Genevieve Johnson
g.johnson@curtin.edu.au

REAL-TIME VERSUS DELAYED-TIME CMC: OBJECTIVE AND SUBJECTIVE IMPACT ON LEARNING

Genevieve M. Johnson
School of Education Curtin University Perth, Western Australia

Abstract

Course management systems such as Blackboard include two distinct modes of web-based discussion, -- real-time and delayed-timed. Both communication formats are promoted as having both advantages and disadvantages with respect to student learning and satisfaction. Ninety-three university students discussed two case studies using two real-time Blackboard chat and two case studies using delayed-time Blackboard discussion. Mastery of case study content was determined via objective examination items and student preference for CMC mode was surveyed. An ABAB research design allowed for comparison of student achievement across communicative conditions (e.g., A = delayed-time discussion followed by an examination; B = real-time discussion followed by an examination). In every contrast of real-time and delayed-time CMC mode, student achievement on objective examination items was equivalent. Many students (43% of the sample) reported the perception that real-time CMC facilitated their learning more than delayed-time CMC. However, such students were at a learning disadvantage, as measured by objective examination test performance, when using that CMC mode. Consequently, results of the current investigation do not support the educational implementation of real-time CMC without corresponding implementation of delayed-time CMC and mechanisms to ensure that students do not rely entirely on real-time text-based communication to master course content.

Introduction

Computer mediated communication (CMC) permits two distinct modes of text-based discussion, that is, real-time and delayed-time (Lee, Kim, & Hackney, 2008). Delayed-time CMC does not require the simultaneous participation of discussants (Thurlow, Lengel, & Tomic, 2004). Widely implemented in post-secondary hybrid and distance education (Fjermestad, Hiltz, & Zhang, 2005), text-based delayed-time CMC is reportedly useful for "encouraging in-depth, more thoughtful discussion; communicating with temporally diverse students; holding ongoing discussions where archiving is required; and allowing all students to respond to a topic" (Branon & Essex, 2001, p. 36). Limitations associated with delayed-time discussion include "lack of immediate feedback, students not checking in often enough, length of time necessary for discussion to mature, and students feeling a sense of isolation" (p. 36).

In contrast to delayed-time text-based discussion, real-time CMC requires the simultaneous participation of discussants (Johnson, 2006a; Thurlow et al, 2004). Although typically an optional course feature (Burnett, 2003), real-time text-based CMC is often recommended as an appropriate discussion format in higher education (Fisher, Thompson, & Silverberg, 2005; Fletcher & Major, 2006; Teng & Taveras, 2005). In a survey of distance educators, real-time CMC was reportedly useful for "holding virtual office hours, team decision-making, brainstorming, community building, and dealing with technical issues" (Branon & Essex, 2001, p. 36). Identified limitations associated with real-time CMC include "getting students online at the same time, difficulty in moderating larger-scale conversations, lack of reflection time for students, and intimidation of poor typists" (p. 36). Despite such limitations, real-time CMC has the advantage of "providing a greater sense of presence and generating spontaneity" (Hines & Pearl, 2004, p. 34).

Research on the relative learning benefits of real-time and delayed-time text-based CMC has been inconclusive. Pérez (2003), for example, required first-year university students to engage in both real-time chat and delayed-time email dialog journals to facilitate Spanish language learning. While a higher number of words were produced in chat rooms, there was no significant difference in new vocabulary across the two groups. Similarly, Abrams (2003) compared the performance of students in a German language course under three instructional conditions: 1) real-time WebCT chat; 2) delayed-time WebCT discussions; and 3) face-to-face small group collaborative assignments. "Analyses of the quality of language indicted no significant difference among the 3 groups either lexically or syntactically" (p. 157). In contrast, Schwienhorst (2003) described a learning network in which students gave and received foreign language support using email or chat. Reportedly, students in delayed-time learning networks were more likely to complete tasks than students in real-time networks. Volet and Wosnitza (2004) analyzed transcriptions of real- and delayed-time student CMC and found that both interactive mediums "showed a substantial amount of social interchange and meaningful learning" (p. 5).

