

## The Impact Of Synchronous And Asynchronous Communication Tools On Learner Self-Regulation, Social Presence, Immediacy, Intimacy And Satisfaction In Collaborative Online Learning

Mahnaz Moallem, Ph.D.

University of North Carolina Wilmington

601 South College Rd., Wilmington, NC 28403—USA

Chair AERA Problem-Based Education SIG

Professor of Instructional Technology & Research, Coordinator of Instructional Technology Program &

Grant Coordinator for Watson College of Education

e-mail: moallemm@uncw.edu

**Abstract:** The emergence of the newer web synchronous conferencing has provided the opportunity for a high level of students to students and students to instructor interaction in online learning environments. However, it is not clear whether absence or presence of synchronous or live interaction will affect the learning processes and learning outcomes to the same extent for all learners with various characteristics, or whether other factors that compensate for the absence of the live interaction can be identified. This paper reports the results of a case study that investigated whether various communication methods (synchronous, asynchronous and combined) impact factors such as self-regulation, social presence, immediacy and intimacy, collaboration and interaction and learning process and outcomes. Multiple sources of data were used to test the consistency of the findings and to examine various factors across different communication methods. The results suggest that factors other than communication methods maybe responsible for learner self-regulation. There is, however, a relationship between student satisfaction, perception of social presence and immediacy and communication methods. The synchronous and combination methods appeared to provide the highest level of social presence followed by the cognitive and emotional support.

### INTRODUCTION

The educational and instructional technologies that are emerging from endless array of tools and concepts have changed and continue to change the way online courses are conceptualized, designed, developed and delivered. Some of these powerful and intriguing concepts such as massive, free and open online courses or MOOCs (e.g., Coursera, Udacity, edX) have potential for changing the way we think about the role of the internet in transforming education and training systems. Others bring to mind not so new, but more fundamental questions about learning and instruction in online courses. For example, how digital, readily accessible and scalable, but traditionally delivered online instruction (e.g., video-presentation, computer-based assessment; use of asynchronous communication systems) is compared with small, participatory, highly interactive, intimate and collaborative online instruction (less lectures and testing and use of synchronous communication tools). Aside from the appealing ideology of accessibility and free education for all, the question still remains: which applications and ideas are rising to enhance engagement and motivation and to impact learning in online courses? How various platforms for delivery of online courses can improve learning and promote critical thinking? How personalized and immediate feedback, assessment of complex learning outcomes, encouragement and self-reliance, personalized questioning and coaching and directed social engagement can be enhanced in online learning using new and emerging technology tools?

One of the emerging technology tools for online learning is web synchronous systems or video conferencing tools (e.g., *Blackboard Collaborate*, *WebEx*, *Saba Centra*, *Adobe Connect*, *Cisco Telepresnece*). This new technology, which affords a complete suite of communication features, has provided the opportunity for a high level of real-time, students-to-students and students-to-instructor interaction in online learning environments. The potential of these complex communication tools for providing *virtual*, yet interactive learning experiences that are closer to what is possible in face-to-face learning environments (Rourke, Anderson, Garrison & Archer, 2001a and b; Shi & Morrow, 2006), while simultaneously providing high levels of learner control and freedom of space make these tools the best viable option for small and highly interactive and collaborative online courses recently presented as *Semester Online Course* initiative (<http://2u.com/semester-online/>; New York Times, 2012; USA TODAY, 2012).

Synchronous web-conferencing is one of the two communication methods (synchronous and asynchronous) used for delivery of course content and for course-related communication and interaction. While its use is still limited (Sloan, 2013), synchronous method for delivery of online courses brings teacher and students together simultaneously in virtual spaces. Asynchronous method, on the other hand, delivers instruction without any specific timetable using communication tools such as e-mail, discussion boards and web 2.0 tools. Although limited due to the relatively new synchronous web-conferencing tools, studies suggest that absence or presence of synchronous or live interaction affects student perception, motivation, interaction and sense of contribution (e.g., Barbour, McLaren & Zhang, 2012; Chen, Pedersen & Murphy, 2011; Falloon, 2011; Hampel & Stickler, 2012; Han & Johnson, 2012; McBrien, Jones & Cheng, 2009; Schullo, Hilbelink, Venable, & Barron, 2007; Teng, Chen, Kinshuk & Leo, 2012). However, much of this research has focused on the quality of interaction or dialogue and learner perception, rather than learning process and learning outcomes. In addition, few studies attempted to isolate learning strategies used in online courses from delivery platforms, making it difficult to describe if the two types of communication methods (synchronous and asynchronous) for delivery of online courses result in different levels and processes of learning, motivation and satisfaction.

The purpose of the present study was to compare three communication methods (synchronous web-conferencing; asynchronous, and a combined method of synchronous and asynchronous) while keeping learning strategies consistent across each method to find out how they influence learner motivation and self-regulation, social presence, satisfaction and learning process and outcomes, in small, interactive and collaborative online courses. The study specifically answers the following questions:

- How do various communication methods (synchronous, asynchronous and combined) impact factors such as self-regulation, social presence, immediacy and intimacy and satisfaction in online learning?
- How do various communication methods (synchronous, asynchronous and combined) impact student collaboration and interaction as well as learning process and learning outcomes?

## REVIEW OF THE LITERATURE

The review of the literature on the effect of the quality and level of interactions offered in various communications modes (i.e. synchronous and asynchronous) on student learning, satisfaction and motivation in online learning environments points to several influencing factors: possibility of affective and interpersonal interactions; social and cognitive presence; immediacy of feedback; motivation and self-regulation; media richness; and collaborative opportunities for learners. These factors are explored in the following sections and are used to construct a framework to guide the present study.

Research on online learning continues to support Moore's contention (1989) of the importance of dialogue or interaction between the teacher and students and among students and between students and learning content for advancing the learning process and for internalizing learning (e.g., Cavanaugh, 2005; Friend & Johnson, 2005; Offir, Lev & Bezale, 2008; Palloff & Pratt, 1999; Shale & Garrison, 1990; Zucker & Kozma, 2003). These and other studies further elaborate that higher level of interactivity (human interaction) captures learner's attention and increases user's engagement with the task environment (e.g., Alessi & Trollip, 2001; Heinich et al., 1989). It is argued that high level of interactivity results in deeper processing of the information, resulting in mastery of the information (Brown, Collins, & Duguid, 1989; Merrill, 1975), aiding the individual in forming a personal mental model of the task (Wild, 1996). According to Moore, distance learning environments, separation between the teacher and students can "lead to communication gaps, a psychological space of potential misunderstandings between the behaviors of instructors and those of the learners" (Moore & Kearsley, 1996, p. 200). Thus, given the literature, one can theorize that when the task is complex and involves the construction of new knowledge, problem solving and shared meaning, the communication utilization of a richer synchronous medium becomes more important (Dennis & Valacich, 1999).

Other studies point that increased interaction results in increased student motivation and satisfaction (e.g., Chiu, Hsu, Sun, Lin & Sun, 2005; Garrison, Anderson, & Archer, 2001; Irani, 1998; Lee, Tseng, Liu & Liu, 2007; Schullo, Hilbelink, Venable, & Barron, 2007; Wang, 2003; Zhang & Fulford, 1994; Zirkin & Sumler, 1995). Furthermore, student's personal perceptions of *social presence* ("degree of salience of other person in the mediated interaction" (Short, et. al., 1979, p. 65)) combined with the capabilities of the medium to present personal and emotional connections (Garrison, 2003) influence interaction, which, in turn, sustain or enhance learner motivation and satisfaction. Included in the construct of social presence are concepts of *immediacy* ("physical and verbal behaviors that reduce the psychological and physical distance between individuals" (Baker, 2010, p. 4)) and *intimacy* (a function of eye contact, physical proximity, topic of conversation, etc. (Argyle & Dean, 1965)). Researchers suggest that instructor's immediacy is positively related to student

cognition, affective learning and motivation (Arbaugh, 2001; Baker, 2004, 2010; McAlister, 2001), and that synchronous online instruction provides more immediacy than asynchronous communication alone (Haefner, 2000; Pelowski, Frissell, Cabral, & Yu, 2005). In addition, a number of studies show that synchronous communication helps break down a sense of isolation, assists in the formation of learning communities and promotes interaction and participation (e.g., Dal Bello, Knowlton, & Chafin, 2007; Fox, Morris, & Rumsey, 2007; Gosmire, Morrison, & van Osdel, 2009; Hrastinski, 2008; Schullo, Hilbelink, Venable, & Barron, 2007; Sharma, 2006; Yang & Liu, 2007).

