ESTABLISHING AN EMPIRICAL LINK BETWEEN COMPUTER-MEDIATED COMMUNICATION (CMC) AND SLA: A META-ANALYSIS OF THE RESEARCH

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Drawing on interactionist and socio-cultural theories, tools provided in computer-mediated communication (CMC) environments have long been considered able to create an environment that shares many communicative features with face-to-face communication. Over the past two decades, researchers have employed a variety of strategies to examine the asserted advantages and possible limitations of learning a second language in such a computer mediated environment. Despite its seeming appeal to language educators, the literature on the effectiveness of CMC in SLA is unable to conclusively support its benefits. This meta-analysis aims to systematically synthesize findings from (quasi-) experimental studies conducted between 2000-2012 to examine whether there was a link between the use of CMC and second language acquisition (SLA). Results from 59 primary studies show a positive and medium effect from CMC interventions. Additionally, communication taking place either asynchronously or synchronously does not seem to have a differential effect on SLA. Furthermore, learners' proficiency level, interlocutor type, research context and task type were found to be variables that would significantly moderate the effectiveness of interaction in such an environment. The above results, however, were interpreted as tentative due to the small n-size of some categories of variables under comparison.

Keywords: Meta-Analysis, Computer-Mediated Communication, Effect Size.

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INTRODUCTION

The past two decades have witnessed a shift away from the conventional use of multimedia or stand-alone programs to facilitate second/foreign language learning to the "communicative and interactive" aspects of language learning that technologies can offer or reinforce (Hoven, 2006, p.237). CMC applications, when appropriately designed for pedagogical goals, instructional context, content, and learners, can closely approximate authentic communications "equivalent to real-life learner-to-leaner or teacher-to-learner communication" (Hoven, 2006, p.241; Sims, 2000) although features of turn-taking and overlaps frequently observed in face-to-face (F2F) communication might not occur in CMC mode due to its technical constraints. Since CMC had traditionally been depicted as one-dimensional, passive and neutral in nature, previous research was not able to distinguish between different technologies under the overarching umbrella of CMC technology. CMC effectiveness must be evaluated in terms of its impact on language learning not as a uniform technology but based on the unique characteristics or features embodied in the different sub-tool and technology utilized in the interaction process (Smith, Alvarez-Torres & Zhao, 2003). Four qualities were proposed by Smith et al., to describe and distinguish different CMC sub-technologies: temporality, degree of anonymity, modality, and spatiality. Temporality describes the mode of time in which communication can take place: either simultaneous (synchronous) or delayed (asynchronous) depending on whether or not there is a substantial time gap between the responses or

messages received from/sent to the interlocutors. Anonymity refers to the degree to which the interlocutors are known to each other in a CMC environment. Some tools such as e-mail are more capable of concealing a user's identity (ensuring anonymity) than others such as video conferencing. Modality refers to the way interaction is supported. Some technology tools, such as chats, support both voice and written communication while others, such as the bulletin boards, allow only textual communication. Spatiality refers to the spatial distance felt by the interactants when engaging in online communication and is of consequence because it is believed to have an impact on the nature of interaction.

As explorations on CMC continue to accumulate, researchers have sought to anchor CMC studies within an array of existing SLA theoretical frameworks. Unique features of computer-mediated communication, such as text-based and computer-mediated interaction, were justified to be beneficial for SLA when examined from the framework of sociocultural learning theory and SLA interactionist theory (Warschauer, 1997). Sociocultural theory stresses that "the human mind is mediated" (Lantolf, 2000, p.1) and humans rely on tools to change the world and to regulate relationships. Among these tools, language is the most important. Using language as the mediation tool, people work jointly to co-construct a context and develop their mental abilities (Lantolf, 2000). L2 acquisition is a social phenomenon (Ellis, 1999). Language learners, through communicative and cognitive activities, not only learn new linguistic forms but also take on new roles, such as those of authors, narrators, and interpreters (Lantolf, 2000; Linell, 1998). The interactionist theory of SLA, which addresses incidental acquisition, emphasizes L2 learning through the process of interacting. Basic components in the SLA interaction process include input, apperception, semantic and syntactic comprehension, intake, integration into the learner's linguistic system and output (Chapelle, 1998). CMC, in a text-based form, renders human interaction easily transmitted, stored, archived, reevaluated and edited, all of which encourage reflection and interaction (Harasim, 1990; Warschauer, 1997).