Research on student preference for CMC mode has been similarly inconclusive (Johnson, 2008). For example, Grimes (2002) surveyed directors of distance education dental programs and concluded that there was no difference in student satisfaction with instructional applications of real-time and delayed-time CMC. In contrast, Shapira and Youtie (2001) reported a case study in which student satisfaction was greater with delayed-time rather than real-time text-based discussion. Nowak, Watt and Walther (2005) concluded that real-time media has social advantages while delayed-time CMC has cognitive advantages. Fletcher and Major (2006), however, provided evidence that student perception of communication mode effectiveness was influenced by task-mode interaction.

To summarize, a considerable volume of research has attempted to clarify the relative learning benefits of real-time and delayed-time text-based CMC (Johnson, 2006a). Unfortunately, as demonstrated by the literature just reviewed, such research primarily reflects case study evaluation and descriptive analysis. Further, subjective measures of perception as opposed to objective measures of achievement typically determine CMC effectiveness. When learning online, however, "students may not prefer what is best for them, i.e., what is most effective for learning" (An & Frick, 2006, p. 12).

"How best to approach the study of new media effects" (Nowak et al, 2005, p. 20) is not a simple matter. Ideally, determination of effect requires random assignment of subjects (e.g., students) to one of two conditions (e.g., real-time or delayed-time discussion) and administration of relevant objective measures (i.e., student learning) following exposure to the random condition (i.e., communication mode). However, random assignment of students to real-time and delayed-time text-based CMC is difficult in the context of existing groups of students (i.e., classes). Instructors, research ethics boards, and students are unwilling to accept random assignment of students within the same class to different learning experiences. Johnson and Howell (2006) argued that the ABAB research design is well-suited to determination of the effectiveness of instructional applications of internet technology. An ABAB research design has two conditions (i.e., A and B) that are contrasted twice (i.e., ABAB) so that patterns of objective measures can be contrasted across conditions.

Research Focus and Questions

The current investigation employed an ABAB research design to determine the effect of real-time and delayed-time text-based CMC on student learning. Objective measures of student achievement were compared with subjective perception of the relative learning benefits of real-time and delayed-time text-based CMC. Such a research design may provide answers to questions of concern to hybrid and distance educators. How do students perceive the learning benefits of real-time and delayed-time text-based CMC? Is there a difference in student achievement, as measured by objective test items, when students discuss

course content synchronously versus asynchronously? Is subjective perception of CMC learning benefits supported by objective measures of student achievement?

Methods

Students in an educational psychology course were required to use two Blackboard communication tools (real-time chat and delayed-time discussion) to analyse four case studies. A case study is an example of an authentic situation requiring professional judgment (Johnson, Howell, & Code, 2005). The four case studies complemented course content organized into four units of study. Mastery of case study learning objectives was assessed with specific multiple-choice items on four in-class examinations. To discuss the four case studies, students were randomly assigned to Condition I (i.e., delayed-real-delayed-real) or Condition II (i.e., real-delayed-real-delayed). Figure 1 presents a visual summary of Condition I; Condition II provided students with chat and discussion in the reverse order. Alternating CMC mode resulted in half of the students in chat and half of the students in discussion for each case study discussion. This alleviated some of the challenges of scheduling real-time chat as well as providing students with equivalent learning experiences across the academic term (i.e., two real-time and two delayed-time text-based case study discussions).

