Investigation of Change in Team Dynamics Over Time: From F2F to Facebook Setting

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ABSTRACT This study investigates how teams' Shared Mental Models (SMMs) change in a computer supported collaborative learning environment and how their SMM scores change in such environments after being exposed to team-based learning in a face-to-face setting. A total of 57 pre-service teachers enrolled in a blended course participated, forming groups of three to five. The teams completed three in-class activities followed by three assignments provided via an asynchronous learning environment. A questionnaire was administered after each assignment. Data was analyzed using a repeated measures ANOVA. At first, the participants appreciated the group work, but their appreciation levels decreased after the first assignment. As they were able to solve issues, they placed more value on teams. Ultimately, SMM scores were higher in the online learning environment compared with the face-to-face setting. Also, with time the learners were better able to exchange information, solve problems, make decisions, openly discuss issues, and complete assignments effectively.

INTRODUCTION

Collaboration requires people to work together in order to complete a task or solve a problem, and this definition does not change for education. Through collaboration, learners with different personalities and learning abilities can combine their knowledge, expertise, and experience for their betterment in education (McGrath and Altman 1966; Sonmez 2005; Sibley and Parmelee 2008; Tan 2008; Acikgoz 2009; Dilci 2011; Unlu and Aydintan 2011; Vasan et al. 2011; Hsiung 2012; Tsay and Brady 2012). Researchers use several terms to represent collaboration in education including team-based learning, learning teams, small group learning, and so on. For this particular study, the term Team Based Learning (TBL) is used.

Well-known theories such as social interdependence (Johnson and Johnson 2009) and social constructivism (Vygotsky 1978) support the idea that students learn better when they interact with each other. This concept is also well documented in the literature. TBL encourages students to learn from their teacher as well as their peers, and as a result, they become active

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learners (Wegerif 1998; Troncale 2002; Tsay and Brady 2012) who ignore gender, ethnicity, religion, or age in order to learn from others (Acikgoz 2009). TBL also helps learners develop higher level cognitive, communication, interpersonal, and group interaction skills (Johnson et al. 1991b; Nunamaker et al. 1991; Slavin 1996; McLoughlin and Oliver 1998; Smith et al. 2005; Clark 2008; Lane 2008; Tsay and Brady 2012; Cheng et al. 2013) and enables educators to learn about their students' learning styles, interests, and abilities (Yonez 2012). Those benefits are not only limited to lower grades. Johnson and colleagues (1991a) reported similar benefits for higher education as well as for adult education.

Although many studies have been conducted to explore the effects of TBL on learners in face-to-face settings, more research is needed to examine how it works in other settings especially in Computer Supported Collaborative Learning (CSCL) settings, a learning environment rooted in computer-mediated communication. CSCL is one of the most popular research topics all over the world and the main reason for such popularity comes from its primary advantage—enabling learners to communicate at a distance via a network for anywhere and anytime learning. In order to benefit from CSCL environments, learners need to interact with each other, share information/experience/knowledge, negotiate, and organize each step carefully to complete a given task. In other words, team (a group of learn-

ers) dynamics holds critical importance in the success of CSCL.

Many researchers examined the benefits of computer supported learning on both, students and instructors. McComb (1994) argued that technology integration enables instructors to submit course materials online, receive assignments, answer students' questions quickly and lead students to feel more responsible about participation in forum discussions. Specifically, use of a CSCL environment resulted in increased student responsibility and participations, caused learners to effectively interact with each other related to a given task or course concepts, and increased academic performance of learners (King 1994; McComb 1994; Althaus 1997; Khine et al. 2003; Baralt and Gurzynski-Weiss 2011; Volchko 2011; Serrano-Camara et al. 2012). As Daradoumis and Marques (2000) and Serrano-Camara and colleagues (2012) have stated, computer supported collaborative work can increase the students' motivation levels, assigned value to a subject, positive attitudes, and social interaction. Johnson and Johnson (2000) and Panitz (2001) found that such teamwork facilitates higher levels of cognitive and communication skills. Moreover, Wang and Lin (2007) concluded that online teamwork increases depth of analysis, quality of decisions, and level of participation. In another study, Harasim and colleagues (1995) found that learners who conducted teamwork in a virtual classroom mastered course materials better and had higher satisfaction compared to peers in a traditional classroom.