There is much empirical evidence that motivation and its related theory of self-regulated learning are of great importance for academic achievement (Zimmerman 1990; Zimmerman & Schunk 2001). Self-regulated learning is defined as “an active, constructive process whereby learners set goals for their own learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment” (Perry & Smart, 2002, p. 741). In sum, self-regulated learners are motivated, independent, and metacognitively active participants in their own learning (Zimmerman, 1990). Researchers studied online learning argue that in online learning environments, learners have to assume greater control of monitoring and managing the cognitive and contextual aspects of their own learning. Thus, the learner's self-motivation increases as a result of self-regulatory attributes and self-regulatory processes in online learning (Eom, Wen & Ashill, 2006). This research highlights the impact of self-regulation on learning achievement in online learning as well as influence of online learning on learners' motivation or self-regulatory behaviors.

Finally, research points to the relationships between media attributes and task complexity in technology mediated learning. The impact of different technology characteristics to present information and for communication may depend on task complexity (Tan & Benbasat, 1990; Tractinsky & Meyer, 1999). In their Media Richness Theory, Daft and Wiginton (1979) refer “richness” to the medium's capacity for immediate feedback, the number of cues and channels utilizing personalization and language variety. Communications that take a longer time to convey understanding, therefore, are less rich. In this context, the richness of communication features provided by the synchronous and asynchronous tools influence learner's ability to engage in solving problems and completing complex learning tasks. Researchers contend that performance of a more complex task requires the learner to generate a more elaborate mental model (White & Frederiksen, 1990). Skehan and Foster (2001) further explain “task difficulty has to do with the amount of attention the task demands from the participants. Difficult tasks, therefore, require more attention than easy tasks (p. 196).” Thus, it can be concluded that engaging learners in complex learning tasks (e.g., problem solving and critical thinking) in online learning environments requires utilization of rich media that provide immediate feedback, multiple cues, message tailoring, emotions and contextual cues.

The above-mentioned factors and findings derived from the literature were used to conceptualize a framework that could describe the variables under investigation, their impact on the design and implementation of the study and to provide the researchers the opportunity to gather general constructs into intellectual “bins” (Miles & Huberman, 1994, p. 18) (see Figure 1). As shown in Figure 1, it is conceptualized that an online course can be delivered using various communication methods or delivery systems. While in all modes of communication interaction could be between student-content, student-student and student-instructor (Moore, 1989), the richness and quality of this interaction and its impact on learning and motivation may differ depending on the influence of the factors identified by the literature (see Figure 1).

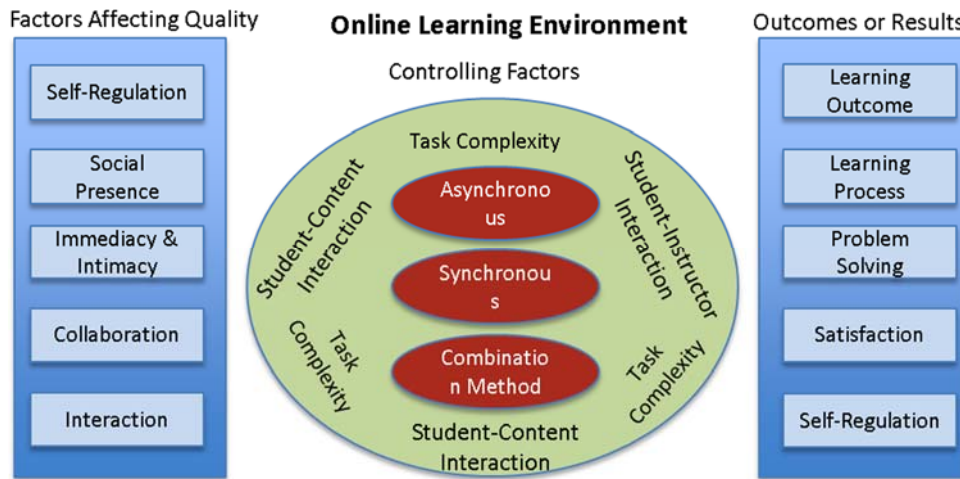


Figure 1. The conceptual framework for the study

## RESEARCH CONTEXT AND PROCEDURE

A small three hour graduate core course (maximum of 15 students) in the Instructional Technology program at a midsize southeastern public university was used to conduct the study. The course is only offered in spring semester in each academic year and is a required course for all students enrolled in the program. Students who enroll in this course have been in the program for at least one semester prior to this course (often fall of the same academic year) and have taken at least three credit hours course in the program. The study was conducted in spring of 2011 and was repeated in spring of 2012 with a new group of students. One of the researchers was the instructor of the record for the course. Fourteen students enrolled in spring 2011 course and 13 students enrolled in spring of 2012. At the beginning of each semester and before the classes started, students were invited to participate in the research by signing a standard informed consent protocol. All enrolled students (both in spring 2011 and 2012) agreed to participate in the study. The study had approval from the university IRB committee.

Three modules (two weeks of instruction for each method of delivery) were used to conduct the study. Module 1 (week 2 and 3) was delivered using asynchronous only method of delivery. Module 2 (week 4 and 5) was delivered using synchronous only method and Module 3 (week 5 and 6) was delivered using a combination method. The first meeting for the course was synchronous and virtual and used as an orientation to explain the course, its syllabus, assignments and problem-based orientation and to form collaborative teams and to complete pre-intervention surveys and questionnaires. In order to ensure consistency in learning strategies and task difficulty for all three modules and across two courses, problem-based learning (PBL) or Constructivist Learning Environments model (Jonassen, 2008) was used as the instructional design framework for the course. Therefore, the focus of learning activities for each module was to solve ill-structured real-world problems to apply targeted knowledge and skills for each module while working in collaborative teams. In addition, the three types of interaction (student-content, student-student and student-instructor) were offered for each module regardless of the communication method. The following provides detail procedure for each module.

*Module 01 (Week 1 and 2) Asynchronous:* Students were assigned readings (e.g., instructors' lecture and multimedia materials) a week earlier. Teams of three or four members were formed to collaborate in completing problem-solving activities for each week. A small group discussion area was created for each team as they worked on their team assignment. A large group discussion forum was also created to provide opportunity for interaction among all students and with the instructor. Students were instructed not to meet synchronously and just use asynchronous tools to communicate and to complete their team assignments even if they might have been in close proximity with each other. At the end of each week, the teams submitted and published their assignment to other groups to review and comment. The instructor also provided written feedback and comments on students' team products and collaboration process in the assignment area.

*Module 02 (Week 3 and 4) Synchronous:* Students were assigned readings (e.g., instructors' lecture and multimedia materials) a week before live/synchronous meeting. During live/synchronous class meeting, students participated in a large group discussion and/or a demonstration with lecture facilitated by the instructor. The large group discussion proceeded with breaking out the large group into small teams that were formed during Module 01. Teams were assigned to collaborate in completing module's problem-solving assignment for the

week during live and synchronous class in their virtual breakout meeting rooms. Students were offered to continue team discussion in their team's designated virtual room to follow up on live or synchronous class and team discussion. However, students were instructed to only use synchronous meetings for completing weekly team activities. At the end of each week's live meeting, teams presented their assignment to other groups to review and comment and later submitted it in the assignment area. The instructor also reviewed students' product and collaborative process and offered feedback during synchronous or live meeting. In addition to oral comments from both students and the instructors, the instructor provided written feedback on teams' products and collaboration process in the team assignment area.

*Module 03 (Week 5 and 6) Combination:* Students were assigned readings (e.g., instructors' lecture and multimedia materials) a week earlier. Students were also assigned to work with their previously formed teams and were instructed to begin discussing and collaborating with their teams on each week's problem-solving assignment using a small group discussion in the forum area. A large group discussion forum was also created to provide opportunity for interaction among all students and with the instructor before live and synchronous class discussion. A live and synchronous class discussion and team meetings followed the asynchronous large and small group discussion. During the live and synchronous class meeting, students participated in a large group discussion and/or a demonstration with lecture facilitated by the instructor. The large group discussion proceeded with breaking out the large group into small teams (breakout rooms). Teams then presented their assignment for both peers' and instructor's review and comments and later submitted in the assignment area. As with the previous modules, in addition to oral comments, the instructor also provided written feedback and comments on students' team product and collaboration process.

The course content and course-related communication and interactions were delivered using Blackboard vista (2011) and Blackboard 9 (2012). Horizon Wimba (2011) and WebEx (2012) video conferencing system or Synchronous Communication Systems (SCS) were used for conducting real time classroom discussion and collaborative group work and presentations. Both SCS systems enabled users to communicate using audio, video, and text and to share files, resources, and presentations using applications such as PowerPoint and Flash. Both platforms also offered functionalities such as application and desktop sharing, which were used for collaboration on jointly developed documents, or for other instructional purposes. For synchronous delivery module, while all students used SCS to communicate with each other and the instructor during live interaction, some students were also physically present in the classroom and had an opportunity to see each other face-to-face and distance students through Cisco large video panel in the classroom and video camera on their laptops and to collaborate with distance students using SCS breakout rooms. All students participated in instruction of three units. All assignments, problem-solving activities and discussion topics were kept consistent across the three modules.