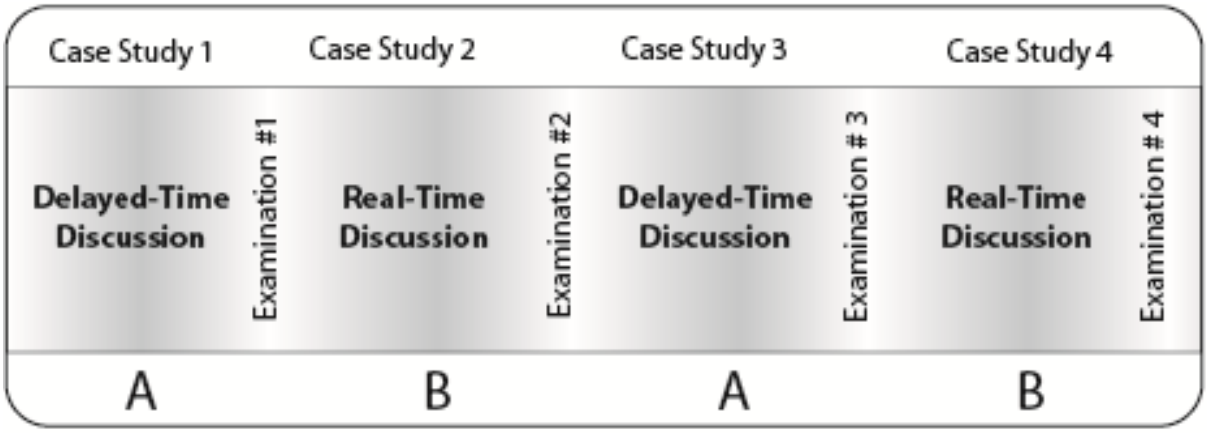

Figure 1. ABAB research design: Condition I CMC discussions

Due to course withdrawal and absenteeism, 93 students satisfied research requirements. Students ranged in age from 17 to 42 years (mean 21.4 years). Approximately 73% of the sample was female which is characteristic of the student population in the participating university program. As presented in Figure 2, participating students varied in terms of experience with real-time and delayed-time text-based CMC. In general, students reported more experience with real-time chat than with delayed-time discussion, although wording of questionnaire items may have influenced student response (e.g., students may not have equated delayed-time discussion with email).

At the end of the academic term, having discussed two case studies synchronously and two case studies asynchronously, students completed a brief questionnaire that assessed demographics (e.g., experience with CMC) and perception of the learning advantage of real-time versus delayed-time text-based communication. The questionnaire included a forced-choice item (i.e., I learned the case studies best when using) in which students selected from two response-options (i.e., real-time chat or delayed-time discussion). Having selected one response-option, the questionnaire asked why and included space for students to provide a written reason for their perception of CMC mode learning advantage.