Despite many benefits of TBL in both face-to-face settings and online settings where learners use computers to communicate, some factors have negative effects, such as team size, lack of cohesiveness, leadership issues, poorly defined goals and expectations, social loafing, mismanaged conflicts, team member dissatisfaction, and poor communication (Strong and Anderson 1990; Comer 1995; Cox and Bobrowski 2000; Deeter-Schmelz et al. 2002; Chiang 2005; Aggarwal and O'Brien 2008; Levine and Violanti 2008). A team's shared mental model can also affect the quality of teamwork (Cannon and Edmondson 2001; Mathieu et al. 2005; Johnson and Lee 2008; Johnson et al. 2011).

According to Cannon-Bowers et al. (1993: 228), shared mental models (SMM) are comprised of team members' structured knowledge, which "enables them to form accurate explanations and expectations for the task, and in turn, to coordinate their actions and adapt their behavior to demands of the task and other team members." SMMs help researchers further understand how team members work together in complex, dynamic, and uncertain contexts (Cannon-Bowers and Salas 1990). Johnson and O'Connor (2008: 116) have stated that SMMs enable team members to "explain other members' actions, understand what is occurring with the task, develop accurate expectations about future member actions and task states, and communicate meanings efficiently." As addressed in the literature, there is not a single mental model. For instance, Mathieu and colleagues (2000) reported four different types of models, including technology/equipment, job/task, team interaction, and team related. Johnson et al. (2007) further identified five factors of an SMM, namely task and team knowledge, task and communication skills, attitude towards teammates and task, team dynamics and interactions, and resources and working environment. Klimoski and Mohammed (1994) have observed that at a given point in time, team members may hold more than one mental model.

Although some studies have shown how teams' SMMs work in specific learning environments such as face-to-face or online settings, empirical research has yet to determine how SMM scores change if learners are exposed to TBL first in a face-to-face setting and then in an online setting. Thus, two fundamental research questions were addressed in the current study:

1. How do teams' SMM scores change over time?
2. How do teams' SMM scores change in an online environment after exposure to TBL in a face-to-face learning environment?

METHODOLOGY
Settings

The data for this study was collected as part of a course entitled Mathematics Education in the Department of Early Childhood Education in a state university in Turkey. Throughout the fall semester of the 2014-2015 school year, the researcher designed a computer supported collaborative learning environment for students. While weekly face-to-face meetings continued throughout the semester, participants completed some course requirements online. To this end, the researcher decided to use a social media site, Fa-

cebook in this instance, to complete assignments and conduct asynchronous group discussions. Besides the posts related to assignments, students were also encouraged to post about exams, course topics, course schedules, social activities, and so on.

First, students were introduced to the course and given information about how it would proceed. Students created groups of three to five and stayed in the same group throughout the semester, as suggested by Michaelsen and Sweet (2008). There were four three-member groups, three four-member groups, and seven five-member groups. Another requirement of the course was to have a Facebook account for asynchronous group discussions. Two participants did not have an account and agreed to open one within a week.

As part of the course, participants had to complete several tasks as a group. The assigned teamwork was completed first in face-to-face settings (three times) and then in online settings (three times). Until participants completed all three in-class team activities, they were not exposed to any online teamwork. Examples of assignments include evaluating the kindergarten curriculum in terms of mathematics activities for face-to-face settings and using Facebook to discuss the mathematics teaching strategies of a kindergarten teacher captured on video by participants. The researcher tried to weigh the workload of activities balanced for both face-to-face and online settings. After each completed assignment, participants were asked to fill out a questionnaire individually to evaluate their work. Example assignment types and durations are evaluation of kindergarten curriculum in the second week during course hours and online evaluation of video clips captured in real classroom settings by group members in tenth week. Students filled out the questionnaire after each assignment.