The amount of research on CMC has been unprecedented especially with technologies moving toward Web 2.0 or even 3.0, making social networking and collaborative interaction via the target language easier and more flexible. Empirical studies focused on learning products or the learning process have been conducted using a combination of quantitative, qualitative, or mixed methods, which involve learners across different educational levels, ages, and L1 backgrounds. Researchers have either focused on the analysis of speech input and output in the negotiation process resulting from different modes of CMC or employed instruments to measure certain SLA effects after such interventions. A certain amount of research has also tried to resolve the still debatable issue of whether CMC or face to face interaction is more beneficial for SLA and at what levels of outcome. Topics that have received attention include (a) the differential effect of face-to-face, synchronous CMC and asynchronous CMC (Blake, Wilson, Pearson, Cetto, & Pardo-Ballester, 2008; Fitze, 2006; Heins, Duensing, Stickler, & Batstone, 2007), (b) comparative discourse analysis of output produced by language learners in different CMC environments (Böhlke, 2000; Liaw & Master, 2010; Patterson, 2000), (c) the effects of different CMC tools on: pronunciation (Alastuey, 2010; Lord, 2008); oral proficiency (Abram, 2003; Hirotani, 2009; Payne & Ross, 2005; Payne & Whitney, 2002; Wang, 2010); pragmatic competence (Liu, 2007; Sykes, 2005;); writing (Jou, 2008; Liang, 2010; Shang, 2007); grammar (Sauro, 2009); vocabulary (Fuente, 2003; Lee 2009; Sasaki & Takeuchi, 2010), and reading (Izquierdo & Reyes, 2009; Jou, 2008; Kung, 2004; Li, 2009). A large number of studies have also investigated students' perceptions of CMC (Chao & Lo, 2011; Mahfouz, 2010; Ray & Hocutt, 2006).

In general, various studies have revealed: (a) the likelihood that a relationship between working memory (Payne & Ross, 2005; Payne & Whitney, 2002; Wang, 2010) and oral proficiency and chat-room discussion can be utilized to develop L2 oral proficiency (Payne & Whitney, 2002); (b) overall, e-mail exchanges improve students' writing performance (Shang, 2007); (c) students demonstrate a greater lexical range and used more complex and varied discourse in CMC than in the face-to-face mode (Fitze, 2006; Sykes, 2005); (d) interactional and intercultural competencies are important dimensions of online

electronic discussion for language learning (Kung, 2004; Liaw & Master, 2010), and (e) students perceive the applications or experiences of CMC activities for facilitating different levels of language learning as positive and helpful (Izquierdo & Reyes, 2009; Lee, 2009; Mahfouz, 2010).

Computer-mediated communication, with its various modes and tools, has been extensively used in all areas of SLA; however, research on its effectiveness has been inconclusive. For example, following Healy-Beauvois (1992) and Kern (1995), Payne and Whitney's study (2002) further supported their finding that L2 oral proficiency can be developed through synchronous computer-mediated communication (SCMC) (e.g., synchronous chatroom) interaction in the target language, while two later studies conducted by Fuente (2003) and Hirotani (2009) did not support such a finding. Although it has been suggested that findings from primary studies need to be replicated in different contexts with different participants and treatments (Payne & Whitney, 2002) to further pin down the effects of CMC, we argued that a comprehensive and systematic meta-analysis would be more efficient and effective in telling us the overall effect of CMC interventions, directing our future research efforts in this field and providing evidence-based pedagogical suggestions. A more detailed introduction of how meta-analysis works in research synthesis is provided in the next section.

WHAT IS META-ANALYSIS?

Meta-analysis is a "formalized statistical method" for averaging the effects found across a set of scientific studies or observations (Oswald & Plonsky, 2010, p. 85). The primary purpose of meta-analysis is to integrate findings by analyzing a large collection of results from primary studies (Glass, 1976). The difference between a meta-analysis and traditional narrative literature review is that the latter is usually done on studies with different topics for the purpose of reinterpretation or hypothesis-generating, while the former is a hypothesis-testing method (Baumeister & Leary, 1997). "Meta-analysis" has been variously employed, including study effect meta-analysis, homogeneity test-based meta-analysis and psychometric meta-analysis, depending on the purpose of the review (Liao & Hao, 2008). However, by applying systematic statistical methods to measure the treatment effects observed in quantitative studies, meta-analysis has received recognition as a favorable scientific research synthesis compared to traditional reviews, such as the narrative literature review described above, vote counting, or the P values method (Hunter & Schmidt, 2004; Li, 2010; Liao & Hao, 2008).

Meta-analysis has become a "preferred" way of synthesizing research findings in many scientific disciplines (Aytug, Rothstein, Zhou, & Kern, 2012, p.103; Cooper, 2009). Previous meta-analysis of CMC studies took many forms, such as the employment of a narrative review to explore the role of SCMC for SLA (Sauro, 2011); the investigation of the overall effectiveness of computer assisted language learning (CALL) (Felix, 2005, 2008); a discussion of characteristics of CMC with reference to socio-cultural and interactionist theories (Hata 2003); a critical review of CMC from various theoretical perspectives (Nguyen, 2008), scrutinizing the effect of text-based synchronous computer mediated communication on SLA (Lin, Huang, & Liou, 2013) and employing both narrative review and meta-analysis approaches to explore developments in technology and language learning, (Zhao, 2003).