## **PARTICIPANTS**

Fourteen students enrolled in spring 2011 course and 13 students enrolled in spring of 2012. Table 2 summarizes student demographic information in each semester. As it is shown in Table 1, students were varied in their age and work experiences in both semesters. While 71-61% of students in each semester indicated that they had not taken an online course that used a synchronous communication tool before, about the same percentage (63-69) noted that they had taken online courses that had used asynchronous communication tools. According to the demographic data, in both semesters students were heterogeneous with regard to age, background and experiences. Students' prior work experiences ranged from teaching to working in business and industry, military and private sectors. In spring of 2011, 35% of students had teaching background in k-12, 10% had administrative background in public schools and higher education and 55% had business and corporate experience. In spring of 2012, 69% of students had teaching background while 30.8 % had experience working in business and industry. In spring 2011, 57% of students were full time and 43% were part time. In spring of 2012, 46% were full time and 54% were part time.

**Table 1.** Student demographic data

Questions	%		%		%	
	Spring 2011 (N = 14)		Spring 2012 (N = 13)		2011 & 2012 (N = 27)	
Previously taken an online course that used synchronous communication tools	Yes 28.6	No 71.4	Yes 38.5	No 61.5	Yes 33	No 67
Previously taken an online course that primarily used asynchronous communication (forum; e-mail) tools	Yes 63.3	No 35.7	Yes 69.2	No 30.8	Yes 67	No 33
Number of credit hours taken in the program?	3-9 courses		2-10 courses		2-10 courses	
Age	22-30 50	31+ 50	22-30 38.5	31+ 61.5	22-30 42.4	31+ 53.6
Gender	M 28.6	F 71.4	M 46.2	F 53.8	M 37	F 63
Prior college degrees.	BS/B A 85	ML A 15	BS/B A 100	MS/M A 0	BS/B A 85	ML A 15
Prior years' work experience	2-24		6-27		2-27	

During the first class meeting (orientation to the course) students were asked to complete Felder and Soloman's (1998) Index of Learning Styles Survey (a self-scored survey) and report their results to the instructor. Table 2 shows the results. With regard to how students preferred to process information, in 2011 more students were reflective learners (learning by thinking things through; working alone) while in 2012 the majority of students were active learners (learning by trying things out; working with others). In both years, more students were oriented toward learning facts and procedures (sensing) rather than concepts, theories and meanings (intuitive) and were more visual than verbal. In 2011, similar number of students preferred learning sequentially (in small steps and in orderly manner) and globally (learning holistically and in larger steps). However, in 2012, more students preferred learning sequentially.

**Table 2.** Students' learning styles results

Learning Styles	% % (#/13) 2011 (#/13) 2012	Learning Styles	% % (#/13) 2011 (#/13) 2012	Learning Styles	% % (#/13) 2011 (#/13) 2012	Learning Styles	% % (#/13) 2011 (#/13) 2012
Reflective	53.8 (7) 7.1 (1)	Intuitive	23.1 (3) 7.7 (1)	Visual	61.5 (8) 61.5 (8)	Sequential	46.2 (6) 69.2 (9)
Active	38.5 (5) 76.9 (10)	Sensing	69.2 (9) 76.9 (10)	Verbal	38.5 (5) 30.8 (4)	Global	53.8 (7) 23.1 (3)
Balanced	7.7 (1) 15.4 (2)	Balanced	7.7 (1) 15.4 (2)	Balanced	0 7.7 (1)	Balanced	0 7.7 (1)

## METHODOLOGY

The study adopted an interpretive or descriptive case study methodology to explore the questions of the study in its context using variety of data sources (Yin, 2003, 2014). According to Yin (2003), a case study design should be considered when: (a) the focus of the study is to answer "how" and "why" questions; (b) it is difficult to manipulate the behavior of those involved in the study; (c) it is important to cover contextual conditions because they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. Thus, even though the results are limited in terms of "generalizability," a case study methodology was found to be suited for the study because it allowed the researchers to gain deeper insights into values of various communication methods for delivery of online courses.

Multiple sources of data were used to test the consistency of the findings and to examine various factors across different communication methods. The following data-gathering strategies were used: (1) questionnaires to measure student self-regulation, perception of social presence, immediacy and intimacy and student satisfaction;

(2) an inventory to assess student learning styles; (3) archive records of student collaboration during group work; (4) results of assessment (knowledge quizzes and solutions to the problem solving tasks) of students' learning of the content and achievement of the modules' objectives; (5) instructor's perception and reflection logs and students' responses to reflective questions at the end of each intervention/module; and (6) archive of student postings, chat logs and audio archive of SCS class discussion.

Different techniques (quantitative and qualitative) were used to organize and systematically review and analyze various types of information. Statistical analyses examined the interrelationship among variables within each delivery method first, and then the results were used to make comparisons across the three methods of delivery, looking for differences, similarities and patterns. In addition, comparative analysis was conducted between data collected in spring 2011 and the replicated study in spring 2012. The primary focus of this comparative analysis was on the overall pattern of results and the extent to which the observed pattern of variables in 2012 matched those of 2011 and if not what differences were observed.

## RESULTS

**Research Question 1.** *How do various communication methods (synchronous, asynchronous and combined) impact factors such as motivation and self-regulation, social presence, immediacy and intimacy, satisfaction, collaboration and interaction?*

### SELF-REGULATION

Student self-regulation skills were assessed at the beginning and at the end of each module using Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1991). However, in order to triangulate the consistency of the results, motivation or student self-regulation skills were also assessed using observation of students' behaviors using criteria such as participation in collaborative activities and discussion, interaction with the content and responses to a series of reflective questions.

The adopted scale for assessing self-regulation consisted of 38 items (scale of 1-7; 1=not true of me; 7 = very true of me) in six categories: *Intrinsic* (4 items), *Extrinsic* (4 items), *Task Value* (6 items), *Control of Learning Beliefs* (4 items), *Self-efficacy* (8 items), and *Self-regulation* (12 items) with reported reliability ranged from 0.52 to 0.93 (Pintrich, et al, 1991). The survey was administered prior to the intervention and then administrated at the end of each method. The Cronbach's alpha reliability Co-efficient was .74 (2011) .96 (2012) for 38 items in six categories. The data collected from both semesters were analyzed using a paired sample *t*-test. The results did not show any significant difference between students' self-regulation prior to the course and after each intervention. Students' overall average score on four items measured *intrinsic motivation* was high prior to the course (ranging from 6.46 to 5.25) and remained high at the end of each module with slightly better scores for synchronous and mixed methods (see Appendix A). Students' overall average score for 4 items measured *extrinsic motivation* was lower (5.55 to 3.62) compared to intrinsic motivation (6.43 to 5.55) prior to the intervention, and remained the same at the end of each module suggesting that students appeared to remain more intrinsically motivated to learn the content of the course (see Appendix A). The overall average scores for extrinsic motivation across the three delivery methods in 2011 were higher suggesting that 2011 students were more extrinsically motivated.

The overall average score for six items measured *task-value* was high prior to the intervention and remained consistently high at the end of each method. This result was not surprising since the course is a required foundation course and students perceive the course content as being important to their program of study (see Appendix A).

The overall average scores for four items measured *control of learning* were high prior to the intervention. The average score for one of the two negative items ("If I don't understand the course it is because I did not try hard enough") declined slightly (although not significantly) at the end of module two (synchronous learning approach) in 2011 (5.9 to 4.9) suggesting that students seemed to feel more in control of their own learning before intervention. This difference was also observed in year 2012 data (from 5.5 to 5.0) although not significant. In year 2012, pairwise comparison of the average score between pre-intervention and the three delivery methods for a positive item ("If I try hard enough then I understand the course materials") showed significant difference between pre-intervention and after module one (asynchronous method) (M difference = 0.45 (SD =.69);  $t(2.19, df = 10) p < .05$ ) and module two (synchronous method) (M difference = 0.80 (SD=1.03);  $t(2.45, df =9) p < .05$ ). Again, this result suggests that 2012 students felt more confident in their ability to control their own learning before the intervention and it is likely that they lost some of this confidence after the synchronous and asynchronous methods (see Appendix A). There was no significant difference between pre-

intervention and combination method suggesting that the control of learning was sustained during combination method.

The overall average scores for eight items measured *self-efficacy* as high (6.72 to 5.42) prior to the intervention and remained consistently high at the end of each method with no significant difference between students' self-efficacy prior to the course and after each intervention.

