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Communications of the Association for Information Systems

Traditional, Hybrid and Online Teamwork: Lessons from the Field

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Abstract:

Preparing students to work in teams benefits learning experiences and provides a stronger foundation for the challenges of the workplace. Team-based learning (TBL) is an instructional strategy where small groups become closely coupled teams through repeated face-to-face collaboration on various projects and assignments. This paper illustrates how traditional team-based learning can be extended to the online environment. Different techniques are discussed based on the use of computer-mediated tools in hybrid (a mix of face-to-face and distance learning) and in completely virtual settings (without face-to-face interactions). Based on experiences gained through implementations of TBL in various courses, this article presents implementation options as well as the challenges of team learning in various environments.

Keywords: team-based learning, online learning, computer-mediated instruction, virtual teams, e-learning technologies

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I. INTRODUCTION: HELPING RICHARD THE ATHLETE

Small group student interaction facilitates active participation and engagement in any learning environment. Many instructional strategies use team activities, and many approaches to teamwork have long been proven beneficial to student learning [Bruffee 1993; Kagan 1994]. We experimented with a specific approach to team learning and supplemented it with the introduction of computer-mediated communication (CMC) tools. Team-based learning (TBL) is an instructional strategy initiated by Michaellesen, Fink, and Knight [2002] as a means to extend and enrich learning through repeated small group interaction. In this paper, we describe our journey from a face-to-face TBL implementation with minimal CMC, through a hybrid implementation (a mix of face-to-face and distance learning), and then to a completely virtual environment (without face-to-face interactions). This journey was undertaken in order to accommodate diverse learners' needs and to provide an opportunity for all students to engage in team-learning experiences that mimic the needs of their future workplaces.

As an instructional strategy, team-based learning (TBL) has been deployed predominantly in the face-to-face classroom. Content is grouped into modules delivered throughout the semester using an iterative process: module preparation, readiness assessment, and activity application.

Each module begins with a "module preparation" phase requiring students to study before the first face-to-face meeting of the module.

The "readiness assessment" phase follows, with the objective to measure preparation. It includes an individual readiness assessment test (iRAT) as well as a team test (tRAT) completed in class.

The "activity application" phase follows, with the goal to engage teams in discussions and structured knowledge sharing activities [Michaellesen et al. 2002].

The success behind face-to-face TBL is the high synchronicity of each phase and task (activity) within each module. The module phases, which are iterative in nature and are designed to reinforce learning, require a strong alignment with the preceding modules. This synchronicity is somewhat challenging to replicate in an asynchronous (online) environment, as discussed later in this article.

To illustrate how TBL works in practice and where CMC tools benefit learning beyond the face-to-face classroom, we introduce the "real" story of Richard. Richard is a student athlete completing his dual degree in business and MIS, while managing athletics, campus activities, and other commitments. Using Richard's example (and many other similar experiences), we identify ways that computer-mediated tools coupled with TBL strategies can enrich the learning of our "always-dynamic" student population.

Richard is an undergraduate student taking Systems Analysis and Design (SAD) in a face-to-face classroom. His time is fully booked with several commitments. In particular, his volleyball game schedule requires him to travel during the academic semester, limiting his ability to meet face-to-face outside of class time. Before he attends his SAD class, Richard carefully reads all instructional materials and related book chapters and prepares notes for the readiness assessment test. Upon arrival to class, he shares his notes with his team members and begins to take his individual readiness assessment test (iRAT), using the notes he has prepared. Following the iRAT, he works with his team on the same test to reach consensus on the correct answers. Richard disagrees with his team about a few test questions. After each team member shares his/her own thoughts on the valid answers, eventually the team reaches consensus for all test questions and submits their team test (tRAT) for grading. For the remainder of the class, Richard and his team work on applying what they learned through in-class activities.

Upon arrival to the next class, both individual and team test papers are returned to the students. Richard's team notices that one test question did not receive proper credits, leading the team to a formal tRAT appeal, which needs to be prepared outside of class time. In the next session, the appeal is reviewed by the instructor, who finds some design ambiguity issues with the test question and considers the team's appeal valid. Without the opportunity for the team to connect outside of class time, credits would not have been given back to the team for the question corresponding to the appeal.

In this real TBL scenario, Richard enjoyed his team interaction experience. However, he complained that it was difficult to keep track of his team activities outside of the face-to-face classroom. In particular, when he was out of town for game related obligations, he wanted to be able to participate in the team discussions and contribute to his team assignments remotely. For Richard, an effective TBL experience must extend online.

Richard, like many other students with external commitments (e.g., athletics, family, and campus activities) can benefit from the flexibility of the computer-mediated (virtual) environment. Virtual learning environments can supplement the face-to-face classroom by extending learning and student interaction beyond class meeting times. There is also a time saving benefit to redirect tasks, such as appeals in TBL, to the virtual environment, making better use of face-to-face classroom time.

For instructors (like ourselves) trying to replicate and evaluate TBL's success in computer-mediated environments, we found a number of aspects that should be taken into account when moving from synchronous to asynchronous learning. For example, the direct transfer of traditional TBL to a virtual environment unveils the non-linear nature of computer-mediated communication. This contrasts with the linear instructional strategy behind traditional TBL. Moreover, the instructional strategies used to increase active learning in face-to-face (F2F) classes often differ when they are transferred to hybrid environments (where F2F meetings are interfaced with online activities and communication) and differ even more when extended to distance learning courses (where students never meet but use collaborative software tools to communicate with the instructors and their classmates).