Participants

Participants included 57 (44 female and 13 male) teacher candidates majoring in Early Childhood Education and enrolled in Mathematics Education. Their average age was 19.7 years and they were all in their second year of the program. At the beginning of the semester, the candidates were informed about the project and asked for their consent to participate. Students were also told that they could withdraw from the project if they wished. All teacher candidates agreed to participate voluntarily and none of them withdrew from the study.

Instrument

For this study, the characteristics of SMMs suggested by Johnson et al. (2007) were taken into consideration, that is, task and team knowledge, task and communication skills, attitude towards teammates and task, team dynamics and interactions, and resources and working environment. In order for participants to evaluate their teamwork after each assignment, a questionnaire developed by Johnson et al. (2007) and translated into Turkish by Johnson et al. (2011) was used. The Team Assessment and Diagnostic Instrument (TADI) measures the sharing of team knowledge and consists of five factors with 42 5-point Likert scale items ranging from 'strongly agree' to 'strongly disagree'. Cronbach's alpha coefficients are given in Table 1. Based on the rules provided by George and Mallery (2003), all values were found to be higher than the acceptable rate.

Table 1: Reliability scores of TADI factors

TADI factors	Present study Cronbach's alpha
General task and team knowledge (GTTK)	0.83
General tasks and communication skills (GTCS)	0.81
Attitudes towards teammates and task (ATTT)	0.73
Team dynamics and interactions (TDI)	0.82
Resources and working environment (RWE)	0.63

Data Analysis

The data collected for this study was analyzed using descriptive statistics including means and standard deviations. In addition, to examine the change in participants' attitudes towards teamwork over time, a repeated measures ANOVA was employed with a significance level of .10 due to a small sample size.

FINDINGS AND DISCUSSION

As part of this study, teacher candidates completed three in-class and three online team as-

signments. When all of them were combined (see Fig. 1), an average TADI score of 4.09 was calculated, which may be interpreted as overall member satisfaction with the TBL experience. When SMM scores were examined closely over time, some fluctuations were observed. After teams were initially formed, they may have appreciated the novelty of TBL as an instructional strategy. Thus, at the first stage, as expected, team SMM scores were high (T_{f2f-1}). However, as time progressed, appreciation levels decreased, possibly due to workload, interaction issues, or personal issues. As a result, team SMM scores decreased. Once teams were able to cope with those issues, an increase was observed from T_{f2f-2} to T_{f2f-3}. Teams' SMM scores continued to increase, despite a small decrease for $T_{online-2}$, and the highest SMM score for the semester was for the final group work ($T_{online-3}$). Several studies from the literature found similar results (Espinosa and Carley, 2001; Lewis, 2004; Lee and Johnson, 2008; Johnson et al. 2011).

In order to examine whether team performance changed significantly during the study, a repeated measure analysis was employed. Since the result of Mauchly's Test of Sphericity was sig-nificant ($p > 0.005$), the Greenhouse-Geisser correction was used to test the repeated measure analysis. The result showed significant changes over time ($F(3.19, 169.04) = 3.789$, $p = .010$). Significant changes were observed between T_{f2f-1} and T_{f2f-2} ($p = 0.001$), T_{f2f-2} and $T_{online-3}$ ($p = 0.000$), T_{f2f-3} and $T_{online-3}$ ($p = 0.088$), and $T_{online-2}$ and $T_{online-3}$ ($p = 0.047$). As seen in Figure 1, team SMM scores for online tasks were generally higher than those for face-to-face tasks.