The few previous meta-analyses or research reviews failed to produce a quantitative measurement of the overall effect of CMC in SLA, leaving the cause and effect relationship between CMC interventions and language learning outcomes to be clarified, established, and most importantly updated. Adopting Cooper's (1982) five-stage model of the integrative review, this meta-analysis seeks to (a) present an overview of empirical studies of CMC in SLA conducted between 2000 and 2012, (b) investigate the overall effectiveness of the wide range of CMC interventions/tasks adopted in SLA classrooms, and (c) identify variables that might moderate the effect of CMC on language learning. I focus the analysis on the following research questions:

1. Compared to face-to-face communication or no (i.e., passive study without interactive)

communication, how effective is CMC in facilitating second language learning/acquisition?

2. Is the effectiveness of CMC related to whether the communication is taking place asynchronously or synchronously?

3. Do learners with more advanced language proficiency and in higher educational contexts benefit more from CMC than others?

4. Do the following methodology features impact the effects of CMC differently: (a) task type, (b) interlocutor type, (c) CMC modality, (d) research setting?

Definition of Terms

Operational definitions of major constructs were developed drawn on conceptual definitions in the literature to establish and delimit their scope for this meta-analysis.

Second Language Acquisition (SLA)

In this meta-analysis, SLA is operationalized as the acquisition of tools language learners need to rely on in order to successfully carry out communication with the target language users. The tools are composed of but not limited to speaking, reading, writing, listening, and the respective components that make up the tool, such as grammar, pronunciation, vocabulary, etc. Such capacities were acquired through the use of a particular feature of technology in a learning situation from which a discernible change in the learning process, the learning climate, or the learning achievement was found and measured (Felix, 2005) immediately after the change. Following this operational definition, this meta-analysis synthesized the immediate/short-term but not delayed effectiveness of CMC on different language outcomes right after the CMC interventions were removed or became unavailable.

Computer-mediated Communication (CMC)

Computer-mediated Communication refers to multimodal, often Internet-mediated communication (Thorne, 2006), which was made possible by utilizing " … a wider variety of online tools which include social networking sites, virtual realities, and gaming…" (Goertler, 2009, p.75). In this meta-analysis, CMC is loosely defined as any real-time or delayed communicative transaction that occurs through the use of tools taking advantage of networked technology capabilities.

METHODS

This meta-analysis was conducted to investigate the overall effect of CMC on SLA. Specifically, the independent variable examined is communication mode (face to face vs. asynchronous/ synchronous CMC). The potential moderator variables were identified both from the methodology and learner features, and included: task type, CMC modality, research setting, interlocutor type, learners' educational level and L2 proficiency level. The dependent variable is the effect sizes calculated from the eligible studies based on the random-effect model with justification provided. In the following, the steps taken in conducting the current meta-analysis are described.

Literature Search

Key words were first identified from primary studies and then used alone or in different combinations to search for relevant studies. The major key word used to guide the search was *computer-mediated communication*, in combination with techniques/platforms commonly utilized to engage in such communication including email, chat, discussion forum, Web 2.0, etc. *ESL, EFL or language learning* were used interchangeably to limit search outcomes to research contexts of language learning/teaching only. The "file-drawer" problems were minimized by inclusion of both published and unpublished studies

while considering the fact that studies reporting statistical significance were more likely to be published than those with no significant difference (Hunter & Schmidt, 2004; Li, 2010; Lipsey & Wilson, 2001; Rosenthal, 1979). The unpublished studies included theses, dissertations and conference presentations that were not published in proceedings, and manuscripts that may have never been subjected to any kind of peer review. The major databases searched included Education Abstracts Full Text (Wilson), Education resources Information Center (ERIC), ProQuest Psychology Journals, Springer Online Journal Archives, JSTOR - Arts & Sciences III Collection, EBSCOhost, Linguistics and Language Behavior Abstracts (LLBA), and the Social Science Citation Index. Manual searches of peer-reviewed journals were also conducted to ensure a maximum coverage of eligible studies. The first priority search included CALL-specific and education technology-related journals (Smith & Lafford, 2009). These journals were manually searched issue by issue and included Language Learning & Technology, Computer-assisted Language Learning, ReCALL, System, CALICO, and the JALT CALL Journal. The second priority of search included journals that were overall related to SLA, language learning, teaching, and practices. These journals included, but were not limited to: Language Learning, the Modern Language Journal, TESOL Quarterly, Canadian Modern Language Review, Second Language Writing, Foreign Language Annals, Second Language Research, and Studies in Second Language Acquisition. The third priority of searching included journals that published research utilizing educational technology overall but not necessarily in language learning contexts, including the Journal of Computer-assisted Learning (JCAL), the British Journal of Educational Technology, Educational Technology Research & Development (ETR&D), Computers & Education. References provided from the primary studies were also manually checked to expand the range of potentially eligible studies.