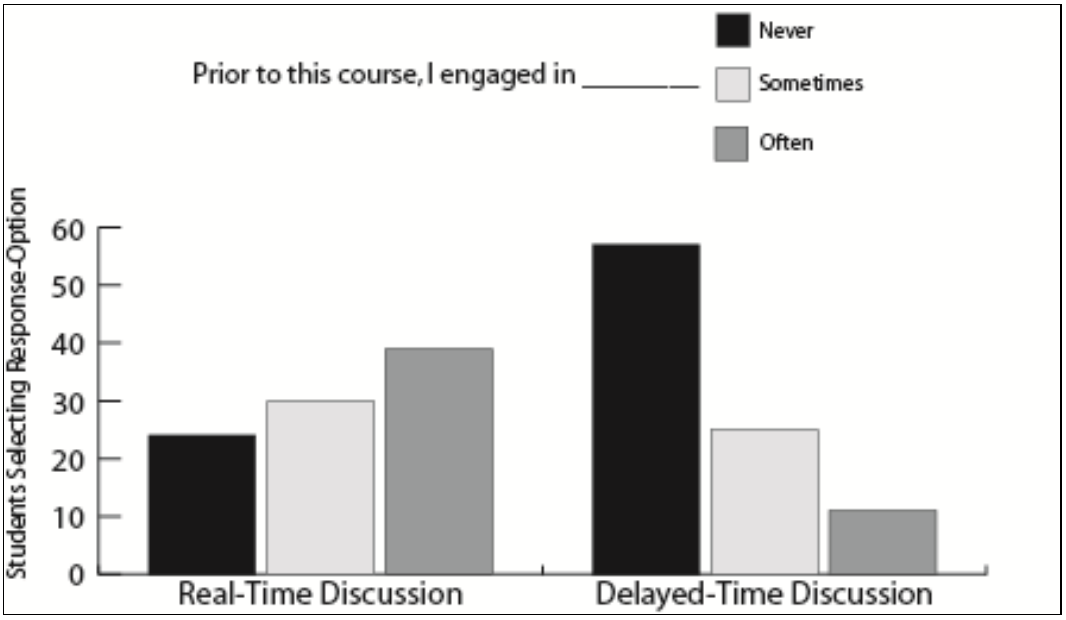

Figure 2. Student self-report of previous experience with CMC format

Student grades in the educational psychology provided two measures of student achievement; 1) overall achievement and 2) CMC achievement. Overall achievement, defined as final course grade, was determined by summing student percentage scores on eight required course elements -- four examinations and four CMC discussions. One examination and one case study corresponded with each module of course content. Regardless of research condition (i.e., I or II), all students took the same examinations. Examinations were administered during class time and included both multiple-choice and written-response items. Overall achievement as measured by final course grade ranged from 52% to 94% with a mean of 74.6% (*SD* = 8.5) for the group of participating university students.

Two measures of CMC achievement were obtained; 1) examination-specific and 2) mode-specific. Three multiple-choice items on each examination assessed student understanding of the case study discussed online during that module of course content. Multiple-choice items, developed by the researcher, required a range of cognitive skills including recall of specific fact (e.g., *In Case Study 2, Evan could best be described as*), comprehension of information (e.g., *In Case Study 2, Jordan was diagnosed as BD because*) and evaluation (e.g., *In Case Study 2, who made a professional misjudgement*). CMC examination-specific achievement means for the four examinations were 2.7, 2.6, 0.9, and 2.3, respectively. The conspicuously low mean for CMC achievement as measured with the third examination was likely an artefact of specific unit content and corresponding case study examination items. The third unit of course content was highly theoretical. Such abstraction was reflected in case study examination items (e.g., *Which of the following describes Amy's teaching style in Case Study 3? Behaviourist, Social Cognitivist, Constructivist, Information Processing*).

CMC achievement was also defined in relation to communication mode. The examination-specific CMC achievement measures were summed across CMC mode. That is, for students in Condition I, the case study multiple-choice items on the first and third examinations were summed to reflect achievement when cases were discussed in delayed-time; the case study multiple-choice items on the second and fourth examinations were summed to reflect achievement when cases were discussed real-time. For students in Condition II, the case study multiple-choice items on the first and third examinations were summed to reflect achievement when cases were discussed in real-time; the case study multiple-choice items on the

second and fourth examinations were summed to reflect achievement when cases were discussed in delayed-time. The total number of correct case study examination items for cases discussed in real-time ranged from 0 to 6, mean 4.3 (*SD* = 1.2) and in delayed-time ranged from 2 to 6, mean 4.2 (*SD* = 1.4).

Independent-sample t-tests compared examination-specific CMC achievement across conditions. Independent-sample t-tests also compared previous CMC experience for students who expressed the perception of real-time or delayed-time text-based communication mode learning advantage. Student responses to the open-ended item (i.e., reasons for perception of CMC mode learning advantage) were thematically categorized and tallied. Pearson Product Moment correlations determined the relationship between overall achievement and CMC achievement. One-way analysis of variance compared overall achievement and CMC achievement for students grouped according to perception of CMC learning advantage (i.e., the forced-choice item *I learned the case studies best when using* in which students selected *real-time chat* or *delayed-time discussion).*

Results

Figure 3 provides a visual summary of CMC achievement, as measured by examination items that assessed mastery of each case study, in relation to the two experimental conditions (i.e., discussion-chat-discussion-chat and chat-discussion-chat-discussion). As illustrated, there were no significant differences in student achievement across communication modes. Students who discussed the first case study in real-time, on average, correctly answered 2.6 of the three multiple-choice examination items that assessed mastery of case study content. Students who discussed the first case study in delayed-time, on average, correctly answered 2.8 of the same three multiple-choice items. Such a small difference was insignificant. The same pattern of insignificant differences in CMC achievement held true for every alternation of real-time and delayed-time text-based CMC. As would be expected, the correlation between overall student achievement and CMC achievement was significant ($r = .47$, $p < .001$).