This article extends Michaelsen's [2002] team-based learning instructional strategy beyond the face-to-face classroom. It discusses implementation strategies for different levels of computer mediation (hybrid or completely online) across multiple semesters and multiple undergraduate and graduate Information Systems courses. Our discussion is supported by assessment studies on the impact of computer-mediated TBL presented in other outlets [Gomez et al. 2007]. The key point is that the TBL iterative module process for the computer-mediated classroom and for distance learning cannot be migrated as-is from traditional TBL. Our goal is to provide a summary of lessons learned from multiple implementations that we undertook in two different universities in the Northeast and West of the United States (in courses such as Systems Analysis and Design, Principles of Information Systems, Database Management, and Business Intelligence).

The next section, Section II, provides a summary of traditional TBL environments. Section III introduces the use of TBL in computer-mediated environments for hybrid and distance learning. Section IV presents key opportunities and the challenges of computer-mediated TBL to date. Section V summarizes findings and highlights future work. Each section presents lessons learned from actual TBL implementations.

II. TEAM-BASED LEARNING OVERVIEW

Team-based learning is an instructional strategy that uses small group interaction to achieve increased educational effectiveness. To date, it has been adopted primarily in the face-to-face classroom. TBL is founded on constructivist learning theories and its related applications, such as cooperative learning, an instructional strategy whereby organized small group activities depend on the social exchange of information among learners. The driving forces behind TBL are based on team dynamics (group interaction) that impact both the individual and his/her role in the team, and the team's role in the classroom. Team interaction can "*develop to a point where the individual inputs result in an outcome better than the best individual and better than the sum of the parts*" [Watson and Michaelsen 1988]. Naturally, team-learning outcomes do not necessarily reflect evenly distributed individual learning outcomes. Individual team members could still learn little, or 'free ride' in a high performing team. This is where Michaelsen's approach stands out. With its careful balancing between multiple individual and team activities, TBL is well positioned to achieve high team-learning outcomes while leveraging better individual learning experiences. Two key factors associated with this successful dynamic include: *accountability* at the individual level, and increasing the intrinsic motivation of *learning from others* [Kluge 1999].

The effectiveness of team learning has been researched for some time [Johnson and Johnson 1999; Watson, Kumar, and Michaelsen, 1993; Shaw 1983; Steiner 1972]. An extensive discussion of this research is beyond the scope of this article, which provides references to earlier literature for an in-depth discussion of the "if" and "why" of TBL. The main objective of this article is to provide examples and lessons learned from recent implementations of TBL approaches in hybrid and online environments. We, therefore, focus on the "*how*" and "*how not to*," with the hope of providing practical guidance to future successful extensions of a noteworthy instructional technique, which we describe and extend.

Traditional Team-Based Learning in the Classroom

Michaelson's traditional TBL phases, adapted to our instructional settings, are represented in Figure 1 and reflect the reiteration of individual and team work for each phase of a module, both inside and outside the classroom. A module generally consists of two to three meetings grouped by, for example, topics such as "information systems strategies," "data management," and "business intelligence." The main emphasis of TBL is the linear organization around work modules across the semester, consisting of five to seven three-phased sequences:

- 1) Module preparation
- 2) Readiness assessment
- 3) Activity application

Figure 1. Learning Activities of Traditional Team-Based Learning

Within the three phased sequence, personal accountability is reflected in individual module preparation, individual readiness assessment, and individual deliverables for activity application. Learning from others is reflected in the team readiness assessment and activity application, whereby teams discuss course materials through cases and applications. Teams vary between five to eight members who work together for the duration of the course.

To reinforce learning and the recall of materials learned, module concepts are applied from the preparation to application phases where teams engage in problem solving activities [Michaelson et al. 2002]. Within a typical semester, students will advance to a new module five to seven times providing several opportunities for accountability and for learning from others, thus strengthening the key factors associated with successful team dynamics [Kluge 1999]. The key novelty of the TBL approach is that the instructor does not engage in any - or very few - lecturing activities and only acts as a facilitator for team-based learning [Michaelson et al. 2002].

As summarized in Table 1, all reading materials for the module are assigned during the module preparation phase. Students work individually on the reading materials outside of the classroom and need to allocate ample time for the readings. At the beginning of a new F2F class period, students take the readiness assessment test individually. Upon completion of the individual readiness assessment test (iRAT), students gather in their assigned teams and take the same readiness assessment test (tRAT). Upon completion of the tRAT, teams can appeal questions

marked wrong. The appeal process generates further discussion among team members, providing another opportunity to reinforce learning and the discussion of class materials.

During the activity application phase, which might last for two to three classes, team assignments (case study, problem solving tasks) related to the module are introduced. Teams work together to produce a final product(s) in-class. Once all teams complete an activity, knowledge sharing across teams takes place during the same class meeting time. In addition to phased learning modules, peer evaluations can be introduced at the course level (see course organization in Figure 1) to assess individual satisfaction with team deliverables and perceptions of individual and team performance (accountability).