Ocker et al. (1995) stated that online groups produce better outcomes with lower satisfaction compared to face-to-face TBL. In addition, according to Palsole and Awalt (2008), in online settings, TBL can be time consuming, which might be a strong predictor of low SMM scores, especially if TBL is being implemented for the first time. Also, Coppola et al. (2004) have observed uncertainty and risk in online learning environments, especially if a learner does not know what to expect or how to proceed. The results of the current study might provide a solution for obtaining higher team SMM scores. Between the first two assignments, a significant decrease occurred for in-class activities. However, while scores also decreased between the
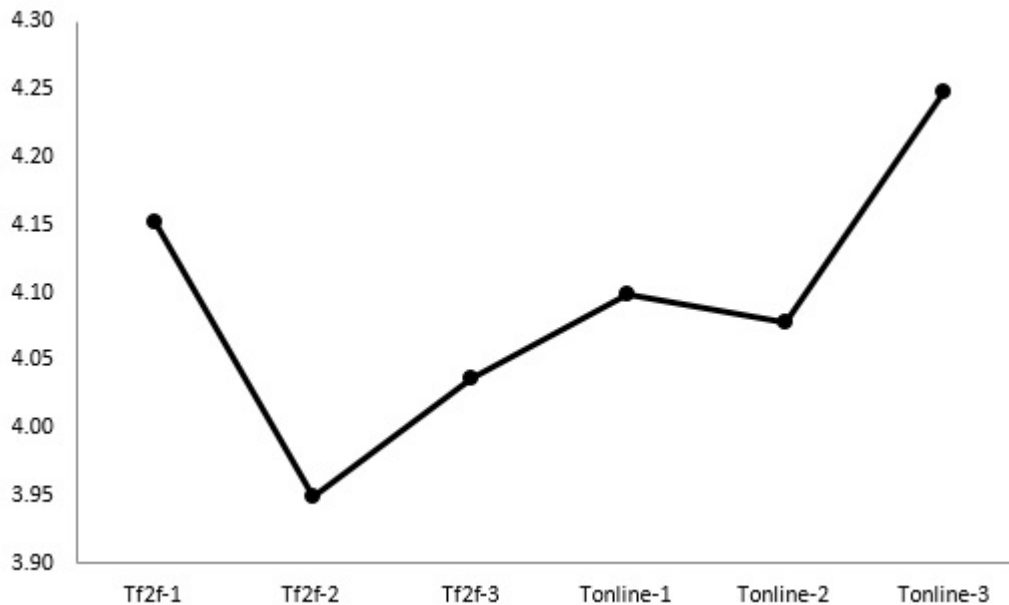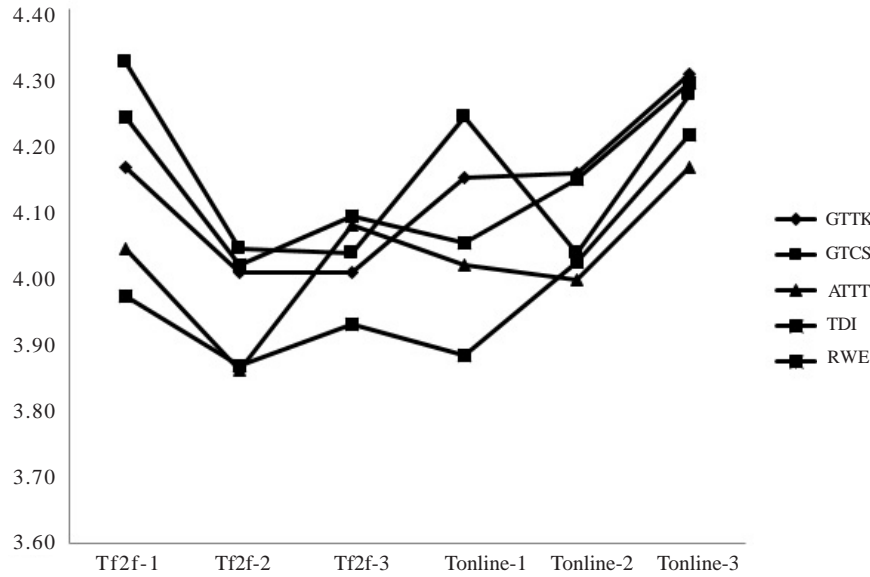

Fig. 1. Trend in TADI scores for online and face-to-face settings

Fig. 2. Change in factors over time

first two online tasks, the change was not significant. The final group work ($T_{online-3}$) produced the highest score of all, which may indicate that team members were able to cope with issues better in virtual environments due to their prior face-to-face TBL experience.

The instrument measuring sharedness of team knowledge had five factors. Figure 2 shows the change in each factor over time, demonstrating a sharp decrease in SMM scores from T_{f2f-1} to T_{f2f-2} for all factors. For the final group task ($T_{online-3}$), all scores were around or above their starting points.

