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Utilizing Web Tools for Computer-Mediated Communication to Enhance Team-Based Learning

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ABSTRACT

Team-based learning is an active learning instructional strategy used in the traditional face-to-face classroom. Web-based computer-mediated communication (CMC) tools complement the face-to-face classroom and enable active learning between face-to-face class times. This article presents the results from pilot assessments of computer-supported team-based learning. The authors utilized pedagogical approaches grounded in collaborative learning techniques, such as team-based learning, and extended these techniques to a Web-based environment through the use of computer-mediated communications tools (discussion Web-boards). This approach was examined through field studies in the course of two semesters at a US public technological university. The findings indicate that the perceptions of team learning experience such as perceived motivation, enjoyment, and learning in such a Web-based CMC environment are higher than in traditional face-to-face courses. In addition, our results show that perceived team members' contributions impact individual learning experiences. Overall, Web-based CMC tools are found to effectively facilitate team interactions and achieve higher-level learning.

Keywords: *ALN; asynchronous learning networks; collaborative learning; computer-mediated communications (CMC); learning outcomes; peer assessment; team-based learning*

INTRODUCTION

Instructors of both traditional face-to-face and online classrooms seek active learning techniques that engage the learners. The increased use of Web-based computer-mediated communications (CMC) as support tools that supplement the face-to-face classroom ("blended learning") and enable active learning between face-to-face class times fit this quest. CMC is regarded as an efficient computer support tool to facilitate student participation (Phillips & Santoro,

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1989). Prior research (Wu & Hiltz, 2004) reports that adding asynchronous online discussions through CMC platforms enhances students' learning quality in a face-to-face class setting. Although various Web-based computer-mediated communications learning strategies have been applied in the field (e.g., online collaborative learning), limited research focuses on computer-supported team-based learning in a face-to-face classroom. Team-based learning (TBL) is an instructional strategy that promotes active learning in small groups that form a team over time (Michaelsen, Fink, & Knight, 2002).

Our goal is to assess the impact of team-based learning when introduced in a face-to-face classroom that utilizes Web-based CMC as a supplemental learning tool between classes, thus increasing team interaction across the semester. A Web-based computer-mediated communications tool called WebBoard™ was utilized in our computer-supported team-based learning research to facilitate team learning activities and communication. This paper describes results from this experience. The paper begins with a literature review building on constructivist learning, collaborative learning, small group learning, and Bloom's taxonomy theories. It then provides examples of the Web-based interface and pedagogical implementation, introducing a model for assessing computer-supported team-based learning. Research questions, hypotheses, and data analysis results are presented. Finally, the limitations of the study and future research efforts are discussed.

We believe that our contribution is two-fold. First, we describe an approach for transferring a grounded pedagogical approach to a Web-based environment by supplementing the experiences from a face-to-face classroom. Second, we document preliminary assessment results that support the feasibility and effectiveness of the proposed approach. This discussion should be of interest to educators and researchers in expanding the use of current Web-based learning management systems with a structured modular approach through the integrated use of discussion forums to achieve higher-order team learning outcomes.

THEORETICAL BACKGROUND

Constructivist Learning Theory

Leidner and Jarvenpaa (1995) classify learning models and discuss their relevance and impact in information systems educational approaches. The broadest categories of this classification are objectivism and constructivism. Objectivism posits that learning occurs in response to an external stimulus. Learners respond to the stimulus by modifying their behaviors. This model assumes that abstract representations of reality and knowledge exist independently from the learners. Teaching consists of transferring knowledge from the expert to the learner. Opposite to objectivism, constructivism posits that learning is not a process of knowledge assimilation, but an active process of constructing individual mental models, in which knowledge is created in the mind of the learner. In this model each individual controls the pace and depth of his/her instruction. The instructor is only a moderator in the process of hypothesizing, questioning, and discovering the conceptual relationships between and among various objects.

Team-based learning uses a constructivist approach, which converts the learner from a passive to active learner. This differs from the traditional teacher-learner

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or objectivist approach. Students in this constructivist learning environment play a more active role as learners, since they need to be well-prepared in order to effectively engage in various class activities, such as to facilitate class discussions, to be able to take challenges from their peer learners and instructors, and so forth. Therefore, the constructivist approach is aimed to facilitate students' critical thinking to achieve higher-level learning.