Table 1. Traditional Team-Based Learning Phases per Module

Activity	Activity Location
(1) Module preparation (individual)	
Students complete the assigned readings for the entire module and prepare for the readiness assessment phase by focusing on module concepts.	Outside class
(2) Readiness assessment (individual and team)	
Students complete the individual readiness assessment test (iRAT).	In-class
Teams complete tRAT (same iRAT test as given to students individually for the module).	In-class
(3) Activity Application (individual, team and class)	
Students complete supplemental activity materials (additional readings and mini-assignments) needed for team activity.	Outside class
Students participate in team activities. Activities begin with a discussion of the topics, initiating an information exchange process that proceeds on rotation until all team members have contributed to the interaction.	In-class
Students share activity results across teams and provide feedback to each other.	In-class
Instructor presents supporting materials to the class whenever s/he realizes that further elaboration is needed.	In-class
(4) Peer evaluation (individual)	
Students participate in peer evaluations which are conducted at least two times per semester (interim/mid semester and end of semester).	In-class or outside

Lessons Learned and Challenges in the Traditional Classroom

Time (or lack thereof, or its uneven distribution) is the constant challenge of TBL implementations, regardless of the delivery environment (F2F, hybrid, or online). In the traditional classroom, the linear nature of each work module smoothly accommodates the face-to-face meeting times where students attend classes following a clear (registrar determined) course schedule. However, activities outside of class are not recommended or necessary because all active learning components are completed in the F2F classroom. In our F2F classrooms, we observed some teams needing additional time to complete an activity or to better identify possible grounds for appeals of test results. Students with excused absences, such as Richard's, are also limited to contribute.

Another time related challenge in the face-to-face TBL process is the length of time spent on completing the individual readiness assessment test. Some students need more time than others. Others are constantly arriving late to class and their lateness may disrupt the team discussion of the test answers and the team consensus on these answers. Finally, the in-class activity completion time may also vary per team, leaving limited space for general inter-team dialogues, which are often engaging and allow the instructor to clarify content and learning material.

Computer mediation supports a better time management practice, since many activities can be completed independently in an asynchronous context at the student's own pace. Students who need more study time can have unlimited access to materials available in an online repository. Taking advantage of a shared repository that extends classroom activities and can better consolidate and codify outcomes has been one of the main drivers of the authors' exploration of TBL in computer-mediated settings; this approach is described next.

Ironically, while many time constrained aspects of the F2F classroom have been mitigated by transferring the activities online, a number of additional, still time related, problems have surfaced with the virtual experiences. We offer these experiences as "food for thought."

III. COMPUTER-MEDIATED COLLABORATION ENVIRONMENTS FOR TEAM-BASED LEARNING

The amount of computer mediation introduced into the TBL classroom impacts the techniques, tools, time, and coordination of modules and activities. The hybrid and the completely online courses herein described differ in approach (and results). This suggests that the transfer from face-to-face TBL to online TBL is not necessarily incremental, and its success is contingent upon experimentation and practice in both hybrid and completely online classrooms.

Computer mediation can be used for any of the general components of the linear TBL modular process. Collaborative CMC environments are designed to facilitate and aid in the consolidation of deliverables. They enable managing feedback in a central online repository, and thus are particularly useful in a TBL environment. To maximize the learning benefits associated with computer-mediated learning, the best fitting collaboration technologies that support the learning tasks need to be identified for each module. The use of a single learning management system (LMS) such as WebCT, WebBoard, Blackboard, or the open-source Moodle, may suffice. In some cases, multiple tools and the use of ad hoc collaborative applications may benefit learning by increasing the communication flexibility, which is currently weakly embedded in single LMSs.

Nevertheless, caution should be taken to avoid cognitive overload. We experimented with different tools across courses (Skype and desktop sharing applications), but we only used one LMS per course, to help identify the most effective learning environments that provided the best task-technology fit (see Figure 2 in the appendix which shows our mapping of LMS tools across various TBL tasks).

TBL in the Hybrid Classroom

The hybrid classroom introduces a mix of in-class F2F instruction coupled with out-of-class (online) computer-mediated instruction between class meeting times. Adapting TBL for the computer-mediated classroom allows the instructor to proactively assess and adjust the flow of team interactions based on both in-class and online learning progress. Table 2 identifies the key changes we implemented and are currently using for each phase of a module for the hybrid classroom, based on the list of activities that characterize the TBL process in Michaelsen's original work. Table 5 of the Appendix also shows the comparison across implementations (F2F, hybrid, and online).

In the hybrid classroom, a new module begins online with module preparation (phase 1). For instance, in our graduate Systems Analysis and Design class, students were assigned reading materials from both the course textbook and refereed journal publications about one week before the readiness assessment phase. To reinforce module preparation, students were asked to individually post a short summary in WebBoard (one type of LMS that offers an online discussion board) from one of the textbook chapters or from one of the articles corresponding to that week's module. Each student from the classroom was also asked to respond to another classmate's summary. Students were also encouraged to prepare with readiness assessment notes to share with their teammates.

Initially, we had students arrive at the F2F classroom where the iRAT was administered. Upon completion of the individual readiness assessment test (phase 2), students joined their teams to take the same readiness assessment test as a team. Thereafter, we moved the individual readiness assessment test online. The appeal process was also moved to the CMC environment to maximize the use of in-class time to discuss new materials or to clarify content. Moreover, we found this especially useful since not all teams would appeal questions and the number of appeals per team would vary.

During activity application (phase 3), a portion of the classroom activities, including the sharing across teams (discussions), was also moved to the computer-mediated environment. This provided an opportunity for the instructor to follow each team more thoroughly, allow for discussion time, and use some of the in-class time to address new topics / issues.

