The Effectiveness of Computer-Mediated Communication on SLA: A Meta-Analysis and Research Synthesis

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Abstract. Over the past two decades, a large body of research has been conducted on the effectiveness of computer-mediated communication (CMC) employed as either stand-alone or instructional tools in SLA classrooms. Findings from this large body of work, however, are not conclusive, making it important to identify factors that would inform its successful implementations. This meta-analysis of empirical studies was conducted to examine the effects of CMC on language learning outcomes by calculating Cohen's *d* effect sizes (Cohen, 1988) for each study on different learning outcomes. Altogether 56 primary studies were retrieved as eligible studies between 2000-2011, including 27 journal articles, 12 dissertations, 12 theses and 5 conference papers. Each study went through a two-level coding, the first level being study-feature coding and the second level effect-size coding. Twelve substantive and methodological features were coded for each study in the first level, 6 of which were identified as potential moderator variables that would affect the effectiveness of CMC differently. Tentative findings of this meta-analysis include: (a) there was a small to medium effect for CMC compared to face-to-face communication, (b) the effect of CMC was not equal for all language skills, and (c) small group sizes produced the largest effect compared to no grouping at all or groups with more than 3 students.

Keywords: CMC, meta-analysis, SLA.

1. Introduction

Computer-mediated communication, defined as "multimodal, often (but not exclusively) Internet-mediated communication" (Thorne, 2008, p. 325), has been used extensively in second/foreign language classrooms since the late 1990s when the Internet became widely and immediately available for the general public, including educational sectors. CMC holds promise for language learning due to mounting evidence supported pedagogical benefits it brings to learning experiences. For example, the real-time nature

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of the synchronous mode of CMC, such as Internet Relay Chat (chat room), creates a communication environment that simulates face-to-face conversation without visual clues. Via networked connection, CMC also extends a traditional language classroom to one that includes global communication involving a diversity of cultures if possible. Access to target language users, which used to be a mission impossible, is now as easy as a click of the mouse via "the instrumentality of computers" (Herring, 1996, p. 1). Through the 1970s into the early 1990s, the primary CMC tools were text-based; among them, email, Internet Relay Chat (ICQ) and MOOs (text-based virtual environments), were most popularly adopted in the language classrooms. With the advance of second-generation web applications, such as blogs, wikis and podcasts, the shortcomings of text-based CMC have been greatly overcome via advanced technologies that could distribute sound, video and varieties of media (Thorne, 2008). Meta-analysis has been used to integrate and compare the result of several studies since it was first introduced by Glass (1976). With the advancement of statistical techniques and controversial issues being mostly dealt with, meta-analysis has now become a preferred way of synthesizing research findings in scientific disciplines (Aytug, Rothstein, Zhou, & Kern, 2012). Over the past two decades, research syntheses conducted to answer questions such as how effective are technologies in promoting language learning were abundant; yet, specific syntheses particularly focusing on CMC remain scarce.

1.1. Statement of the problem

The integration of CMC into a language classroom remains to be a trend, and as the amount of anecdotes and empirical studies on CMC in language field recently increased, there is an urgent need for a valid conclusion to confirm our instinct that CMC does help language educators achieve intended results for their students.

1.2. Research questions

To enable precise analyses and interpretations of primary research findings, the study adopted a quantitative meta-analysis approach to synthesizing findings from empirical studies published between 2000 and 2011. Two overarching questions guided this research synthesis:

- How effective is CMC in promoting second/foreign language skills (versus face-to-face communication or communication without computer/technology mediated devices)?
- What are potential factors that mediate the effectiveness of CMC in promoting the acquisition of language skills?

2. Methodology

Empirical studies reviewed in this paper should meet the following criteria:
- The study was published between 2000 and 2011;

- The study made use of some form of CMC (e.g., email, chat, conferencing, discussion forums, etc.) either exclusively or in conjunction with other instructional tools/methods;
- The study addressed either the nature of the language produced during CMC and/or the effect of CMC on L2 learning. (Both conditions required quantitative data);
- The study employed an experimental or quasi-experimental design;
- Studies recruited participants who were L2 or foreign language learners;
- Studies included should report adequate quantitative information for effect sizes to be calculated.
- For study reports across several sources, only one report was included in the meta-analysis.

2.1. Coding scheme

Each eligible study was coded at two levels: study level and effect size level. In the study level, coding, study characteristics, methodological characteristics and publication characteristics were coded (Lipsey & Wilson, 2001). Study level characteristics were further examined to decide whether they mediated the effectiveness of language learning outcomes. The entire coding consisted of three stages. In stage one, two coders independently coded each of the 56 primary studies in compliance with the coding sheet. In stage 2, half of the primary studies were selected randomly and codes were compared between the two coders. The initial inter-rater reliability was computed using the formula: number of agreed-upon codes over the total number of codes.