In order to examine whether team SMM scores changed significantly for each factor during the study, a repeated measure analysis was employed (see Table 2). In their study, Jarvenpaa and Leidner (1998) compared the early and later stages of teamwork in terms of communication and member actions in virtual learning environments. Based on their findings, social exchanges shift over time to predictable communication with explicit, substantive, and timely responses. In terms of member actions, while at the beginning members cope with technical issues, they focus later on tasks rather than pro-

Table 2: Repeated measure analysis results

TADI factors	Greenhouse-Geisser	Significant changes
GTTK (General task and team knowledge)	F(3.82, 210.10) =3.252, p = .014, η^2=0.99	T_{f2f-2} - $T_{online-2}$ T_{f2f-3} - $T_{online-3}$
GTCS (General task and communication skills)	F(3.76, 207.11) =3.587, p = .009, η^2=0.98	T_{f2f-1} - T_{f2f-2} T_{f2f-1} - $T_{online-2}$
ATTT (Attitudes towards teammates and task)	F(3.49, 192.70) =2.494, p = .052, η^2=0.98	T_{f2f-1} - T_{f2f-2} T_{f2f-2} - $T_{online-3}$
TDI (Team dynamics and interaction)	F(4.08, 224.10) =2.871, p = .023, η^2=0.91	T_{f2f-1} - T_{f2f-2} T_{f2f-2} - $T_{online-3}$ T_{f2f-1} - $T_{online-2}$
RWE (Resources and working environment)	F(3.730,205.17) =4.097, p = .004,η^2=0.92	T_{f2f-1} - $T_{online-3}$ T_{f2f-2} - $T_{online-3}$ T_{f2f-3} - $T_{online-3}$ $T_{online-1}$ - $T_{online-3}$

cedures. Similar trends occurred in the current study. As the setting changed from in-class to online, team members were able to focus more on tasks. The change in dynamics and interaction showed strong relationship development among team members.

While asynchronous discussions allow for an increase in group synergy, they also enable group members to gather information from various resources to support their learning (Nunamaker et al. 1991; Welsh et al. 2003). Moreover, they hinder the negative effects of group process losses (Nunamaker et al. 1991). An online learning environment enables asynchronous discussions that allow group members to re-read messages, review tasks, and search for information before articulating an appropriate response, increasing the quality of reflections (Harasim 1990) and decision-making (Rice 1984). As seen in Figure 2 and Table 2, a gradual increase occurred for general task and team knowledge (GTTK), team dynamics and interaction (TDI), and resources and working environment (RWE), despite a sharp decrease for T_{f2f-2}. More specifically, in the online setting, team members felt that they were better able to manage information, solve problems, make decisions, discuss issues, and select strategies. This result might be due to the experience they gained during face-to-face TBL.

CONCLUSION

Team-based learning provides many opportunities for learners and lecturers, especially when people from different backgrounds come together to accomplish a given task in an online learning network. TBL improves higher level cognitive, communication, interpersonal, and group interaction skills. Many studies have investigated TBL and the factors that affect its success. This study focused on how the teams' shared mental models changed in computer supported collaborative learning environments after learners were exposed to TBL in face-to-face settings. The results show that learners were better able to exchange information, solve problems during tasks, make decisions, openly discuss issues, and select strategies for completing assignments. In turn, participants also seemed to place more value on teams.

RECOMMENDATIONS

The current study may help instructors and designers of computer supported collaborative learning environments to consider a critical perspective, and expose learners to TBL, first in face-to-face settings and then continue employing it online. Further studies are needed to replicate findings with larger populations from different backgrounds. Also, in replications, different aspects namely gender, educational background, and technology skills may be taken into account. In addition, future research should focus on whether such a setting order affects team members' academic performances. Finally, this study only aimed to investigate the learners' shared mental models in terms of task and team knowledge, task and communication skills, attitude towards teammates and task, team dynamics and interactions, and resources and working environment. This research should be expanded to include other mental models to find more effective ways to increase the effects of TBL on learning in both online and face-to-face settings.

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