This research explores how the constructivist approach can be utilized to promote team-based learning in a Web-based CMC tool environment. Building on experiences from face-to-face team-based learning teaching (Michaelsen et al., 2002), computer-mediated communication tools are adopted to expand the collaboration opportunities via online team activities between weekly classes. Suitable technologies used in this context are listservs (email distribution lists with a Web-based interface) and asynchronous learning network systems (e.g., WebBoard, WebCT, BlackBoard, or similar technologies provide both a synchronous and an asynchronous discussion environment).

Collaborative Learning

Built upon the constructivist theory, collaborativism suggests that learning quality enhances through shared understanding of more than one learner. Due to social interactions and intensive sharing among collaborative learners, collaborative learning results in higher learning compared with individual-oriented learning (Leidner & Fuller 1996). Schlechter (1990) found that learners perceived higher-order learning by generating more creative ideas and more diverse reasoning in collaborative small study groups.

Our computer-supported team-based learning approach takes advantage of collaborative learning strategies, with more structured teams, which exist for a relatively longer period (in our case, in the entire semester) and with a stable team setup (i.e. same team members), in comparison to other approaches where most teams are built much more casually and temporally.

Small Group Learning and Team-Based Learning

The importance of small groups learning and knowledge creation has been increasing in both education and industry. Team-based learning focuses on fixed small groups, which are established for semester long collaboration instead of temporary purposes. Small groups promote each other's learning and success by holding each member personally responsible for the fair share of the work (Johnson, Johnson, & Smith, 1991). This turns the learning experience into a process, which improves the quantity and quality of the learning by leveraging long-term caring and peer relationships (Johnson & Johnson, 1999). Team-based learning simulates the similar peer collaboration experience in a real world. Therefore, the team-based learning experience may represent a useful training for students' long-term career success.

The main emphasis of team-based learning is the organization around modules (work units) across the semester, consisting of 5-7 three phase sequences (Michaelsen et al., 2002). Each sequence includes preparation, application and assessment before moving to the next unit. Teams should be five to seven members in size. They evolve through four essential procedures: team formation, student accountability, team activities, and high quality feedback (Michaelsen et al., 2002). Our research

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uses these four procedures as the basis for the introduction of computer-supported techniques.

Phased Cognitive Development Perspectives

The approaches presented in this study are based on pedagogical theories that recognize the role of incrementally promoting higher-level learning through progressive team activities. Bloom, Englehart, Furst, Hill, and Krathwohl (1956) organize learning based on different phased cognitive development stages of information elaboration, starting from knowledge and comprehension to the higher levels of evaluation and synthesis. Bloom et al.'s taxonomy of learning goals and objectives summarizes the way student learning progresses through various stages of increasing complexity.

Bloom's taxonomy is particularly useful to identify a progression of learning, which is applied to the computer-supported team-based learning process. In the lower levels of the taxonomy (knowledge, comprehension, application) students absorb knowledge that is presented to them, comprehend it, and learn how to rank order and make inferences in other contexts. In the higher levels of the taxonomy (analysis, synthesis, and evaluation), students learn to generalize and transfer what they learned to their personal interpretation of reality. They learn to analyze and classify the models they have created. While the synthesis and evaluation levels of the taxonomy can also be accomplished by individual learners, *collaborative methods* and *working in teams* provide opportunities to excel in integrating associations and making judgments through communication with peers. In this collaboration mode, students can reach the higher levels of the Bloom's taxonomy.

WEB-SUPPORTED TEAM-BASED LEARNING EXPERIENCES

Computer-supported team-based learning conducted via a Web-based CMC tool was introduced in a 15-week semester, face-to-face graduate course at a US public technological university during the Fall 2004 and Spring 2005 semesters. The first class period introduced the computer-supported team-based learning instructional strategy. The class was divided into teams of five to six students, including at least one woman and at least one student with a wireless laptop. The course materials were divided into six modules, with no midterm or final. Two out-of-class individual article reviews were assigned to the students.