Table 1.   Coding scheme

Characteristics	Description
Publication type	Journal article/Book or book chapter/ Dissertation/thesis/Technical report/Conference paper (proceedings)/Other
CMC Mode	Synchronous/Asynchronous/Both
CMC tool/platform	Email/Chat/Discussion forum/Instant Messenger/Blog/E-portfolio/ Wiki/Other (specify)
CMC Tool	Voice/text
CMC activity conduction	In class/After class/Both
CMC option	Required activity/Optional activity/Other
Group size	1-5 people/6-10 people/11-15 people/More than 15 people/No grouping
Length of experiment	Short: Less than one month Average: between one month and four months (one semester) Long: more than one semester
Outcome measurement	Standardized achievement test (specify the title of the test) Teacher/Researcher developed achievement test Other (specify)
Sample's educational level:	Elementary school level and below/Middle school level/College level and above
Sample's L2	English/German/Japanese/Chinese/Spanish/Russian/Others
Sample's L1	English/German/Japanese/Chinese/Spanish/Russian/Others
Research design	Pretest/Posttest control group design/posttest only control group design/One group only pretest and posttest design/Non-equivalent comparison group design
Randomization	Yes/No
Reliability	Internal consistency, test-retest correlation, etc.

Low interference characteristics such as the total sample size of the study, research setting and participants' L2 were strived to reach the 100% inter-rater reliability. In stage 3, discrepancies in coding between the two coders for high-interference features such as the outcome measurement, treatment description, treatment duration, etc., were discussed and resolved. The final inter-rater reliability was 98%. Table 1 above provides the study-level coding scheme of major features in this meta-analysis.

2.2. Outcome measures

Treatment effects on four major language skills were measured and compared in this meta-analysis. Specifically, the outcomes included listening, speaking, reading and writing. Various competencies (e.g., grammatical, discourse, strategic, sociolinguistic competences, which make up specific language skills were classified into those specific skills. For example, studies that investigated grammatical or pragmatic competence were classified into the outcome category of writing. In the same vein, studies that investigated effect of CMC on pronunciation were classified into the outcome category of speaking.

2.3. Effect size calculation

The effectiveness of CMC on language skill acquisition was expressed by calculating effect sizes for each study on different learning outcomes. The effect sizes were calculated as the difference between the means of the treatment and the control groups divided by the pooled standard deviation of the sample, i.e., Cohens' d. The potential outliers were checked for their influence on the overall mean effect. The effect sizes were also weighted/corrected for small sample sizes (Bangert-Drowns, Hurley, & Wilkinson, 2004; Höffler & Leutner, 2007). If a study did not provide descriptive analysis data but F values, effect sizes were calculated using the procedure suggested by Glass (1976).

3. Results and conclusion

3.1. Overview of eligible studies in review

The final body of meta-analysis included 56 studies (data collection was completed by December 2011): 5 conference papers, 12 masters' theses, 12 doctoral dissertations and 27 journal articles. A total of 282 effect sizes were calculated from the 56 studies which contained a combined sample of about 3,713 participants. The sample size ranges from 12 to 354. 45 studies were published between 2006 and 2011; 11 studies were published between 2000 and 2005. Among the studies, 10 studies were carried out in middle schools, 2 in primary schools and the majority of studies were conducted in university/college settings ($N = 44$). In terms of research design, 49 studies included in the meta- analysis adopted a quasi-experimental design, using either a nonrandomized static-group posttest comparison design (5 studies), a nonrandomized one-group pretest-posttest design (16 studies), or a nonrandomized pretest-posttest control group

design (28 studies). Only 7 studies adopted a true experimental design with participants randomly being assigned to treatment groups and a true control group. English (44 studies) is still the dominant target language of most CMC studies, followed by Spanish (9 studies), German (2 studies) and French (1 study).

3.2. The effectiveness of CMC on language learning outcomes

The results showed that of the 56 studies included, 79% (44 studies) of the study-weighted effect sizes were positive and favored CMC integration, while 21% (12 studies) of them were negative and favored face-to-face or communication without any computer-mediated devices. 19 studies (34%) reported large effect sizes, 11 studies (20%) reported medium effect sizes and 26 studies (46%) reported large effect sizes based on Cohen's (1988) interpretation guidelines of effect sizes. The overall effect size is .554, with 95% confidence interval between .482 and .626. Due to the limitation of space, moderator analysis results were not included in the paper; however, this meta-analysis found that task type, group size, participants' educational level, CMC mode, CMC tool and outcome measures were potential moderators that would affect the overall effectiveness of CMC intervention.

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