In our example (above) from the hybrid graduate Information Systems Principles courses, the readiness assessment tests (iRAT and tRAT) were administered in class at the start of a new module. An activity was then assigned which began in the classroom and then continued online. Each team had their own online workspace for exchanging ideas and submitting answers to assigned tasks. The Appendix presents one sample assignment (a case study) that illustrates the requirements and activities teams were required to complete (see Table 4).

Table 2. Hybrid Team-Based Learning Phases per Module

Activity		Activity Location
(1) Module preparation (individual)		
	Instructor assigns reading materials using the learning management system (LMS). Reading materials remain available online for consultation throughout the course.	Outside class
	Students post short summaries or RAT notes in their team forum. Short summaries are designed to team discussion, whereas, the RAT notes are designed to share before taking the iRAT.	Outside class
(2) Readiness assessment (individual and team)		
	Students complete the Individual readiness assessment tests (iRAT) online (for some implementations) by using utilities, such as quizzes and survey tools available in most LMSs.	Outside class
	Teams complete the Team readiness assessment tests (tRAT) in the face-to-face classroom. In-class tRATs allow sharing of answers and free discussion within teams. Such synchronous discussions are not easily transferable online.	In-class
(3) Activity Application (individual, team, and class)		
	Students prepare to engage in team activities by reading newly assigned supplemental materials, cases, and mini assignments.	Outside class
	Teams engage in activities that begin in the face-to-face classroom for synchronous interactions. Activity discussions but may continue outside of the classroom based on activity complexity.	Primarily in class – can continue outside class
	Classroom teams share activity results beginning in the F2F classroom. Discussions place emphasis on key points and continue online as needed for thorough clarifications and enhanced discussions.	Primarily in class – can continue outside class
	Instructor introduces (i.e., mini lecture) supplemental learning materials or clarifies points raised during the sharing process on an as needed basis.	In-class
(4) Peer evaluation (individual)		
	Students complete peer evaluations (interim/mid semester and end of semester) online through data collection mechanisms (such as the survey tools of LMS).	Outside class

Lessons Learned and Challenges in the Hybrid Classroom

The key to success within the hybrid environment is to maximize synchronous interactions (where all group members are present) in the face-to-face classroom. This can be done, for example, by moving non interactive components online (individual preparation, iRAT, appeals). The team readiness assessment tests (tRAT) continue to work well in the face-to-face environment where the instructor can moderate and control the coordination of activities.

A major challenge remains when trying to advance along a linear continuum (the TBL modular approach) in the asynchronous environment, which is, by nature, often more amenable to hyperlinked navigation. In practice, during the F2F meetings the instructor continues to coordinate, control, and supervise the activities throughout each phase, as if he/she were managing the traditional face-to-face classroom. However, the management of class time and F2F activities is greatly enhanced by the opportunity to delegate specific tasks to the computer-mediated environment. This leaves more class time for synchronous team readiness assessment and activity application tasks like solving problems and case studies.

Other challenges typical of online environments rest with students who shall be named “the laggards.” For example, sequencing the timing of online contributions becomes almost essential. Some students tend to post their answers right on the due date. This causes a “rush” to complete the assignment, with quick contributions that may not necessarily be of high quality. One option to bypass this problem is to require each student contribution to differ from the preceding contributions, which may in turn push students to post earlier. Another strategy would be to establish daily deadlines (first post on Monday, second on Tuesday, third on Wednesday, etc.).

TBL in Distance Learning Courses

In online courses, many of the techniques used in the hybrid classroom can naturally be leveraged, although some techniques become more complex. We identify key adjustments from hybrid to our online implementations (Table 3). Access to the reading materials for module preparation (phase 1) is still online. Students learn the module materials at their own pace based on the module dates posted by the instructor. Students move ahead to take the online individual readiness assessment (phase 2) test by a specific due date. The team readiness assessment test is also completed online by the team and is followed by the appeal process. Both the tRAT and appeal have separate due dates. All these activities are asynchronous, that is, they do not require students to interact at the same time. However, they do require individuals and teams to complete assignments within specific deadlines in a linear manner (iRAT, tRAT, appeal). The activity application (phase 3) is completed online utilizing team interaction areas (such as discussion boards) where the instructor actively monitors progress within the team's working area. As illustrated in Table 3, the peer evaluation (phase 4) can be implemented in the same manner as the hybrid environment.

Table 3. Distance Learning Team-Based Learning Phases per Module

Activity	Activity Location
(1) Module preparation (individual)	
Students use the LMS (same as hybrid).	Outside class
(2) Readiness assessment (individual and team)	
Students complete the iRAT online (same as hybrid).	Outside class
Students complete online for the tRAT with an alternate approach (i.e., asynchronous feedback through a discussion board). Online tRATs cannot be easily transferred to an online environment in collaborative testing systems, unless students use desktop sharing tools to complete a test together while conducting a conference call.	Outside class
(3) Activity Application (individual, team, and class)	
Students prepare to engage in team activities by reading supplemental materials, cases, and mini assignments (same as hybrid).	Outside class
Students complete case reviews and online discussions in the LMS. Discussion effort for students is generally higher and some team may decide to meet F2F to brainstorm.	Outside class (some teams may also meet)
Students build summaries for discussion and activity completion. Emphasis on synthesis of key messages posted in the discussion boards is essential. Capturing key points visually (through documents and presentations) is a critical component to facilitate streamlined classroom sharing.	Outside class
(4) Peer evaluation (individual)	
Students complete online (same as hybrid).	Outside class

The online-only transition can complicate the flow of activities. For instance, in one of our undergraduate System Analysis and Design courses, individual students were asked to draw a context-level data flow diagram (DFD) for a specific information system, and their teams worked on the same DFD afterwards. In the face-to-face class, individual students drew their own DFDs, using Visio software or simply using paper and pencil. The team then discussed all key components that should be included in their context-level DFD based on prior individual thoughts. Team members sat together around a workstation and opened one Visio file to modify the DFD with all team members' input.