The graduate courses in which we conducted this research was re-modeled, according to Michaelsen et al. (2002). Several steps of the TBL instructional strategy were modified to incorporate the use of a Web-based CMC tool called WebBoard (http://www.webboard.com/) intended for active learning activities between weekly face-to-face classes. A phased approach to active learning assignments via WebBoard was implemented across the two semesters of the study (Gomez & Bieber, 2005). Particular emphasis was placed on additional individual preparedness pre-module activities and team post-module activities through the use of WebBoard; a learning management system that provides a flexible interface for classroom discussion management. Figure 1 shows a typical discussion interface in WebBoard. The left frame provides an organized list of class activities. The right frame shows the details of each individual posting. For example, in the first semester, students posted preparation materials on WebBoard (http://www.

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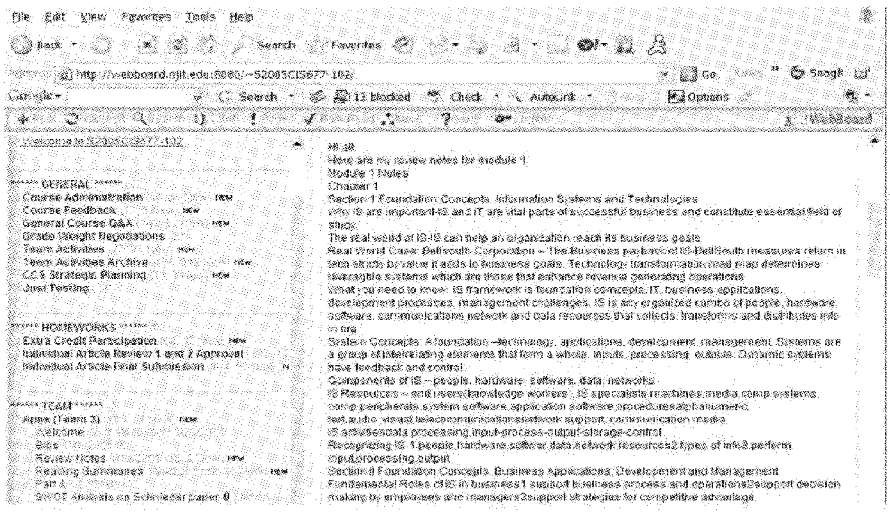
Figure 1. WebBoard interface



webboard.com/) and wrote their post-team activity results on a poster in class. In the second semester, teams posted results of their work on WebBoard instead of handwriting on posters.

The team-based learning activities are based on an iterative process that divides the course into five to seven modules (themes/work units), as Michaelsen et al. (2002) suggests. A module is defined as a work unit or theme. Each module introduces increasingly complex materials that students must master before a subsequent module is introduced. A module can span more than one week's worth of course materials, but a single activity should not span more than one class. Web-based CMC tools enable spanning beyond the single class time (when materials are hard to understand) by enabling the team to work between scheduled class times. Each of the modules must then be subdivided into individual preparation (reading materials and discussions), readiness assessment tests (individual and team), multiple team activities, and post module assessment.

The instructor acts as a facilitator across each module. He/she is responsible for hypothesizing, questioning, and discovering the conceptual relationships between and among various concepts (Passerini & Granger, 2000), and spending more time on preparation of the readiness assessment tests (RAT) and team activities, rather than course lecturing. The instructor plays a pivotal role in the TBL process, both for the course organization and ongoing module activities. In lieu of class lecturing, the instructor actively participates in the classroom as a task coordinator and time manager while observing each team's discussions to readily intervene either as a subject matter expert or to clarify points of the task. Timely grading and feedback are essential aspects of the TBL process and should not be overlooked when planning. The instructor also provides feedback when team activities come together for sharing across the classroom.

Our emphasis with the introduction of Web-based tools to the TBL process is on the individual preparedness of the student

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before taking the individual readiness assessment test for a given module and subsequently taking the team readiness assessment test. To accompany the reading assignments, students were asked to post a short reading summary and then reply to another student's reading summary. In the Fall 2004 semester, the reading summaries were discussed online across the classroom. In the Spring 2005 semester, the reading summaries were discussed within each team. Our observations across both semesters indicate that discussions within the team demonstrated two benefits: extended discussions with the team and increased discussions prior to the team readiness assessment tests, reinforcing the preparation at the start of a new module. This suggests that discussions between team members are more effective and rewarding than discussions across the entire classroom. In reviewing the discussion board postings, the length and depth of the discussions were richer and more engaging when individuals were discussing within their team. This provides the additional benefit of increased team cohesion; a quantitative measure to be included in future research.