In questionnaire item *I learned the case studies best when using*, 39 students selected real-time chat and 51 students selected delayed-time discussion (3 students did not select either response-option). Students who selected real-time chat reported more experience with chat than students who selected delayed-time discussion ($t = 2.28$, $df = 88$, $p = .025$). There was no significant difference in the overall achievement of students who selected chat and those who selected discussion. When asked the reason for the learning advantage of chat or discussion, most students provided brief written comments. Such comments were thematically organized into seven categories. As presented in Figure 4, student justification for perception of learning advantage was not unique to CMC mode; students provided the same reason for their perception of the learning advantage of both CMC modes.

Perception of CMC mode learning advantage was not significantly related to overall achievement or CMC mode-specific achievement when cases were discussed in delayed-time. However, when cases were discussed in real-time, a significant CMC achievement difference emerged between students who reported a real-time chat advantage and those who expressed the alternate perception. That is, the two measures of CMC mode achievement (exam results for cases discussed in real-time and delayed-time) were compared between two groups of students, -- those who reported preference for real-time discussion and those who reported preference for delayed-time discussions. Visually summarized in Figure 5, students who indicated that they learned the case studies best when using real-time chat scored, on average, 3.9 on the six examination items that assessed mastery of case studies discussed in real-time; students who reported that they learned the case studies best when using delayed-time discussion scored, on average, 4.5 on the six examination items that assessed mastery of case studies discussed in real-time. It is unlikely that such a difference occurred by chance ($t = -2.24$, $df = 88$, $p = .027$).