The overall average scores for ten out of 12 positive items measured *metacognitive or self-regulation* skills as moderately high and remained moderately high (6.14 to 4.93) at the end of each method, with no significant improvement. Average scores for two negative items were also moderately low prior to the intervention and remained moderately low (4.78 to 3.57) with no significant decrease at the end of each method. Although not significantly different, mean scores in 11 items (except for item 34) in both years were slightly higher for the synchronous and combination methodologies, suggesting that students' motivation or self-regulation might have improved slightly at the end of the synchronous and combination methods.

In sum, the results of self-regulation survey pointed to no significant changes across various methods of delivery. However, slight positive changes were observed in student self-regulation for the combination methodology. As indicated earlier, observation of students' behaviors also confirmed this result. In addition, students' responses to the reflective questions indicated that in response to the question: "Overall, how would you explain your learning experiences for the past two weeks? Do you think you achieved the modules' objectives? If not why, if yes, how?" more students indicated that they achieved the objectives of the module at the end of combination method and thought the mixed method allowed them multiple opportunities for learning the materials. Analysis of self-regulation data, therefore, suggests that it is very likely that students' motivation or self-regulation are influenced by factors other than the communication method.

### **SOCIAL PRESENCE**

A 12 item social presence scale originally constructed by Gunawardena and Zittle (1997) measured students' reaction to social presence or student ability to participate in community of inquiry to construct meaning (scale of 1 to 5, 1 = very unsatisfied, 5 = very satisfied) in three categories: *affective* or expression of emotion (5 items), *interactive* or open communication (4 items) and *cohesive* or group commitment and sense of belonging (3 items). Modification of the wording of the scale was made as needed to adjust it to the courses content. Permission was obtained from Gunawardena to make these minor modifications and use the scale. Cronbach's alpha reliability for the 12 items was .82. Students in both years consistently scored the synchronous and combination method higher than the asynchronous method for all 12 items. In addition, except for item one ("Messages in the unit were impersonal") and nine ("Discussions using the classroom technology tend to be more impersonal than face-to-face discussions"), there was significant difference between the asynchronous and combination method for 10 items for both 2011 and 2012 years and between the asynchronous and synchronous and combination method for some items within the categories of affective and cohesion (see Table 3).

Analysis of overall scores for both years using a paired sample *t*-test showed that the average scores for all items except item 1 ("Messages in the unit were impersonal") increased significantly between the asynchronous and combination method as well as in four areas in the category of affective between the asynchronous and synchronous and synchronous and combination method. Significant difference was also observed in item five ("The introductions in the unit enabled me to form a sense of online community") and item 12 ("I was able to form distinct individual impressions of some course participants") between the synchronous and combination method.

The consistency of the results of the social presence survey for both years confirms that students see more likelihood for emotional expression and group interaction and collaboration in the combination method approach. However, students did not see significant difference in communicating freely and openly across various methods, although some differences were observed in favor of the synchronous versus asynchronous method. This result is not surprising since the combination method provided more opportunities for establishing interpersonal and emotional connections, which could have created a stronger sense of social presence. In addition, the results suggest that social presence is still stronger (although not significantly different) for the synchronous method compared with the asynchronous method.



Table 3. Results of social presence

Item Scale 1-5 (1 = very unsatisfied, 5 = very satisfied) Item 1-5 (affective); 6 - 9 (interactive); 10 -12 (cohesive)	Asynch		Synchs		Mixed	
	M (SD)	N	M (SD)	N	M (SD)	N
1. Messages in the unit were impersonal.	3.33 (.89)	12	3.33 (.78)	12	3.75 (.97)	12
	3.71 (1.2)	14	3.46 (.69)	11	3.36 (.92)	11
2. The communication used in this unit was an excellent medium for social interaction.	2.25 (1.3)	12*	3.42 (1.1)	12*	4.50 (.67)	12*
	2.79 (.80)	14*	3.55 (1.2)	11*	4.55 (.52)	11*
3. I felt comfortable conversing through this unit's medium.	2.83 (1.0)	12*	3.75 (1.2)	12*	4.75 (.62)	12*
	3.21 (1.1)	14*	3.82 (.60)	11*	4.46 (.52)	11*
4. I felt comfortable introducing myself in this unit.	3.67 (1.0)	12*	4.42 (.52)	12	4.75 (.52)	12*
	3.71 (.83)	14	4.18 (.75)	11	4.73 (.47)	11
5. The introductions in the unit enabled me to form a sense of online community.	3.17 (.94)	12*	3.00 (1.2)	12*	4.50 (.52)	12*
	3.29 (.73)	14*	3.64 (1.1)	11	4.36 (.51)	11*
6. I felt comfortable participating in the discussions.	3.67 (.78)	12	3.92 (1.1)	12	4.33 (.89)	12
	3.64 (1.0)	14*	4.00 (.63)	11*	4.55 (.52)	11*
7. The instructor(s) created a feeling of a community.	4.00 (.74)	12	4.08 (.90)	12	4.33(.65)	12
	3.43 (.76)	14*	3.82 (.75)	11	4.46 (.69)	11*
8. The instructor(s) facilitated discussions in the modules.	4.00 (.74)	12	3.91 (.83)	12	4.25 (.87)	12
	3.64 (.63)	14*	3.82 (.98)	11*	4.64 (.51)	11*
9. Discussions using the classroom technology tend to be more impersonal than face-to-face discussions.	3.00 (1.0)	12	3.33 (1.2)	12	3.75 (1.1)	12
	3.57 (1.3)	14	3.82 (.87)	11	4.20 (.78)	11
10. I felt comfortable interacting with other participants throughout the unit.	3.58 (1.1)	12*	3.58 (1.2)	12*	5.58 (.90)	12*
	3.43 (1.1)	14*	4.09 (.30)	11	4.27 (.65)	11*
11. I felt that my point of view was acknowledged by other participants throughout the unit.	3.58 (.90)	12*	3.83 (1.2)	12	4.58 (.52)	12*
	3.50 (.86)	14	4.09 (.54)	11	4.18 (.60)	11
12. I was able to form distinct individual impressions of some course participants	3.23 (1.1)	12*	3.92 (.97)	12	4.17 (.72)	12*
	3.36 (.84)	14*	4.00 (.63)	11	4.00 (.78)	11*

\*Significant Difference (p<.05)

### IMMEDIACY AND INTIMACY

A 34-item scale (items taken from a scale created by Gorham, 1988) measured students' reaction (scale of 1 to 5) to the construct of social presence as it relates to *immediacy* ("physical and verbal behaviors that reduce the psychological and physical distance between individuals" (Baker, 2010, p. 4)) and *intimacy* (a function of eye contact, physical proximity, topic of conversation) in two categories of verbal (20 items) and non-verbal (14 items) communication. Cronbach's alpha reliability for the scale was .78. Interestingly enough, except for a few items that addressed instructor's physical gestures during communication (e.g. "Looks at class while talking"; "Gestures while talking") there were no significant differences across the asynchronous, synchronous and combination methods for the majority of the items in the categories of verbal and non-verbal communication (see Table 4). However, the average scores for two items in the category of verbal showed significant differences between the asynchronous and synchronous methods, although average score for the first item was low (item 1: "Uses personal examples or talks about experiences she/he has had outside of class" (M difference = -.46 (SD = 1.0); t (-2.11 (df = 21) p<.05); item 5: "Addresses students by name" (M difference = -.18 (SD = .40); t (-2.2 (df = 21) p<.05). There was also a significant difference in item 19 ("Will have discussions about things unrelated to class with individual students or with class as a whole") between the asynchronous and synchronous methods (M difference = -.18 (SD = .85); t (-2.2 (df = 21) p<.05) and between the asynchronous and combination method (M

difference = -.68 (SD = 1.0);  $t$  (-3.2 (df = 21)  $p < .05$ ). A significant difference was also found between the asynchronous and combination method for item 16 (“Asks questions that solicit viewpoints or opinions”) (M difference = .48 (SD = .74);  $t$  (2.36 (df = 20)  $p < .05$ ).

Table 4. Results of immediacy and intimacy

Answer Options Item 1-20 (Verbal) Item 21-34 (Non-verbal)	Asynch 2011M(SD) 2012 M (SD)	Synch 2011M (SD) 2012 M (SD)	Mixed 2011 M (SD) 2012 M (SD)
1. Uses personal examples or talks about experiences s/he has had outside of class.	3.66 (1.07)* 3.54 (.97)	4.09 (.93)* 3.82 (.98)	3.89 (1.2) 3.64 (.92)
5. Addresses students by name.	4.83 (.39)* 4.70 (.48)	4.90 (.30) * 5.00 (.00)	4.78 (.44) 4.91 (.30)
16. Asks questions that solicit viewpoints or opinions.	4.91 (.30)* 4.46 (.52)	4.37 (.67) 4.64 (.51)	4.33 (.71)* 4.20 (.63)
19. Will have discussions about things unrelated to class with individual students or with class as a whole.	2.17 (1.1)* 2.23 (.83)	2.82 (1.1)* 2.36 (.92)	2.89 (.93)* 2.73 (1.2)
22. Gestures while talking to class.	3.67 (1.07) 3.39 (1.1)	4.09 (.54) 3.73 (1.1)	4.00 (.71) 3.64 (1.1)
31. Stands behind podium or desk while teaching.	2.92 (.94) 3.82 (1.27)	3.27 (1.68) 3.09 (.83)	3.56 (1.3) 3.18 (1.3)

\*Significant Difference ( $p < .05$ )

Overall, the results of the immediacy and intimacy survey show that except for a few physical behaviors that are naturally absent in an asynchronous communication method and verbal intimacy behaviors that are often established as a result of physical proximity, there is no major difference across various communication methods. In other words, when learning strategies emphasize multiple forms of interactions, collaboration among students and instructor’s feedback (high social presence), students do not feel a sense of isolation, are able to form learning communities, and use interaction and collaborative problem-solving activities to feel closer to their peers and the instructor.