The student transition from their individual preparedness activities to the readiness assessment tests. Individual preparedness activities include all reading materials for the module, reading summaries, and individual exam notes for sharing with teammates, requiring students to organize their preparation time. It is suggested the questions for the readiness assessment tests should span the modules reading materials and be geared toward concepts; not detailed questions typically categorized as "by rote". The questions should be broad enough to cover all of the module's reading materials. Michaelsen et al. (2002) suggests approximately twenty multiple choice questions at the start of each new module for the readiness assessment test (RAT). Our research used a point system for the team readiness assessment test where teams were given a scratch card and were allowed to select more than one answer. Points were awarded in decreasing value (e.g. five points first try, three points second try, one point third try). Teams are permitted to appeal a question, with five to ten supporting sentences to ensure a concise and well thought out rebuttal. Students build cases with convincing evidence to persuade the teacher to award credit for an answer missed by the group on the test (Michaelsen et al., 2002).

Multiple team activities per module are needed with increased levels of complexity and are not assigned until after the team readiness assessment test. Typically team activities span two or three weeks for a single module, but a single activity does not carry over from one week to the next. The ideal activity is one that is a case study or has a problem-solving aspect to the activity. After each team activity, deliverables were reviewed and critiqued by the other teams, possibly for extra credit. The review and critique occurred in the FtF classroom for the first semester and using WebBoard for the subsequent semester. The premise was to deepen the learning and reinforce the objectives of the activity, while providing the instructor an opportunity to comment. Upon completion of a team activity, students should review the other teams' deliverable and provide feedback to generate discussion.

Figure 2 summarizes the team-based learning iterative process and where computer-supported activities were introduced in this study.

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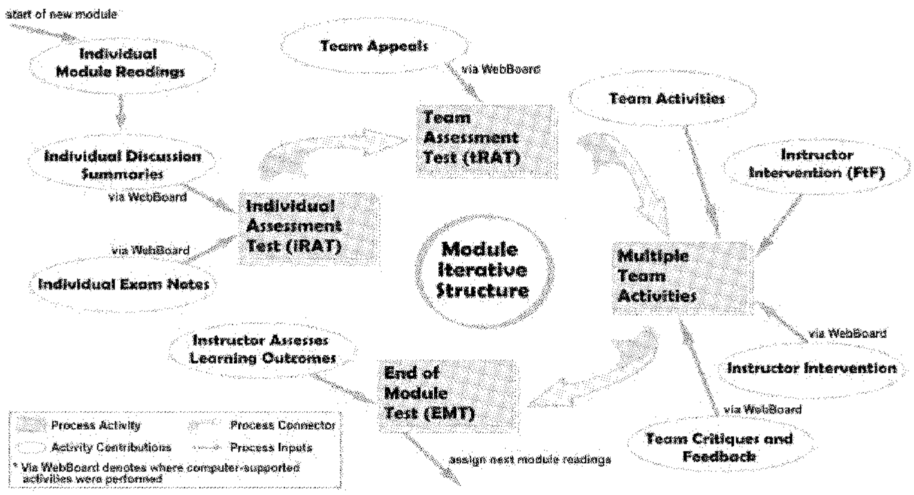
Figure 2. Computer-supported team-based learning events



ASSESSING COMPUTER-SUPPORTED TEAM-BASED LEARNING

The constructivist approach, cooperative, and collaborative theories and models, provide the background for the elaboration of the team-based learning assessment framework reviewed in this study (see Figure 3). Earlier research on Web-supported participatory examinations (Wu, Bieber, Hiltz, & Han, 2004) and collaborative examinations (Shen et al., 2004), informs the proposed team-based learning constructs and expected relationships. In order to succeed in this TBL process, students should prepare first, so that they can contribute their insights to the whole team (*individual preparedness* construct). We assume that their individual preparedness might bring more confidence for them on the value their team member's contributions to problem solving, and they can also integrate and gain more insights from their team members. During this TBL process, students can learn more by communicating efficiently, and by building trust among their team members. Overall, we expect that the whole TBL process will provide the students an enjoyable learning experience, and will motivate them think at the higher levels of Bloom's learning taxonomy, enhancing the quality of the learning experience. Figure 3 lists the key constructs and hypotheses tested in this study.