When a simple class activity like the one described is transferred to hybrid or online classes, the process changes. First, individual students need to post their own contributions to an assignment entry created by their instructor in an LMS. Then, the team needs to use the discussion board to share their preferred strategies for drawing the context-level DFD. To control this process, instructors generally end up using two different functions in the LMS. One is the "assignments" function, wherein each individual effort can be documented before sharing. The other is the "bulletin board" wherein the instructor can assign teams and ask for a follow up discussion, only after individual students have submitted their own DFDs. This aspect is rather cumbersome, as current LMSs do not offer easily controllable sharing features (unless another desktop sharing application is utilized, requiring synchronous interaction and the instructor's simultaneous presence to review such interaction).

Lessons Learned and Challenges in Online TBL

In an asynchronous learning environment (which is by default the nature of online courses) students need to schedule their preparation carefully so that it can take place before other team activities. The instructor schedules the individual readiness assessment (iRAT) first, followed by the team readiness exercises in asynchronous mode. Synchronicity in the team readiness activities would be ideal, but challenging for students who work full time and opt for online courses to ensure flexibility in their schedules.

In our institutions, we are unable to enforce synchronicity in online learning as the population of students that self-selects for distance courses relies on asynchronous activities (to be completed at a variety of times). Some students may be able to work at the beginning of the week, while others work only at the end. Instructors implementing TBL online may need to consider alternative activities and morph tasks in a way that accommodates a more flexible schedule (the students should have the flexibility to use the weekends or late evening hours to complete activities). This is necessary, not only because of the student population's work commitments, but also since many of the traditional in-class TBL discussion activities are more time consuming when transferred online. Activities that could be traditionally completed in a 3-hour timeframe may now extend to a week-long discussion due to the lack of immediate feedback and the overhead of reading multiple messages posted at different times.

Clearly, this may be one of the strengths of online TBL. It enables capturing a copy of the discussion at a deeper and more informed level than the spontaneous interaction within the class. It also enables easy tracking of contributions for each individual student, who might have felt less compelled to speak in the classroom. Nevertheless, the time lapse between activities challenges the instructor's ability to advance the course in the same linear manner as in the face-to-face and hybrid classrooms. It also requires adapting the deliverables, as well as managing reminders, and the "last minute" submission spree typical of distance learning courses. Asynchronous and Web-based environments are typically more suitable for non-sequential and hyperlinked navigation and the linear nature of TBL is weakly mapped by current LMS tools. Hence, the advantages of the flexibility seem quickly overshadowed by its same disadvantages (too much flexibility).

To offer practical guidelines, Table 5 in the appendix presents a comprehensive list of TBL components and compares their progressive adaptation to the hybrid and online models described in the previous paragraphs.

IV. KEY OPPORTUNITIES AND CHALLENGES IN TBL IMPLEMENTATIONS

In this section, we introduce key opportunities and challenges for both hybrid and distance learning courses using TBL. These aspects have been extrapolated from our TBL experiences and a review of relevant aspects in earlier research. Although not exhaustive, the list of opportunities and challenges is a preliminary guide to aid other implementations.

Opportunities Across Learning Environments (from F2F, Hybrid, to Online TBL)

It's You First!

Individual student preparation plays a key role in TBL, no matter how enriching the team-learning experience may be. Before students engage in teamwork, it is essential for them to complete the preparatory tasks that characterize Michaelsen's approach. Individual preparation (module preparation and individual activity application) is instrumental to the execution of team tasks. Students' knowledge (readiness to engage) before entering the traditional classroom or an online class can also impact the instructional strategies used, causing the instructor to adjust assignments as the semester progresses.

The assessment of individual preparation ensures accountability [Michaelsen et al. 2002]. This is why the use of evaluation instruments such as the individual readiness assessment test (iRAT) is a fundamental component of the TBL model. Its implementation increases the motivation to prepare by increasing accountability through repeated testing. While our interest is to increase intrinsic motivation, the consistent use of individual quizzes acts as a strong extrinsic motivator as it identifies and isolates the individuals that are not ready to engage in team discussions. With the iRAT results available, the instructor can quickly set up remedial mechanisms.

You Are Only as Strong as Your Weakest Link!

TBL implementations focus on accountability as a key to foster healthy and fair team-learning environments. Nevertheless, focusing only on motivating individuals through external factors (such as performance on iRATs and individual activities) misses the point. It is worth repeating the cliché that "teams are only as strong as their weakest links." With its focus on team deliverables, TBL pushes higher performing students to step in to engage, tutor, and support weaker (or less motivated) team members. This is why both individuals and teams are accountable for their deliverables. After all, this is not different from the workplace where co-workers need to step in to make sure that the

quality of the final deliverable is acceptable to the manager. Recognizing the extra mentorship and work that dedicated individuals put into the activities is an essential component of making sure that each team will evolve into a cohesive group, which is the essence of what TBL wants to achieve. As one student stated:

My teammates were a lot of help. When I didn't understand they would explain more to me... I learned a lot from them.