### STUDENT SATISFACTION

Student satisfaction was measured at the end of each intervention using a 20-item questionnaire (scale of 1 to 5, 1 = very unsatisfied, 5 = very satisfied) with three sub-categories: *teacher social presence* (6 items); *teacher support* (8 items) and *student interaction and collaboration* (6 items). The survey items were compiled from the literature. Cronbach’s alpha reliability was .91. The results showed that 2011 students rated items related to “teacher social presence” higher for the synchronous method and highest for the combination method, although the differences except for item 5 (“Overall, the instructor for this course helped to keep students engaged and participating in productive dialog”) were not significant. However, the results were somewhat different for year 2012. Students in 2012 rated all six items in the category of teacher social presence significantly different between the asynchronous and combination methods, as students in year 2012 thought the instructor’s social presence was significantly higher for the combination method compared with the asynchronous method. The difference between the asynchronous and synchronous was not significant.

Students in years 2011 and 2012 also rated all items related to the category of “teacher support” higher for the synchronous and highest for the combination method with significant difference between the asynchronous and combination method for year 2012 for all items except the two items that measured instructor’s feedback. The latter result suggested that 2012 students felt more supported by the instructor during the combination approach compared with the asynchronous method. However, they did not think that the instructor’s feedback was significantly different across all three methods, although slightly better in the synchronous and combined methods.

Items measured “student interaction and collaboration” showed similar pattern of response. Both 2011 and 2012 students scored the synchronous and combination approaches higher than the asynchronous approach, although the difference except for item 15 (“I work with others”) was not significant. 2012 students rated item 15 significantly higher for the combination method compared with the asynchronous method suggesting that they had more opportunities to work with others when combination method was used.

Table 5. Results of student satisfaction

<b>Answer Options</b>	<b>Asynch</b>	<b>Synch</b>	<b>Mixed</b>
<b>Item 1-6 (Teacher Social Presence)</b>	2011 M (SD) 2012 M (SD)	2011M (SD) 2012 M (SD)	2011 M (SD) 2012 M (SD)
1. Overall, the instructor for this course was helpful in identifying areas of agreement and disagreement on course topics that assisted me to learn.	4.15 (.69) 3.62 (.87)*	4.23 (.60) 4.00 (.77)	4.60 (.70) 4.39 (.87)*
2. Overall, the instructor for this course was helpful in guiding the class towards understanding course topics in a way that assisted me to learn.	4.46 (.77) 3.54 (.88)*	4.61 (.65) 4.09 (.83)	4.70 (.48) 4.40 (.51)*
3. Overall, the instructor in this course acknowledged student participation in the course (for example replied in a positive, encouraging manner to student submissions).	4.54 (.66) 4.00 (.58)	4.61 (.65) 4.00 (.89)	4.60 (.52) 4.39 (.65)
4. Overall, the instructor for this course encouraged students to explore new concepts in this course (for example, encouraged "thinking out loud" or the exploration of new ideas).	4.39 (.87) 4.00 (.58)*	4.38 (.87) 3.91 (.83)	4.20 (.79) 4.62 (.51)*
5. Overall, the instructor for this course helped to keep students engaged and participating in productive dialog.	4.46 (.66) 3.54 (.88)*	4.46 (.66) 3.91 (.94)*	4.70 (.79)* 4.58 (.70)*
6. Overall, the instructor for this course helped keep the participants on task in a way that assisted me to learn.	4.54 (.66)* 3.54 (.88)*	4.53 (.66) 3.91 (.94)	4.70 (.48)* 4.69 (.61)*
<b>Item 7-14 (Teacher Support)</b>			
7. If I have an inquiry, the instructor finds time to respond.	4.69 (.75) 4.15 (.90)*	4.62 (.77) 4.55 (.52)	4.90 (.31) 4.95 (.55)*
8. The instructor helps me identify problem areas in my study.	4.08 (1.04) 3.46 (.88)*	4.39 (.87) 4.09 (1.1)	4.00 (1.05) 4.59 (.80)*
9. The instructor responds promptly to my questions.	4.54 (.78) 3.93 (.64)*	4.69 (.63) 4.55 (.82)	4.90 (.31) 4.85 (.82)*
10. The instructor gives me valuable feedback on my assignments.	4.39 (.96) 3.90 (.76)*	4.46 (.97) 4.18 (.98)	4.60 (.70) 4.65 (1.14)*
11. The instructor adequately addresses my questions.	4.39 (.87) 4.00 (.71)*	4.54 (.78) 4.64 (.51)	4.80 (.42) 4.61 (.65)*
12. The instructor encourages my participation.	4.54 (.78) 4.08 (.86)*	4.54 (.78) 4.45 (.69)	4.60 (.70) 4.77 (.44)*
13. It is easy to contact the instructor.	4.62 (.65) 4.31 (.75)*	4.62 (.87) 4.55 (.93)	4.90 (.32) 4.77 (.44)*
14. The instructor provides me with positive and negative feedback on my work.	4.62 (.86) 4.27 (.80)	4.62 (.87) 4.50 (.71)	4.60 (.70) 4.60 (.66)

Item 15-20 (Students Interaction & Collaboration)			
15. I work with others.	4.61 (.87) 4.33 (.60)*	4.85 (.38) 4.45 (.69)	4.90 (.32) 4.61 (.51)*
16. I relate my work to others' work.	4.31 (.63) 4.15 (.69)	4.38 (.65) 4.27 (.65)	4.30 (.95) 4.38 (.65)
17. I share information with other students.	4.46 (.66) 4.30 (.63)	4.54 (.66) 4.45 (.52)	4.70 (.48) 4.46 (.78)
18. I discuss my ideas with other students.	4.38 (.65) 4.23 (.60)	4.46 (.66) 4.36 (.80)	4.50 (.71) 4.53 (.66)
19. I collaborate with other students in the class.	4.69 (.48) 4.15 (.80)	4.77 (.44) 4.36 (.67)	4.80 (.63) 4.46 (.77)
20. Group work is a part of my activities.	4.70 (.48) 4.30 (.48)	4.77 (.44) 4.36 (.67)	5.00 (.00) 4.3 (.66)
2011 N	13	13	10
2012 N	13	11	13

\*Significant Difference ( $p < .05$ )

Cross analysis of the results of satisfaction survey with students' learning styles indicated that the differences between students' rating in year 2011 and 2012 could have been due to differences in students' preferred learning styles and their strong opinion about learning. While more than half of the students (54.5%) in year 2011 were reflective learners the majority of students in year 2012 were active learners (75.6%). Further analysis of students' responses to open-ended reflective questions at the end of each method confirmed that reflective learners tended to be more positive about the asynchronous only communication method compared with active learners, although it appeared that using various methods helped students reconsider their preferred styles of learning. The following are example excerpts of the comments made by the active and reflective learners.

#### Active learners

"... Over the past two weeks I realized that I rely on auditory information to aid me in fully understanding the material."

"... I prefer to discuss ideas rather than contribute in a written thread."

"... I like being able to bounce ideas/thoughts/questions off of others. It was difficult not having that class discussion."

"... I get a lot out of the face-to-face meetings and discussion about the topic." "The advantage was that I like to talk over topics in real-time and have an exchange of ideas."

#### Reflective learners

"... It was easier to focus on the texts and use the discussion area to improve my understanding."

"... I had to re-read the materials for better understanding and try to answer my own questions."

"... I am a thinker who needs to process and think about stuff and then it kind of comes to me in a flash and that was easier to do when I didn't have a lot of "voices" coming at me in a group conversation where I have to think on the run and process what everyone is saying with no time to think about it.

"... because I was forced to do more writing and pay closer attention to the readings."

Overall, the results of this survey showed that students' satisfaction was high regardless of the method of delivery, although students appeared to be more satisfied with combination methodology. The results further showed that students' satisfaction was higher (although not significantly) for the synchronous and combination methods in the two categories of "teacher social presence" and "student interaction and collaboration" and significantly higher for combination method in the category of "teacher support." This result suggests that students appear to be more satisfied with the synchronous and combination methodology in these very important areas.

