is limited data presented in the problem and students are presented with one of three choices as an outcome of their problem analysis.
6. Upon completion of the GC the instructor then reconvenes the class as a whole and then, again, the instructor facilitates the Q&A from each group and records GC results on the board for all groups. The ambiguity of the problems admits multiple perspectives and the lively class discussion draws on the instructor facilitation skills to ensure class concepts are reinforced.
7. Peer evaluation is an important part of the process and was given as an after-class on-line homework assignment; to simplify the process we used the CATME system.

A critical component of the TBL process is the development of the individual readiness assessment and grand challenge. It is proposed by Michaelson (2008) that in order for the TBL to be most effective, care must be taken to adhere to the "3Ss" throughout:

- All individuals and group efforts are centered on the *same problem*.
- Course concepts are used to make and defend *specific choices*.
- The specific choices of the group work are public and *simultaneously reported*.

Overall, each TBL session requires considerable preparatory time (offline) by the instructor and along with the extensive amount of grading to be performed after the TBL, it is often remarked that TBL is a very labor-intensive technique. In comparison to the classic lecture-format, the instructor must:

- Ensure that each group is properly formed (critical with a diverse, international class),
- Foster the idea that students are accountable for their own learning (dialetic format),
- Readiness assessments and grand challenges must be carefully designed to focus on the application of specific concepts,
- Feedback to students and groups must be immediate.

As a result, TBL was used on select days throughout each semester, not as replacement for every class session.

It is important to briefly mention two instruments that facilitated the TBL implementation effort. The first concerns the formation and evaluation of teams, and the second addresses the measurement of critical thinking skills.

1. The CATME tool was developed by a team lead by Matthew W. Ohland, Associate Professor, Engineering Education, Purdue University (CATME, 2008). This was a highly effective tool that helped in team formation and gathered peer evaluation data to assess team member effectiveness.
2. The Critical Thinking Skills rubric developed by Washington State University (2008) was used as a self-assessment technique for each student at two points throughout a given semester. Though elective self-assessment is limited, the form allowed the instructor to develop a sense of student progress on the development of CTS. The process of assessing CTS is not a part of the conventional TBL process, it was simply introduced as a way for the instructor to begin establishing some cause and effect between teaching techniques and student CTS outcomes.

STRIDES AND STUMBLES

Changing the direction of a course from simply presenting and testing on concepts to the situation where students are required to use the concepts is potentially risky. The present work was not without some "learning moments" and for the sake of simplicity we have divided the discussion into "strides and stumbles." Four unanticipated "stumbles" occurred:

1. **Increased workload**. Although several case studies warned about the increased workload associated with TBL, these warnings were not taken seriously. Failure to anticipate preparatory and grading time suggests that TBL novices try to identify a colleague to help launch TBL or where team-teaching can be accommodated.
2. **Grading complexity**. TBL is a multi-dimensional process and at least five elements of the process can be subject to grading or general assessment (IRA, GRA, GC, Class participation, Peer Review). Developing a grading profile to weigh the various elements and integrate into a single TBL "grade" required several iterations.
3. **Tolerating silence**. At the outset and for some subsequent TBL sessions, students or groups may have to pause for some time prior to answering a question or responding to a comment. The natural inclination of the instructor was to jump in to "help" but this interfered with allowing the students time to "process then report."
4. **Simultaneous coaching and evaluation**. During the phase of the process involving groups "reporting out" a single instructor must manage the process of coaching with questions while simultaneously evaluating student reasoning. This is an overwhelming (tiring?) aspect of the TBL experience. Add observers to the class.

It seemed that the (long-term) "strides" associated with TBL outweighted the (sort-term) "stumbles" and could be characterized in three ways:

1. **Enhanced class participation**. The entrepreneurship course weighted class participation as much as 25% of a student grade. Thus the instructor has a mechanism for monitoring class participation in a grade book. Prior to TBL the class participation was at the 15%-25% level. Student participation in class discussions was as high as 70% on TBL class days.
2. **ESL engagement**. Although diversity is welcome in entrepreneurship discussions, typically English as a Second Language (ESL) students (and even shy domestic students) seem reluctant to share their opinions in the larger class sessions. The small-group supportive structure appeared to encourage many to speak up; particularly when these students represented their group, they had some prior peer approval which seemed to empower them to share their thoughts.
3. **Improved class readiness**. Anticipating the IRA prior to class, many students (self-reported) that they made a stronger effort to at least review chapter materials prior to class. Recitation of chapter concepts in class discussion underscored that some form of preparatory work had been performed.

IMPACT ON CTS

End-of-semester evaluations for 3 consecutive semesters revealed the memorable and enjoyable class experience provided by the TBL experience. But to several critics a question remained: "Was this just fun or was it educational?"

Activities to improve student CTS – long before the implementation of the TBL – included the selection of the University of Washington CTS rubric for data collection. Although a significant amount of data has been collected, it is illustrative to point out changes in just one dimension of the CTS. As shown in the chart below, there was a dramatic change in the ability to "develop an individual hypothesis" before and after TBL. While the nature of the data collection method is subject to more scrutiny, instructor evaluations of student essays concur with the statistics and suggest a causal relation.

		Develop individual hypothesis	
		2008	2009
Week +6	Mean	4.320	4.429
	SD	0.912	0.598
Baseline	Mean	4.267	4.139
	SD	0.640	0.816
Delta	Mean	0.053	0.290
	SD	0.272	-0.218
Imrovement Mean		**1.2%**	**14.5%**

Figure 2. CTS improvement: Develop Individual Hypothesis

SUMMARY

Entrepreneurship requires the ability to make choices within a context of ambiguity and limited data. Moving from individual, quantitative, directed thinking about a well-defined engineering problem to unbounded, qualitative, self-directed decision-making challenges many students, and our experience is that TBL has an impact on fostering these competencies. We have also discovered that implementing TBL takes what is otherwise a "large" class (40 students) and restores a "small class" feeling.

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