- **Definitions**: *Perceived Individual Preparedness* is a self-reported student assessment of deep versus superficial study of the materials (Gomez, Wu, Passerini, & Bieber, 2006; Michaelsen et al., 2002); *Perceived Team Member Value or Contributions* is the positive perception of the value of teamwork (Isabella & Waddock, 1994); *Perceived Trust/Communication Skills* refers to the openness of communication within the teams (Coppola, Hiltz, & Rotter, 2004); *Perceived Motivation* refers to the intrinsic and extrinsic factors that influence students' interest and attitudes towards the learning expe-

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rience (Malhotra & Galletta, 2003); *Perceived Enjoyment* is the extent to which the learning activity (the team based learning experience) is pleasant and satisfactory to the learners (Davis, Begozzi, & Warshaw, 1992); *Perceived Learning* focuses on perception of the course quality; usefulness and extend of individual learning experiences as reported by the learners (Wu et al., 2004).

In exploring the relationships and impacts of computer-supported team-based learning, we focused on a number of factors that could impact students' perceptions of learning. We adopted and modified a few validated constructs—"perceived learning," "perceived motivation" and "perceived enjoyment"—from asynchronous online discussion research (Wu & Hiltz 2004). In addition, we created two new constructs called "perceived individual preparedness" and "perceived team members' value/contributions." More specifically, we expect that the collaboration experiences and team-based activities completed by the teams throughout the courses will have a positive impact on perceived learning. Individual preparedness, measured as a self-reported student assessment of their deep versus superficial study of the materials, will positively impact the perceived value and contribution of the team-learning experience. This assumption follows Michaelsen et al.'s (2002) findings that individual contributions to team-output will promote team development and reduce social loafing and, therefore, will have a higher impact on the overall team-based learning experience.

Prior asynchronous learning networks research (Wu & Hiltz, 2004; Wu et al., 2004) shows a positive correlation between perceived motivation, enjoyment, and learning, when students participate in designing, answering, and grading exam questions on an asynchronous learning networks tool. These findings occur in the context of students' learning experience from online discussions through computer-mediated communications platforms for blended classes, which mixed traditional classroom lecturing with asynchronous online discussions.

Individual preparedness and perceived member contribution to computer-supported team-based learning are expected to have a positive impact on learning, as well as on motivation and enjoyment of the team-based learning experience. In particular, motivation and enjoyment will act as intervening variables (see Figure 3). We also expect motivation to positively impact the overall enjoyment of the team-based learning exercises. Following Thorndike's "Law of Intensity" and "Law of Readiness" (Thorndike, 1932), we expect that students who are engaged in the learning process through the multiple collaboration experiences embedded in the course organization, will be more motivated to learn, and will enjoy the learning experience better.

Lastly, we expect that the independent variables of individual preparedness, perceived team member value and contribution to computer-supported team-based learning will impact the level of trust and openness of communication within the teams, indirectly influencing communication and enjoyment. Establishing trust early (swift trust) in online communities has been found to have a positive impact (Coppola et al., 2004) on the learning experience. While we do not report results on trust measures (further analysis and reiteration are needed as trust measures were collected only in the Spring 2005 reit-

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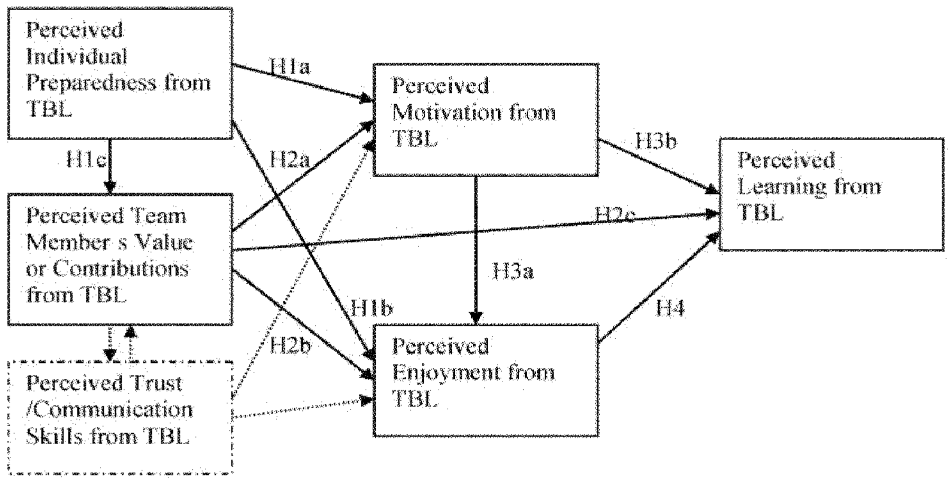
Figure 3. Team-based learning (TBL) framework