**Research Question 2.** *How do various communication methods (synchronous, asynchronous and combined) impact student collaboration and interaction as well as learning process and learning outcomes?*

In addition to satisfaction survey items that measured collaboration and interaction across three methods of instruction, student collaboration and interaction were also assessed using archive records of student collaboration during group work, reflective questionnaire at the end of each module and assessment of teams' solutions to the problems (team activities). As indicated earlier, survey items showed that students rated

collaboration and interaction somewhat higher for synchronous and combination method (although not significantly except for one item) compared with asynchronous method. This finding was consistent with the students' responses to the reflective questions in which they thought it was easier to work with their peers to complete problem-solving activities during combination method although they were still able to work collaboratively in both asynchronous and synchronous only methods as well.

The following are excerpts of students' responses to reflective questions at the end of each communication method.

#### **Synchronous only method**

“ . . . It was a bit inefficient to have to talk about everything, instead of being able to post questions or comments for later reflection or response.”

“I felt it was harder to get together with team members since we had to meet in real time, but the end result was much better since we didn't have to wait for feedback.”

“The team work was easier in that we were VERY focused to complete the activity so it did not carry on and on thereby requiring additional meetings.”

“ . . . I found it easier in that we could discuss activities face to face, but it also was difficult in that if I didn't make the meetings or class, I did not know what was going on and could not contribute to the activities or to class.”

#### **Asynchronous only method**

“ . . . The biggest challenge for me was in having to wait online for people to respond to simple questions or tasks that involved procedures.

“ . . . The challenge was in doing the activities just through the discussion area. But, the advantage was to be more with ourselves in developing our understandings of the readings.”

“ . . . Even though our team was able to complete the assignments and I was able to provide valuable contributions to the process, I disliked the lack of a team dynamic or harmony on our projects.”

“We spent a lot of time in discussion threads and it was tough to collaborate. We would have saved a lot of time, if we could have talked in person or Skype.”

“I found myself stressed; trying to find time to respond to discussion boards and be an active participant. I also was trying to be a good team member and regularly respond and read responses from my team mates.”

#### **Combination method**

“ . . . My learning experience has been a lot better (clearer). My team and I enjoy working and learning together. It has been a lot easier on all of us because we are all teachers with full time jobs and other classes.”

“ . . . I usually attempt to post information on a discussion board and then follow up with telephone, texts or chats. I like for people to have an opportunity to read through an assignment and sometimes trying to talk it out immediately doesn't work best for everyone.”

“ . . . I would say that my experience is substantially improved over having the limitations of synchronous and asynchronous only communication. Adding further, I felt significantly less frustrated with the material than I had with the previous restrictions.”

“ . . . This was my favorite so far. It is much easier to coordinate when it comes to team assignments. We can use the discussion space but also talk about it "live" which is the best of both worlds. There really weren't any challenges that I saw.”

Archive of students' interaction during team work was further analyzed using Theory of Interaction and Performance (TIP) developed by McGrath (1991). McGrath (1991) states that successful groups always undertake three functions at the same time: (1) the first is working on a common task together (*production function*); (2) the second is achieving and facilitating a quality interaction and communication among group members (*group well-being*); (3) the third is providing effective help to the other members when needed (*member support*). Using TIP theory, archive of students' interactions were analyzed to evaluate their effectiveness (scale of 1 to 3 with 1= low; 2 = moderate and 3 = good) regarding task performance (defined by instructor's assessment of the quality of each team's written solution/response to the problem solving activity using a rubric) and group functioning (defined as (1) all group members interacted effectively with one another

(actively participated in creating, changing and reading or listening) and (2) each member took proper role and action and supported other members' ideas and contributions.

Analysis of teams' rating for the three functions showed that the quality of teams' products (written solution/response) differed across teams when different communication methods used (see Table 6). There was a significant difference in team's performance between asynchronous and synchronous method (M difference = -.661 (SD =7.23);  $t(-4.75)$  (df = 26)  $p<.00$ ) and synchronous and combination method (M difference =4.76 (SD =8.14);  $t(3.04)$  (df = 26)  $p<.005$ ). However, there was no significant difference between asynchronous and combination method, although overall, teams did better in combination method. In addition, comparison of 2011 teams' products with 2012 teams' products show that overall, 2011 teams performed better across all three methods. Analysis of group function (measured by the degree of members' participation in the discussion and the quality of their contributions) pointed to higher score in degree of participation during synchronous and combination methods, but higher quality of contributions by team members during asynchronous and combination method. In addition, there was more verbal evidence of member support during synchronous and combination method compared with the asynchronous method. It appeared that during the asynchronous method, teams' discussion was mainly focused on members' contributions to construction of the response, although there were some support messages. On the contrary, during synchronous discussion (in both synchronous and combination method), team members offered more quick thoughts and supported each other (e.g., agreed with each other) more often, although the content of their contributions were not the same quality compared with asynchronous discussion. In addition, it appeared that during synchronous method, teams' recorders tended to incorporate more members' comments in their formulation of the final responses (teams often used Google doc to formulate team's discussion) during synchronous method than they did during asynchronous method. Teams' responses often included more of the team's recorder's thoughts than individual members.

**Table 6.** Results of assessment of teams' solutions to problem solving activities

Team Problem Solving Activities	Teams' Average Scores (2011) M (SD)	Teams' Average Scores (2012) M (SD)	Average 2011 & 2012 N = 27	Combination of both Activities M (SD) (2011 & 2012)
Asynchronous Only	87.69 (5.25) (N= 13)	67.50 (8.49) (N = 14)	77.22 (12.43) (N = 27)	<b>79.72</b> (9.72)
Activity 1 Activity 2	86.92 (5.96) (N = 13)	77.66 (6.42) (N = 14)	82.22 (7.64) (N = 27)	
Synchronous Only	91.92 (2.53) (N = 13)	85.71 (9.37) (N = 14)	88.70 (7.54) (N = 27)	<b>86.33</b> (7.42)
Activity 3 Activity 4	88.08 (9.25) (N = 13)	82.29 (12.20) (N = 14)	85.07 (11.07) (N = 27)	
Combination	93.85 (2.19) (N = 13)	73.93 (18.62) (N = 14)	83.52 (16.69) (N = 27)	<b>81.57</b> (12.82)
Activity 5 Activity 6	78.07 (15.35) (N = 13)	81.07 (12.43) (N = 14)	79.63 (13.72) (N = 27)	

For each module two quizzes assessed individual students' knowledge. Table 7 summarizes student performance in modules' quizzes. Students' average scores for modules' quizzes were consistent with teams' performance in problem solving activities. Overall, pairwise comparison of the average scores showed significant differences between synchronous and asynchronous methods (M difference =-24.2 (SD =13.30);  $t(-9.28)$  (df = 25)  $p<.00$ ), asynchronous and combination methods (M difference =-20.1 (SD =14.36);  $t(-9.28)$  (df = 25)  $p<.00$ ) and between synchronous and combination methods (M difference = 4.21 (SD = 6.93);  $t(3.15)$  (df = 25)  $p<.05$ ). Overall, 2011 students did better across all three methods, although the differences were not significant. In addition, students in both years consistently scored higher in quiz 2 of each module. This result might be because by the time students completed quiz 2 of each module, they had a much better understanding of the content. However, the lower scores for combination method compared with the synchronous method were somewhat surprising, given more opportunities that students had to clarify their understanding of the content. Further analysis of students' postings in the asynchronous class discussion before and after synchronous meeting during combination method indicated that before synchronous class discussion students tended to summarize their thoughts regarding readings and after the synchronous discussion only a few posted resources and confirmation of the previous thoughts. Thus, it did not appear that the discussion before and after synchronous

meeting had any impact on clarification of students' thoughts regarding the content, but provided more opportunities for sharing. However, students' posts in the discussion forum during asynchronous method were more focused on exploring examples and asking for more clarification of the content of the module. More data and deeper analysis is required to explore whether or not students' expectation of having access to asynchronous discussion forum impacted their concentration and attention during synchronous meeting, although in reality they did not take advantage of the asynchronous forum for more exploration and deeper understanding.