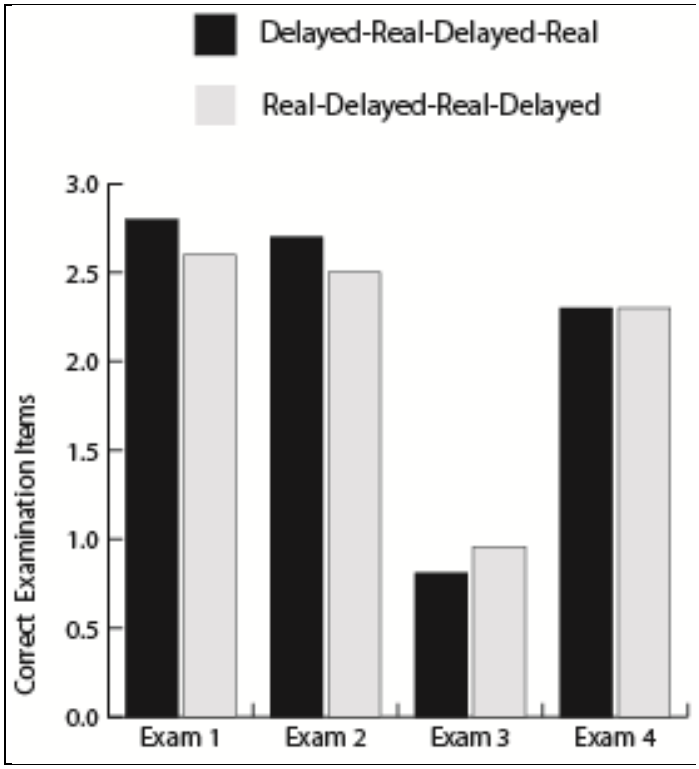

Figure 3. Student achievement across CMC conditions

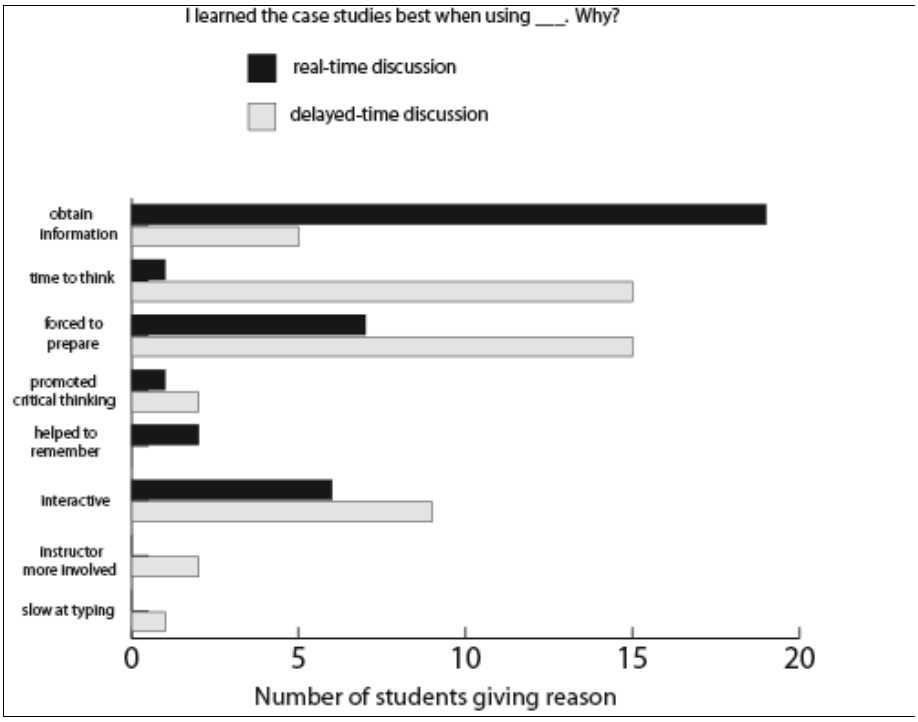

Figure 4. Student reasons for perceived CMC format advantage

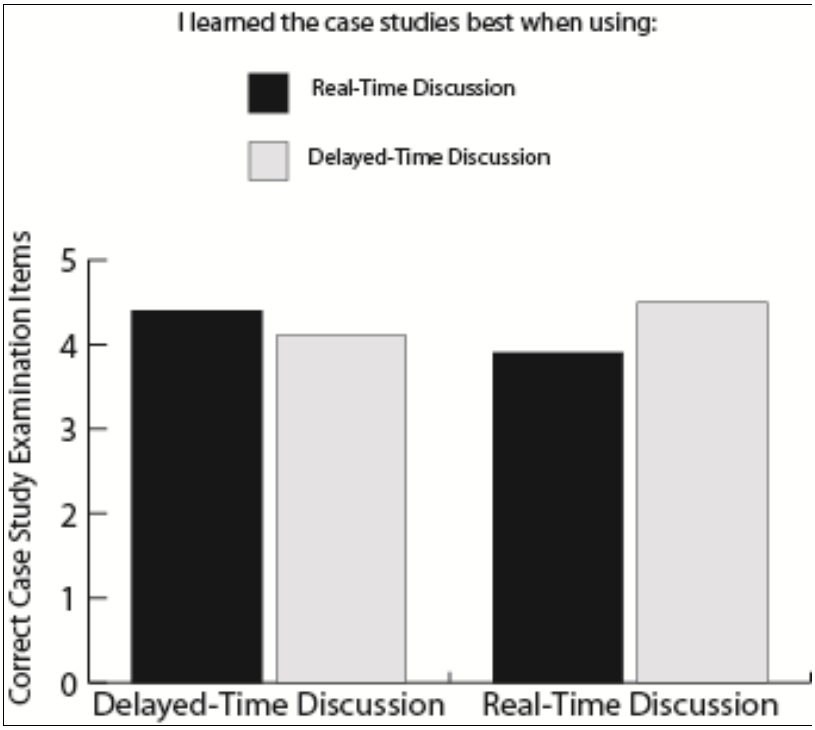

Figure 5. Student achievement across conditions and preferences

Discussion

The results of the current investigation provide no evidence of the instructional superiority of real-time versus delayed-time text-based CMC. In every contrast of real-time chat and delayed-time discussion, student examination-specific CMC achievement was equivalent. When student achievement was low (i.e., exam 3), it was equally low across online discussion conditions. In this regard, neither communication mode can be categorically dismissed or recommended in terms of impact on student learning. It is likely that CMC mode, in and of itself, does not mitigate the impact of other influences on achievement (e.g., motivation, self-regulation, study behaviour). Indeed, the significant relationship between overall achievement and CMC achievement suggests that student learning characteristics predict CMC achievement while CMC mode does not (Johnson, 2007).