eration of the field study), we include trust and communication as an important variable to consider in a computer-supported team-based learning model, which will be influenced by the individual preparedness and team contributions. As discussed in the future research section of this paper, additional observations in the Summer and Fall semester 2005 will supplement our preliminary observations.

Research Questions and Hypotheses

Based on the above discussion, our research is set out to investigate the following general questions:

- Does students' perception of team contributions impact their learning from the computer-supported team-based learning process?
- Does individual preparedness affect perceptions of computer-supported team-based learning experiences?

A number of research hypotheses are therefore derived from the proposed research framework (see Figure 3).

Hypothesis 1a&b: Higher individual preparedness will increase students' perceived motivation and enjoyment from computer-supported team-based learning process.

Hypothesis 1c: Higher individual preparedness will increase the perception of team members' value and contribution to the computer-supported team-based learning process.

Hypothesis 2a&b: Higher perceived team members' contributions to computer-supported team-based learning will increase perceived motivation and enjoyment from this process.

Hypothesis 2c: Higher perceived team members' contributions to computer-supported team-based learning will enhance perceived learning in this process.

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Hypothesis 3a&b: Higher perceived motivation will lead to higher enjoyment and learning from the computer-supported team-based learning.

Hypothesis 4: Higher perceived enjoyment from the computer-supported team-based learning will lead to higher learning.

Methods and Sampling

To test the hypotheses, survey questionnaires were used in the same masters-level information systems course called "Information Systems Principles" during Fall 2004 and Spring 2005 semesters. A total of 73 students volunteered to participate in our computer-supported team-based learning study. Among 73 respondents, 61 students disclosed their demographic information. Over 50% of them are full-time students, about 33% are part-time, and the rest are non-matriculated students, who are studying without officially being admitted to degree programs. About 60% are males, 36% are females, and three people did not provide their gender information. The majority of the respondents are between 21 to 30 years old, about 16% are between 31 to 40 years old, and the rest are between 41 to 50 years old.

Data Analysis and Discussion

In this study, the majority of data was collected from the surveys, which covered all variables proposed in the computer-supported team-based learning research framework (Figure 3). The primary data analysis methods to analyze our survey are descriptive analysis, factor analysis, and correlation analysis. First, descriptive data analysis was conducted to evaluate the validity of the constructs and the reliability of the scale used in the study. All the constructs returned a Cronbach's Alpha higher than 0.70. The detailed question items for each construct are listed in Appendix section.

The factor analysis was then performed to confirm the loading of the questions to the respective factors. In general, the question items show high reliability of the constructs they represent. The exploratory factor analysis technique was used in this study to verify whether the grouping of the survey questions maps to the model constructs. An exploratory factor analysis (EFA) was run to identify the underlying model, the number of factors in the model, and the variables (by type of questions) associated with each factor. Within the factor analysis technique, a principal components analysis (PCA) was used to highlight the number of factors to be extracted from the model. The confirmatory factor analysis (CFA), in its rotated version (VARIMAX rotation) helps to identify the underlying model. The Principal components analysis yielded six factors with eigenvalues >1. We focused on the first five components corresponding to the research model constructs (Table 3) because of the limitation of one of the research constructs (individual preparedness) that yielded ambiguous results and because the additional variance explained by the additional factor did not substantially alter the model (as it is the lowest incremental cumulative variance). In addition, we did not test the trust/communication construct, with a possible impact on the overall model. Limitations of this approach as introduced at the end of this section.