**Table 7.** Results of quizzes across three communication methods

Modules	Quizzes	Average Score 2011 M (SD)	Average Score 2012 M (SD)	Average Score Combined Quizzes (2011 & 2012)
Asynchronous Only (Week 1 & 2)	Quiz 1	54.67 (27.60) N = 12	57.43 (22.27) N = 12	<b>61.23 (15.49)</b>
	Quiz 2	77.37 (14.93) N = 14	56.81 (15.02) N = 14	
Synchronous Only (Week 3 & 4)	Quiz 3	50.94 (27.65) N = 12	62.50 (16.07) N = 13	<b>85.78 (8.08)</b>
	Quiz 4	70.08 (28.03) N = 12	54.08 (23.19) N = 12	
Mixed Method (Week 5 & 6)	Quiz 5	50.52 (30.51) N = 13	69.36 (18.33) N = 11	<b>81.57 (12.83)</b>
	Quiz 6	81.54 (20.87) N = 13	77.64 (19.32) N = 11	

## CONCLUSION

The purpose of the study was to compare three communication methods (synchronous web-conferencing; asynchronous and a combined method of synchronous and asynchronous) while keeping learning strategies consistent across each method to find out how they influence learner self-regulation, social presence, satisfaction, interaction and learning process and outcomes, in small, interactive and collaborative online courses. The results suggested that factors other than communication methods maybe responsible for learner self-regulation. The students who participated in this study were graduate students with the majority being professionals who were either working in education or business and industry. Thus, the students' age, profession and personal interest may have played a major role in their motivation or self-regulation. However, as shown by the literature (e.g., Artino & Stephens, 2009; Dabbagh & Kitsantas, 2004; Delen, Liew & Willson, 2014; Lou & Macgregor, 2004; Oliver & Omari, 1999), it is also likely that strategies (e.g., small and large group interaction, collaboration, peer and instructor feedback and problem-solving activities) that were used to deliver instruction in this study supported regulating and sustaining students' motivation. In other words, although students entered the course with high level of motivation (self-regulation, self-control, intrinsic motivation and task value), they could have lost their motivation if learning strategies were not interactive and engaging. Future studies should control variables such as students' age, gender, experience, personal interest across various communication methods.

The study further revealed that there was a relationship between student satisfaction and perception of social presence and the three methods of communication for delivery of online learning environments. The synchronous and combination of asynchronous and synchronous methods of communication appeared to provide the highest level of social presence followed by the cognitive and emotional support. The results questioned the earlier research that suggested creating immediacy and intimacy (high social presence) in a computer-mediated, asynchronous communication method is challenging (e.g., Dennen, Darabi, & Smith, 2007; Ko, 2012; Thompson-Hayes, Gibson, Scott, Webb, 2009; Schutt, Allen, Laumakis, 2009). The study supports Sherblom's (2010) argument that five factors (medium and media richness, social presence, interaction, student's identity and relationship with the instructor and peers) may moderate the relationship of the computer-mediated communication in learning environments. The results shows that while creating immediacy and intimacy is much easier in the synchronous and combination method, it is likely that interactive and collaborative learning strategies, combined with the instructor's ability to utilize technology could have also resulted in cognitive and emotional connectedness. Learning environments that require learners to work collaboratively and on a real-world problem provide many opportunities for learners to build a community thus feel connected.

The findings of the study also indicated that while students appear to experience stronger feelings and higher levels of satisfaction in the combination method, the differences between the asynchronous and synchronous methods are hard to establish since each delivery method has attributes that are both limiting or enabling. In addition, as advised by other researchers (e.g., Fulford & Zhang, 1993; Clow, 1999; Phillips & Peters, 1999; Roblyer, 1999; Hacker & Wignall, 1997), it is likely that student satisfaction in the combination method is related to their perceived overall interactivity, rather than real measure of interaction and immediacy. Furthermore, the study also provided some evidence in support of an association between student learning styles (e.g., Allen, et al, 2013; Bray, Aoki & Dlugosh, 2008) and their satisfaction with the level of interaction, immediacy and collaboration offered by various communication methods. The students' preference for a combination of asynchronous and synchronous methods could be because the combination of these methods allows students to feel more in control of selecting a communication method that is matched with their personal preferences, situations, conditions, and opportunities. By combining environments, students are able to use a wider range of approaches to learn and interact with their peers and the instructor, thus benefit from current and more advanced technology.

The results of the study further highlight the limitations of the asynchronous communication method for building social and emotional connections and relationships and group interactions. The delayed feedback, difficulty in coordinating team members' interactions and providing a structured process for problem-solving activities, combined with a lack of emotional connection, created challenges for teams while solving problems during the asynchronous method. Conversely, during synchronous team meetings, members were able to intuitively provide a structured process that stimulated greater levels of participation among members, which led to converging members' divergent perspectives during team discussion and interaction. This more effective coordination process could have been accountable for teams' significantly better performance in problem solving during synchronous and combination methods. Consistent with the finding of the past research, this study shows that teams' interaction in the asynchronous method was less personal, more solution-oriented, less friendly and more efficient (Bordia, 1997; Massey, Montoya-Weiss & Hung, 2002). This more task-oriented discussion and collaboration could have created a less satisfying experience for team members, despite the quality of members' contributions during the asynchronous method. Other researchers have also shown the advantages of using the synchronous communication method as a richer medium of communication for building development of social/relational ties among members which ultimately could enrich team performance (e.g., Hrastinski, 2008; Park & Bonk, 2007; Moallem, 2003; Sherblom, 2010). Future research is needed to examine teams' collaboration process and their performance during synchronous and asynchronous communication methods to validate the above-mentioned challenges during problem solving tasks. This result has implications for instructors and designers of asynchronous online courses. Specific strategies should be developed for collaborative online problem solving when rich, synchronous media is not available.

In sum, the study supports the literature indicating that distance delivery, regardless of media or technology used, is not by itself a contributing variable in student achievement.

## LIMITATIONS

This study was conducted in its real-life context to examine the phenomenon with all its complexities; thus, it was limited in its number of cases and participants. Additional research would be needed to verify whether its findings can be generalized. Another limitation of the study was that it occurred in a graduate course. As such, it is representative of a student body that is likely more motivated, self-regulated and more organized, and thus more likely to be successful in online learning. Future studies should look at various communication methods particularly new synchronous technologies and their impacts on undergraduate and less experienced population of students. Finally, while all attempts were made to create equally complex, ill-structured problem solving activities for each module, each module's instructional materials targeted different learning objectives which were addressed in its related problem solving activities.

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**APPENDIX A**

Results of intrinsic and extrinsic motivation

Intrinsic and Extrinsic Motivation	Pre-Interv M (SD) N 2011 2012	Asynch Only M (SD) N 2011 2012	Synch Only M (SD) N 2011 2012	Mix Method M (SD) N 2011 2012
<b>Intrinsic</b>				
1. In a class like this, I prefer course material that really challenges me so I can learn new things.	6.26 (.75) 14 6.16 (.80) 13	6.07 (.62) 14 5.82 (.98) 11	6.46 (.51) 13 5.70 1.06) 10	6.30 (.82) 10 5.75 (.97) 12
2. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	6.43 (.94) 14 5.92 (1.0) 13	6.43 (.51) 14 5.64 (.81) 11	6.39 (.77) 13 5.90 (1.10) 10	6.40 (.84) 10 5.83 (.94) 12
3. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	6.43 (.94) 14 6.00 (1.0) 13	5.93 (.73) 14 5.55 (.93) 11	6.39 (.87) 13 5.60 (1.3) 10	6.30 (.68) 10 5.91 (.90) 12
4. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	6.00 (.96) 14 5.54 (.78) 13	5.86 (.77) 14 5.55 (.82) 11	5.69 (1.5) 13 5.80 (1.2) 10	5.60 (1.08) 10 5.75 (1.3) 12
<b>Extrinsic</b>				
5. Getting a good grade in this class is the most satisfying thing for me right now.	4.86 (1.2) 14 5.42 (1.00) 13	5.00 (.88) 14 5.55 (.82) 11	4.77 (1.4) 13 5.40 (1.1) 10	4.90 (1.4) 10 5.33 (1.2) 12
6. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	4.00 (1.7) 14 4.47 (1.3) 13	3.86 (1.7) 14 4.73 (1.2) 11	3.62 (1.4) 13 5.00 (1.1) 10	4.10 (1.4) 10 5.08 (1.0) 12
7. If I can, I want to get better grades in this class than most of the other students.	4.86 (1.7) 14 5.54 (1.3) 13	5.07 (1.0) 14 4.91 (1.5) 11	4.54 (1.5) 13 5.20 (.92) 10	4.70 (1.25) 10 5.42 (1.38) 12
8. I want to do well in this class because it is important to show my ability to family, friends, employer, or others.	5.79 (1.1) 14 5.15 (1.4) 13	5.29 (1.8) 14 5.18 (1.6) 11	4.78 (1.6) 13 5.30 (1.4) 10	5.10 (1.29) 10 5.25 (1.22) 12