Opportunities in Online TBL

Still Watching You!

Team-based learning is built upon constructivist learning models, like cooperative and collaborative learning, that foster learner construction of new knowledge through participation in social learning experiences (such as knowledge sharing in teams). These instructional approaches focus on converting passive learners to active participants. In TBL, students play a more active role as learners, since they need to be well prepared in order to effectively engage in various class activities, e.g., to facilitate discussions or to be able to answer questions from their peers and instructors. In online TBL, this transformation from passive to active learners is even more evident. Students who do not participate are mostly invisible to the system. Only their active contributions to discussions and outcomes (through posting messages and replying to questions) document their participation. Therefore, using computer-mediated tools further engages students in active learning. Participation and collaboration may be closely monitored (and thus assessed and encouraged) by observing communication patterns retrieved through the LMS features such as communication logs and other usage statistics.

The Power of Networks

Finally, online TBL can embrace the advantages of asynchronous learning networks (ALN) and involve students in a cooperative or collaborative learning community that exploits being part of a larger network of users [Hiltz and Goldman 2005]. Teams can easily monitor their own activities as well as review the activities and discussions of other teams, if the instructor has set up the LMS to share access to the work of other virtual teams. The main advantage of CMC environments is that they can transform individual preparation time into a knowledge sharing exercise if team members are required by the instructor (or freely decide) to post individual preparation notes (or journal logs) in a discussion board.

Challenges in Hybrid TBL

The "Myth" of Active Learning

Much like traditional TBL, the hybrid classroom face-to-face meeting time encounters challenges similar to traditional TBL. For example, when an entire course is transformed to a TBL class, lecturing and the traditional one-to-many teaching model is replaced by in-class activities that continue for the entire semester. However, especially in evening classes offered to part time students, learners are often naturally inclined to be in a "listening" mode rather than in an active learning disposition. Depending on the composition of the team, they may be quickly fatigued with the intense TBL activities. In addition, the constant push for accountability and individual preparation is also challenging since it is a high commitment activity. In other words, students may prefer passive learning because listening to the instructor's lectures may ease their lives, at least in the short term.

Enticing passive learners to become more active learners, instructors could reduce involvement in a whole TBL cycle (modules) by adopting TBL for only a subset of content areas. This reduced load might help the more passive learners become progressively more engaged.

The Difficulty of Good Course Design

The instructor role in TBL differs from the traditional classroom as TBL encourages little to no lecturing. The instructor demonstrates knowledge of course materials through interaction during team activities and classroom discussions. Designing good TBL instructional materials is a demanding task for instructors. It requires offering the best conceptual materials while providing enjoyable team-learning opportunities that can engage teams in working together for the entire class duration. In addition, to effectively and efficiently facilitate within-team and between-team activities can be another challenge. In most cases, in a face-to-face class, instructors can devote most of their time on content delivery, since team communications in-class happen somewhat naturally and simultaneously. When the TBL mode is transferred from in-class to hybrid or online classes, instructors have to spend extra time designing detailed and explicit directions on how students should work in their virtual teams.

For example, in one of our Systems Analysis and Design classes, the instructor did not give enough class time for team application activities after iRAT and tRAT tests, and the students ended up spending a lot of extra time working in teams outside of the class compared to more traditional SAD courses. This problem was exacerbated by the need

to detail expectations and beef up instructions. Some students emphatically argued these points with the following comments:

Give more information and instructions on the assignments, instead of assuming that the students know how to do it. Give more time in class to work in teams. If we are going to have team learning, we need plenty of team time. Our team work shouldn't interfere with our time outside of school.

Tired of Working in Teams?

Another challenge is related to an increased awareness that while the curriculum, and in particular the information systems and management curriculum, pushes students to work in teams, learners are resenting more and more the team experiences they have in the classroom. The diverse motivations, incentives, and interest levels across various student populations actually hinder team progress, thus leading to team failure. While TBL may approximate a typical work environment and prevent future challenges, instructors and peers often find themselves less capable of preventing free-riding and absenteeism than managers and human resource departments that run performance reviews. Thus, the virtuous goal of stimulating learning from peers may be detrimental if the quality of the team experience is unrealistically managed.

The more dedicated students are often refusing to work in teams and increasingly request individual deliverables. This is because these dedicated students play a major role for teams to succeed in TBL activities and their peers rely heavily (or free-ride) on their contributions. With CMC implementations, they need to spend even more time on team activities online.

Comments from some high GPA students (about their frustration with working in teams) are presented following:

- "I would make it a little less focused on team-based learning. I think it is important to have team activities but the amount of team activities in this class seemed like overkill. I think the class would be better if there were some individual assignments mixed with the team projects. That way you are able to do some things on your own and also be required to do some team activities."
- "Some team members lack of motivation and a clear understanding of concepts. For example, when we started working on DFDs, some of the team members did not even know what some of the main components of a DFD were, even though we had just had a quiz on DFDs that very day. I also noticed that much of the team did not even read over sample projects to get an idea of what would be expected of them and how they could contribute to the end product. They just waited to be assigned a job instead of taking initiative and choosing tasks that interested them." (this statement did have some exceptions, though.)