Extraction Method: Principal Component Analysis

Table 4 shows the bivariate correlations among variables and provides intriguing results. In particular, it shows that perceived enjoyment and motivation

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Table 3. Components extraction matrix

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.612	37.442	37.442	8.612	37.442	37.442	4.753	20.665	20.665
2	2.482	10.790	48.232	2.482	10.790	48.232	3.660	15.912	36.577
3	1.721	7.484	55.716	1.721	7.484	55.716	2.454	10.669	47.246
4	1.518	6.602	62.319	1.518	6.602	62.319	2.278	9.905	57.151
5	1.122	4.879	67.197	1.122	4.879	67.197	1.775	7.719	64.870
6	1.034	4.497	71.694	1.034	4.497	71.694	1.570	6.824	71.694
7	.883	3.841	75.535						
8	.826	3.591	79.126						
9	.711	3.089	82.216						
10	.628	2.732	84.947						
11	.524	2.278	87.225						
[...]									
23	8.357E-02	.363	100.000						

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Table 4. Bivariate correlation analysis

	(1)	(2)	(3)	(4)	(5)
Perceived Learning from TBL	1				
Perceived Enjoyment from TBL	0.635**	1			
Perceived Motivation from TBL	0.637**	0.708**	1		
Perceived Team Member's Value/ Contribution from TBL	0.437**	0.518**	0.288*	1	
Individual Preparedness from TBL	-0.171	-0.174	-0.188	-0.026	1

*** Correlation is significant at 0.01 level (two-tailed)*
** Correlation is significant at 0.05 level (two-tailed)*

are highly correlated with the dependent variable of perceived learning (R>0.63 for both constructs). It also shows that perceived team member's contribution positively correlates to learning, enjoyment and the motivation constructs. However, the bivariate correlation analysis shows that individual preparedness is not significantly related to the other variables, and the relationship, if any, is negative.

Based on the results of the above bivariate correlations, we identify that hypothesis 1 (a, b, and c) are not supported. The other hypotheses are supported at the p=0.01, with the correlation between team contributions and motivation significant at the p=0.05 level (see Figure 4).

From the above data analysis results, it is suggested that how individuals value their team members' contribution has significant correlations with their perception of enjoyment and learning quality from computer-supported TBL (Gomez et al., 2006). These results address the first research question on how team interactions positively impact the whole computer-supported TBL learning experiences. In addition, individual opinions on team members' contributions also have a positive impact on their perceived motivation, although the Pearson's R value is not high (R = 0.28). It might be caused by other potential factors from the computer-supported TBL experience, which could decrease students' motivation. For instance, if the team leader is more dominant, his control might impact other team members' motivation.

Surprisingly, individual preparedness does not impact perception of the team-based learning experience. The correlation values among individual preparedness and other variables are not significant. The results also show that their correlation values are negative. There might be a few reasons. First, as indicated earlier, the ambiguous two question items for the "individual preparedness" construct (i.e. ambiguous statement, negative factor loading) have a negative impact on the research framework. The individual preparedness tasks associated with studying differences may not be self-evident to the student increasing the ambiguity of the questions. Moreover, our observations indicate the importance of individual preparedness on the entire iterative nature of the module whereas our

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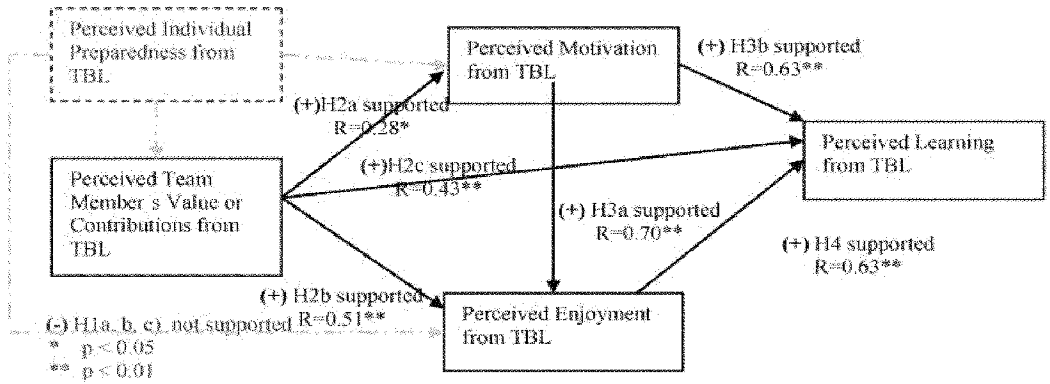
Figure 4. Computer-supported team-based learning bivariate correlation results