Results of Task value

Task Value	Pre-Interv M (SD) N 2011 2012	Asynch Only M (SD) N 2011 2012	Synch Only M (SD) N 2011 2012	Mix Method M (SD) N 2011 2012
9. I think I will be able to use what I learn in this course in other courses.	6.70 (.63) 13 6.08 (.96) 13	6.93 (.27) 14 6.18 (.98) 11	6.77 (.44) 13 6.40 (.97) 10	6.80 (.42) 10 6.00 (.95) 12
10. It is important for me to learn the course material in this class.	6.86 (.54) 14 6.31 (.86) 13	6.93 (.27) 14 6.18 (.87) 11	6.77 (.60) 13 6.20 (1.0) 10	6.80 (.42) 10 6.08 (.90) 12
11. I am very interested in the content area of this course.	6.57 (.65) 14 5.92 (.86) 13	6.42 (.85) 14 5.81 (.75) 11	6.70 (.63) 13 5.80 (1.4) 10	6.60 (.70) 10 5.75 (1.1) 12
12. I think the course material in this class is useful for me to learn.	6.71 (.47) 14 6.16 (.99) 13	6.71 (.47) 14 6.10 (.83) 11	6.85 (.38) 13 5.90 (1.6) 10	6.90 (.32) 10 6.00 (.95) 12
13. I like the subject matter of this course.	6.43 (.51) 14 5.85 (.80) 13	6.21 (1.12) 14 5.73 (.79) 11	6.54 (.66) 13 5.60 (1.4) 10	6.50 (.70) 10 5.67 (.78) 12

Results of control of learning

Control of Learning	Pre-Interv M (SD) N 2011 2012	Asynch Only M (SD) N 2011 2012	Synch Only M (SD) N 2011 2012	Mix Method M (SD) N 2011 2012
14. If I study appropriate ways, then I will be able to learn the material in this course.	6.50 (.86) 14 6.15 (1.1) 13	6.07 (.73) 14 6.18 (.60) 11	6.23 (.73) 13 5.60 (1.2) 10	6.30 (.68) 10 5.42 ((1.1) 12
15. It is my own fault if I don't understand the material in this course.	5.71 (1.3) 14 5.54 (1.2) 13	5.64 (.75) 14 5.18 (.75) 11	5.69 (1.1) 13 4.90 (.99) 10	5.70 (.82) 10 5.33(1.1) 12
16 If I try hard enough, then I will understand the course material.	6.21 (1.1) 14 5.77 (1.2) 13*	5.92 (.91) 14 5.64 (.67) 11*	6.15 (.69) 13 5.00 (1.7) 10*	5.90 (.88) 10 5.50(1.2) 12
17. If I don't understand the course materials, it is because I didn't try hard enough.	5.92 (1.3) 14 5.46 (1.6) 13	5.14 (1.4) 14 5.27 (1.1) 11	4.92 (1.2) 12 5.00 (.82) 10	5.50 (.85) 10 5.50(1.0) 12

\*Significant difference  $p > .05$

Results of self-efficacy

Self-Efficacy	Pre-Interv M (SD) N 2011 2012	Asynch Only M (SD) N 2011 2012	Synch Only M (SD) N 2011 2012	Mix Method M (SD) N 2011 2012
19. I believe I will receive an excellent grade in this class	5.79 (.98) 14 6.16 (.80) 11	5.86 (.66) 14 5.73 (.91) 11	5.70 (.75) 13 5.50 (1.18) 10	5.50 (.71) 10 5.67 (.78) 12
20. I'm certain I can understand the most difficult material presented in the reading for this course	5.43 (1.0) 14 5.54 (1.3) 11	5.07 (1.1) 14 5.00 (1.2) 11	5.31 (1.1) 13 5.40 (.85) 10	5.30 (.95) 10 5.33 (1.3) 12
21. I'm confident I can understand the basic concepts taught in this course	6.72 (.47) 14 6.17 (.72) 11	6.79 (.43) 14 5.82 (.87) 11	6.54 (.66) 13 5.60 (1.4) 10	6.60 (.70) 10 5.92 (.90) 12
22. I'm confident I can understand the most complex material presented by the instructor in this course	5.50 (1.1) 14 5.42 (1.3) 11	5.14 (1.4) 14 5.09 (1.2) 12	5.62 (.96) 13 5.30 (.83) 10	5.30 (1.2) 10 5.42 (1.0) 12
23. I'm confident I can do an excellent job on the assignments and test in this course	5.93 (.73) 14 5.92 (1.1) 11	6.00 (.56) 14 5.55 (.69) 11	5.85 (.69) 13 5.40 (1.6) 10	5.70 (.68) 10 5.67 (.89) 12
24. I expect to do well in this class	6.29 (.61) 14 6.42 (.67) 11	6.36 (.63) 14 5.73 (.65) 11	5.92 (.50) 13 5.60 (1.4) 10	6.10 (.57) 10 6.00 (1.2) 12
25. I'm certain I can master the skills being taught in this class	6.14 (.95) 14 6.08 (.86) 11	5.86 (1.0) 14 5.73 (.47) 11	5.46 (1.1) 13 5.70 (.48) 10	5.66 (1.2) 10 5.42 (1.0) 12
26. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class	6.14 (.77) 14 6.15 (.81) 11	6.21 (.43) 14 5.64 (.67) 11	6.00 (.71) 13 5.30 (1.3) 10	5.80 (.79) 10 5.67 (.99) 12

## Results of self-regulation

Self-regulation	Pre-Interv M (SD) N 2011 2012	Asynch Only M (SD) N 2011 2012	Synch Only M (SD) N 2011 2012	Mix Method M (SD) N 2011 2012
27. During class time I often miss important points because I am thinking of other things	3.93 (1.7) 14 4.25 (1.4) 13	3.36 (1.7) 14 4.73 (1.2) 14	4.00 (1.6) 13 3.80 (1.2) 10	4.00 (1.4) 10 4.42 (1.2) 10
28. When reading for this course, I make up questions to help focus my reading	4.93 (1.5) 14 5.00 (1.4) 13	4.79 (1.4) 14 5.18 (.75) 11	4.77 (1.1) 13 5.11 (.78) 10	4.50 (1.4) 10 5.42 (1.4) 10
29. When I become confused about something I'm reading for this class, I go back and try to figure it out	6.36 (.63) 14 5.77 (1.0) 13	6.21 (.70) 14 5.55 (.82) 11	6.46 (.52) 13 5.60 (.97) 10	6.30 (.68) 10 5.58 (1.1) 10
30. If course materials are difficult to understand, I change the way I read the material	5.57 (.85) 14 5.39 (1.2) 13	5.14 (1.2) 14 5.36 (1.03) 11	5.15 (1.2) 13 5.30 (.95) 10	5.30 (1.5) 10 5.42 (1.1) 10
31. Before I study for new course material thoroughly, I often skim it to see how its organized	6.14 (.77) 14 5.85 (1.1) 13	5.79 (1.5) 14 5.64 (.81) 11	5.31 (1.6) 13 5.60 (.84) 10	5.80 (1.5) 10 5.83 (.58) 10
32. I ask myself questions to make sure I understand the material I have been studying in this class	5.36 (1.4) 14 5.39 (1.1) 13	5.43 (1.2) 14 5.27 (1.01) 11	5.85 (.80) 13 5.40 (1.1) 10	5.50 (1.1) 10 5.58 (1.1) 10
33. I try to change the way I study in order to fit the course requirements and the instructors teaching style	5.50 (1.0) 14 5.70 (.95) 13	5.21 (1.2) 14 5.73 (.65) 11	5.77 (.83) 13 5.30 (.95) 10	5.80 (.92) 10 5.58 (1.4) 10
34. I often find that I have been reading for class but don't know what it was all about	3.57 (1.7) 14 4.78 (2.0) 13	4.14 (1.6) 14 5.09 (1.38) 11	3.77 (1.4) 13 5.30 (1.1) 10	4.60 (1.5) 10 5.50 (1.1) 10
35. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying	5.79 (1.3) 14 5.70 (1.0) 13	5.79 (.98) 14 5.27 (.90) 11	6.00 (.58) 13 5.50 (.97) 10	5.90 (.88) 10 5.75 (.87) 10
36. When studying for this course I try to determine which concepts I don't understand well	5.71 (.91) 14 5.62 (.96) 13	6.30 (.63) 13 5.73 (.79) 11	5.62 (1.1) 13 5.70 (.67) 10	5.70 (.82) 10 5.92 (.80) 10
37. When I study for this class, I set goals for myself in order to direct my activities in each study period.	5.64 (1.3) 14 5.85 (.90) 13	5.50 (1.4) 14 5.60 (.84) 11	5.85 (1.1) 13 5.60 (.84) 10	5.80 (1.0) 10 5.67 (.65) 10
38. If I get confused taking notes in this class, I make sure I sort it out afterward.	5.14 (1.8) 14 5.62 (1.3) 13	5.71 (1.4) 14 5.55 (.69) 11	5.92 (.64) 13 5.40 (.97) 10	6.10 (.74) 10 5.50 (.91) 10