To overcome this challenge, instructors could offer "bonus" incentives to the dedicated students who contribute to their teams, e.g., offer extra points for being a team leader or team facilitator.

Challenges in Online TBL

Increased Instructor Workload

In order to implement TBL in a CMC environment, instructors need to prepare systematic and very explicit step-by-step instructions. This process is time consuming and requires more commitment in both preparation and execution. The online TBL environment requires the instructor (who mostly plays the facilitator role in the TBL classroom) to constantly interact in online bulletin boards. Online TBL comes with the expectation of a 24/7 availability. Furthermore, online TBL instructional materials for team activities have to be more detailed than in face-to-face courses.

This is a common challenge for any online courses. However, TBL activity design requires more time because it is not set up as a one-to-many online lecture, but as a many-to-many (or team-to-team and to-instructor) learning experience. As the instructors facilitate team-based learning, they need to understand how each team behaves and how they can provide best advice to promote student learning in a TBL environment. Therefore, online versions of TBL become a many-to-many learning experience. More time and effort are involved as instructors need to organize modules and detailed task instructions, but they also need to offer advice and interact with each team separately. Throughout the semester, instructors need to pay attention to the initial outcomes of the TBL process, and then to make appropriate adjustments and corrections for the next TBL modules.

To get instructional materials appropriate and suitable for different courses, instructors should first run small pilots to identify content more suitable to TBL. They can, for example, run a small scale TBL module at the beginning of the semester in order to get an overall sense of each different team setup and how students respond to the TBL learning

experiences. For online courses, instructors can set up a social “spot” (meeting area) in LMS to give students an opportunity to get to know each other in a casual, unstructured interaction area. In our courses, we used an online crossword game for students to work together and learn about each other by setting up appropriate roles for each team member.

Virtual Teamwork Demands

A CMC team-based learning environment often requires very intense online interactions for each individual student and his/her teams. Time coordination can be an issue in an asynchronous learning setting. For example, teams might find it hard to allocate a common time to deal with team readiness assessment tests together. See the quotes from our TBL students:

The most frustrating experiences were just simply trying to schedule the virtual meetings. We all have such different schedules and it was very hard to find a common a time to be online using the chat room, or even conference calling.

This was the thing we had the hardest time with in our group. It was hard to find time that we could all be online at the same time. We dealt with it by breaking up tasks into individual projects and then reporting back our results at the end.

Hence higher coordination efforts may be required. Because of this intensity, students can be quickly overwhelmed with the CMC-TBL demands and frustrated with their TBL learning experiences.

Technology Failure and Limitations

Last but not least, even when using well known learning management systems, technological failures or limitations may hinder the effectiveness of the learning experience. In addition, the design of current LMSs is anchored to very limited interaction and collaboration capabilities, often confined to non integrated views (or separate pages) within the LMSs. More flexible collaborative tools that integrate voice, white boarding, instant messaging, and asynchronous threading in a more user friendly environment are necessary to facilitate collaboration. While many open source technologies and tools are available, more traditional LMSs still abound on campuses and cost/benefit considerations do not facilitate easily leapfrogging into better collaborative and integrated solutions.

In practice, students who do not have prior experience with the collaborative learning tools in class need to spend additional time learning the tools. In our classes we had to offer technology-tutoring sessions at the beginning of the semester, to eliminate the technical overhead that could distract from learning the course content.

V. CONCLUSIONS AND FUTURE WORK

The use of team-based learning as an instructional strategy changes the course structure by placing the emphasis on team-based activities. Activities in the TBL classroom are preplanned and linear in nature, and the role of the instructor moves from the “sage on stage” to that of a learning facilitator. Application of the TBL strategy in the computer-mediated classroom must adopt the linear nature of TBL while accommodating the asynchronous nature of student participation online. This article described the key aspects of TBL and highlighted its extensions to hybrid and distance learning classrooms. With these extensions, the success elements of TBL as well as the challenges are increased.

We presented aspects of our TBL approach in various settings. While the value of TBL is evidenced by prior research, including ours (see Gomez et al., 2007), the limitations and challenges herein discussed remain an open issue that may eventually affect the quality of the TBL execution, thus compromising the overall effectiveness of the learning experience.

We plan to focus on both theoretical (by assessing outcomes) as well as practical strategies (by designing better courses, and eventually better programs) to foster more effective TBL activities. Since we observed that many team problems and frustrations are caused by scheduling conflicts, it will be essential to identify whether introducing time optimization strategies to CMC-based TBL will support more effective and efficient team efforts. Time management components will be incorporated into our TBL practices. In addition, more training (both for instructors and students) will be conducted before introducing TBL activities. Understanding which approaches can improve team-based learning online remains our ongoing incremental commitment.

In the long run, we hope to address more radical changes at the program level. While we are cognizant of the difficulties of program scale implementations, we are reinvigorated by recent applications that recognize the value of holistic changes beyond individual courses. For example, in a New York Times education report [Kolesnikov-Jessop

2009] the partnership between Duke Medical School and the National University of Singapore was featured as having taken a bold step to apply the TBL approach to the entire basic science education program. The goal of the partnership is to better prepare students in the medical field for the workplace. Medical students need to nurture team communication and problem solving skills to be ready to quickly apply the content they study. They need to swiftly move from theory to practice by such things as diagnosing and treating their patients. The fact that a well established program such as Duke-NSU chose the TBL as the essence of their curriculum reform opens new hopes for the possibility of comprehensive changes, which will be the challenge of our future work.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX

Table 4. Sample Team Activity

CASE STUDY ACTIVITY

Review the historical case [Zwass 2001] "Making Mass Customization Possible at Andersen." The facts of the case took place from 1985 to 1991, when Andersen Windows increased the number of different products offered. The customized and made-to-order window options became an enabler to shipping and invoicing mistakes, causing the service levels to become unsatisfactory. The failure occurred for the business processes and required a new business model be developed and supported by new information systems.