focus of the current individual preparedness construct was driven from the importance of the readiness assessment test process. The bivariate correlation analysis does not show any significant relationships between "individual preparedness" and other constructs in the framework. This is evidently one of the limitations for this research. For future research, we plan to refine the "individual preparedness" construct with question items targeted at the individual preparedness process more than studying specifically for the tests. Second, there might be an interaction effect of the experimental conditions: the computer-supported TBL process design itself might also impact the results. The team assessment tool (tRAT) is the same test as the individual readiness assurance test (iRAT). Although the overall team scores are better than individual test scores, the test repetition may explain the decrease in the students' motivation and enjoyment. Also they could not perceive more value from their respective team members. We also speculate that the test questions may not have lent themselves well to interesting team discussions, leaving the tRATs uninteresting. Alternatively, this simply may indicate that many students found the TBL process valuable even when they did not prepare in the manner the instructor expected. These results show that our second research question on the role of individual preparedness needs further investigation and analysis to span the iterative cycle of each module (preparation, test, activity) and not simply focus on the readiness assessment test aspect.

There are a number of limitations to this study. First and foremost, we found that some of the constructs could be better specified. Our factor analysis displayed the possible existence of another significant factor which should be further analyzed in future research. This additional factor was associated with an ambiguous question in the individual preparedness construct. Looking at the articulation of the questions in that construct, we identified an instrumentation bias (one item in the construct was weak), which may explain our concerns with the specific construct. In addition, because some of the constructs and the extension of this grounded team-based learning approach to a Web-environment is novel, we should supplement our conclusions with

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an in-depth analysis of qualitative factors (observations, open-ended questions, and content analysis of discussion boards) that may help better understanding the learning outcomes more objectively in a way that complements the perceived learning measures. Adjusting the activities layout in the Web-based environment with our phased approach and the nature of the individual preparedness activities indicate the complexities of this construct. Our qualitative analysis indicates that spanning beyond the individual preparedness question items related to the readiness assessment test to also include question items that measure perceived preparation of the materials related to team activities.

SUMMARY AND FUTURE RESEARCH

Computer-supported team-based learning provides a powerful instructional experience and reduces some of the disadvantages many instructors and students have found with traditional small-group work. Blending the benefits of the face-to-face classroom with computer-mediated communication extends the learning process between the weekly face-to-face sessions keeping the team learning progress and group dynamics growing.

Our research places emphasis on key variables that affect learning in computer-supported team-based learning. Computer-supported team-based learning is still a relatively new pedagogical approach, and to the best of our knowledge, this is the first study blending computer-mediated communications with the iterative team-based learning modular approach proposed by Michaelsen et al. (2002). The use of Web-based CMC learning techniques places emphasis on individual and team learning outcomes. The surveys indicate a high-perception of learning, motivation, and enjoyment. These findings deemed computer-supported team-based learning an approach for further investigation both in the face-to-face classroom and for online learning.

The emphasis of future research will be on team-assessments and group cohesion in a purely Web-based learning environment. The findings around the team activities will allow for additional adjustments in the team-based learning process before it is introduced in a completely online learning mode. Blending the face-to-face class with computer-mediated communications provides a means to gauge the asynchronous learning network process. Future studies will extend the analysis of the computer-supported team-based learning model and research framework using the structural equations model (SEM), trust, communication, and team leadership factors. Further review of individual and team preparedness is also needed. The progressive nature of the readiness exam process and team activities should ensure individual preparation. Because of the novelty of the preparedness and team contributions constructs, we will also implement content analysis of team activities posted on WebBoard to support the evaluation of individual preparedness for each module. Adding qualitative data and observations will enhance our understanding of the constructs. Actual grades and peer evaluation results will also support the measurement of task completion levels.

Team-based learning presents a promising technique employing small teams that actively engage students in learning. We look forward to the day when instructors can effectively use computer-supported team-

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based learning as a standard approach in both face-to-face and online classrooms.

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