Reasons provided by students for their perception of CMC mode learning advantage are subject to interpretation. For example, seven students reported that they learned best when discussing the cases in real-time because that mode forced them to be prepared for the CMC discussion; the same reason was provided by 15 students who reported that they learned best when discussing the cases in delayed-time. Perception of the need and opportunity for CMC discussion preparation may have differed across students. Further, six of 39 students (i.e., 15%) who expressed the perception that they learned the case studies best when using real-time chat and nine of 51 students (i.e., 18%) who expressed the perception that they learned the case studies best when using delayed-time discussion attributed their learning advantage to the interactive nature of the CMC mode. While real-time CMC is often assumed to be more interactive than delayed-time CMC, students may interpret interaction differently. Some students may assume that effective discussion occurs in real-time; other may appreciate the advantages of delayed-time text-based CMC where students review, revise and edit their messages, “allowing them to ensure that the

phrasing and other message characteristics are consistent with the message they desire to send, without the 'costs' associated with delay that would be present in synchronous interaction" (Nowak et al, 2005, p. 3). Again, individual student characteristics (e.g., personality and learning style) are likely to mediate subjective interpretation of CMC communication mode effectiveness.

Students who expressed the perception that they learned the case studies best when using real-time chat were at a learning disadvantage when using that CMC mode. It may be that self-report learning advantage reflects student personal preference. Students who prefer real-time over delayed-time text-based CMC may be more social than students who express the reverse preference. "Since evaluation in higher education is largely cognitive as opposed to social, it is not surprising that highly social students are often at an achievement disadvantage. This may be equally true in both traditional and online learning environments" (Johnson, 2006b, p. 11). Indeed, students with the most previous experience with chat reported the perception of real-time text-based CMC learning superiority. Students who prefer the fast and personal nature of chat may have learning characteristics (e.g., motivation, self-regulation, study behaviour) that sabotage academic achievement under some conditions (Johnson, 2007). Delayed-time text-based CMC may have forced such students to discuss the case studies in a manner that compensated for less than ideally learning behaviour. Conversely, it may be that real-time text-based CMC, while enjoyable, provided a context that exacerbated less than optimal learning behaviour (Johnson, 2011).

Implications for Practice: Text-Based CMC in Educational Contexts

Subsequent research may clarify the specific characteristics that predispose students to preference for real-time or delayed-time text-based CMC. Although the current ABAB analysis may raise more questions than it answers, large sample size and random assignment of subjects to conditions permits preliminary recommendations for educational implementation of text-based CMC.

1. Many students (43% of the current sample) perceived that real-time chat facilitated their learning. In this regard, the educational implementation of synchronous text-based CMC is justified.
2. In general, CMC mode is not related to student learning; there is no significant difference in student mastery of content discussed in real-time or delayed-time. In this regard, the educational use of real-time text-based CMC is justified.
3. While the combined use of text-based CMC modes is frequently recommended (Davidson-Shivers, Muilenburg, & Tanner, 2001; Ligorio, 2001; Ohlund, Jannssch-Pennell, & Digangi, 2000), the results of the current investigation suggest that such combination should be judiciously implemented. If given free choice of communication mode, many students would choose real-time text-based CMC. Such a choice may result in decreased academic achievement.
4. The results of the current investigation do not support the educational implementation of real-time text-based CMC without corresponding implementation of delayed-time text-based CMC and mechanisms to ensure that students do not rely entirely on synchronous text-based CMC.
5. Further research on the learning characteristic of students who prefer real-time text-based CMC is required.

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