Team Application Activity

1. Do a SWOT analysis for Andersen in 1990, before any of the innovations described in the case (*due date of Saturday midnight*).
 - a. Each student should list the Strengths, Weaknesses, Opportunities and Threats for Andersen in 1990. You might wish to consult the competitive forces/strategies model when considering competitive aspects of your SWOT analysis.
 - b. Each student should list each SWOT category using bullets with short answers, justifying each briefly.
 - c. Post one consolidated reply for your team.
2. Analyze the business processes.
 - a. Each student should identify which business processes have been singled out for redesign at Andersen and why (*due date of Saturday midnight*).
 - b. Post one consolidated reply for your team.
3. Fast forward to today. Assume that Andersen has implemented everything suggested in the case.
 - a. Each student should name two to three innovations Andersen could do today that could improve CRM. Answers will be evaluated on how innovative and potentially useful the suggestions are (*due date of Saturday midnight*).
 - b. Each team will rank order the answers by innovation and usefulness after all team contributions are received (*between Sunday-Tuesday afternoon*).
 - c. Post one consolidated reply for your team.
4. Challenge and then rebut challenges.
 - a. Each team may challenge the answers to each question (after Saturday midnight and due by Monday morning).
 - b. Each team may rebut challenges to the answers (after Monday morning and before class on Tuesday afternoon). A short and clear response must be provided on why the challenge was incorrect.

Challenges and Rebuttals

Each team may optionally post one challenge to ONE other team's answer. In the challenge, clearly explain why you disagree with the original answer. Thus, your team can optionally post seven challenges, one for each activity. Note that you can only challenge an answer if no other team has already challenged using your argument! The team being challenged can optionally rebut the challenge by Tuesday afternoon, with a short, clear response why the challenge was incorrect.

Figure 2. Online TBL Activities and LMS Mapping
Source: [Gomez and Bieber 2005]

Table 5. TBL Aspects (Phased From F2F, to Hybrid, to Distance Learning)

TBL Events	Face to Face Traditional	Hybrid Class	Pure Distance Learning Class
Course Organization			
Instructor Lecturing	Discouraged; instructor mostly acts as a facilitator of in-class activities and discussions.	Use narrated lecturing or podcasting as a supplement only; increase participation in online discussion boards.	Use narrated lecturing or podcasting as a supplement only; use most time for online discussions and responding to students' emails / questions.
Module Organization	Divide course into 5-7 modules.	Divide course into 5-7 modules.	Divide course into 5-7 modules.
Team Organization			
Team Size	Organize students into teams of 5-7 students/team, depending on class size.	Organize in less than 5-7 students per team, especially if extensive online interaction is required.	Organize in no more than 3-5 students per team to decrease the overhead of managing large virtual discussion teams.
Team Arrangement	Keep the same teams throughout the semester.	Keep the same teams throughout the semester.	Keep the same teams throughout the semester.
Team Roles	Not specifically defined.	Not specifically defined.	May need structuring to lead asynchronous discussions.
Team Composition	Strive for balancing skills and interest.		
Team Diversity	Strive for diversity among teams to balance gender distribution.		
Team Building	Assign warm up activities for team building in the first face-to-face class.	Assign warm up activities for team building in the first F2F class. Supplement with online interactive games and "light" activities.	Assign warm up activities for online team building with online interactive games and "light" activities.
Learning Module Organization (iterative across semester)			
Module Preparation (individual)	Assign reading materials at start of module.	Assign reading materials at start of module. Use activity logs posted online on individual students' homepages.	Assign reading materials at start of module. Use activity logs posted online on individual students' homepages.
Readiness Assessment (individual & team)	Administer individual test, then as a team in the face-to-face classroom.	Administer individual test online, then as a team in the F2F classroom.	Administer individual test (timed test), then as a team in asynchronous learning mode online.
Team Activity (team)	Complete in a single class; do not carry over to subsequent class. More than one activity per module recommended.	Complete in a single class or carry over to online environment for each activity. More than one activity per module is recommended.	Complete in asynchronous mode online for each activity. More than one activity per module is recommended.
Activity Preparation	Administer supplemental materials.	Administer supplemental materials online for active learning activities.	Administer supplemental materials online for active learning activities.
Classroom Activity Review/ Sharing (team)	Complete after each team activity. Teams share their work with the other teams in the face-to-face classroom.	Complete after each F2F team activity in an asynchronous learning mode online. Teams share their work with the other teams in the online classroom.	Complete after each team activity. Teams share their work with the other teams in the online classroom.
Evaluations			
Peer Evaluation (individual)	Run evaluations 1/3 into semester and again at end of semester.	Run evaluations twice per semester (mid-semester and end of semester), using online survey tools.	Run evaluations twice per semester (mid-semester and end of semester), using online survey tools.

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