Inclusion/Exclusion Criteria

In order for the empirical studies to be reviewed in this meta-analysis, each study had to meet the following criteria:

- Be published between 2000 and 2012.
- Investigated some form of CMC (e.g., email, chat, video/audio conferencing, discussion forums, CMS, Moodle, etc.) either exclusively or in conjunction with other instructional strategies/intervention as long as the effect of CMC could be teased out by making comparisons between treatment groups for which the only difference between them was the CMC intervention.
- Address the effect of CMC by examining the amount of language used during the process or by administering a posttest, both conditions requiring quantitative data.
- Employed an experimental or quasi-experimental design.
- Recruited participants who were L2 or foreign language learners.
- Report adequate quantitative information for effect sizes to be calculated.
- For studies reporting several sources, only one report was included in the meta-analysis.

After initial review of potential primary studies, the following exclusion criteria were drawn to filter out unqualified studies. This designation would exclude studies whose primary focus were:

- Students' attitudes towards or beliefs regarding CMC (Luo, 2005)
- Pedagogical implications/recommendations for using CMC (Blake, 2007; Goertler, 2009).
- Functionalities of CMC (Kenning, 2010), and
- Theoretical position papers (Hampel, 2003)
- The study described the process of CMC from a qualitative perspective (Peterson, 2009).

- The study employed questionnaires/interviews to explore students' perceived effectiveness of the use of CMC (Samsonov, 2001).
- The participants in the study were not identified in any way as L2 learners. For example, studies investigating the use of CMC as a tool for teacher preparation (Johnson, 2006).
- Qualitative/quantitative syntheses/reviews (Belz, 2007).

The rationale for selecting potential moderating variables along with their descriptions and codings are discussed in the following section.

Variables

CMC Mode

In online settings, language learners can engage in communication either asynchronously or synchronously. The latter involves interlocutors in a real-time situation in which they "converse" either by typing messages or by speaking into microphones. Due to its real-time nature, synchronous CMC, such as via chat rooms and Yahoo messenger, is considered to resemble face-to-face interaction to some degree. On the other hand, asynchronous CMC, such as web-based bulletin boards and email, simulate a delayed-time interaction in which extended planning, decoding and encoding time are allowed (Abrams, 2003). Since the communication modes, with their unique technological affordance, might affect the nature of interaction, it is worth investigating and comparing their respective effectiveness for SLA.

CMC Modality

CMC modality was coded as either text or voice, which may significantly affect the quality and nature of interaction. Voice-based CMC allows students to engage in verbal and para-verbal communications in which repair and negotiation are more likely to occur than in the text-based modality (Jenks, 2009) in which participants use personal computers to send typed messages with a potential delay of seconds before appearing on their partner's computer screen. Text-based modality may better fit certain communicational styles, and provide opportunities for more language production (Jepson, 2005).

Task Type

CMC technologies enable L2 learners to engage in networked, internet-based activities that facilitate interaction between learners and other speakers. Learners can now receive information and also engage in learning tasks and activities in various modes, such as visual, audio, and verbal/textual (Hampel, 2006). Although there exist similarities in modes of communication between face-to-face classroom-based interaction and CMC, the very different affordances of the latter create potential as well as limitations in terms of appropriate task designs (Hampel & Baber, 2003). Task designs in accordance with the affordances or limitations of CMC are likely to have a differential effect on the quantity and quality of interaction. It is therefore interesting to investigate task type as a potential factor in moderating the effects of CMC on SLA. The task typology established by Pica, Kanagy, and Falodun, (1993) was used to classify studies since it was probably the most frequently used typology for examining interaction in the task-based learning environment (Smith, 2003). A task is defined as an activity that students carry out actively to reach a prescribed goal either alone or with other peers. Task type was coded as opinion exchange, information gap, jigsaw, decision-making or problem solving in full awareness of the fact that each specified task type might take many different forms.

Interlocutor Type

A subset of CMC studies (Chiu & Savignon, 2006; Iwasaki & Oliver, 2003; Sauro, 2009) has examined the occurrence of self-repair or feedback types in different CMC environments, which provide learners with different tools to initiate their utterances, self-repair, or construct modified responses to their interlocutors (Heift, 2010; Sauro, 2011). Learner uptake, a long-relied-on predictor of successful SLA, is

used to describe the reactions or responses to feedback provided by interlocutors (Heift, 2010; Lightbown, 2000; Loewen, 2004; Lyster, 2007). Different interlocutors might employ different learner strategies or feedback types, thus affecting the amount or nature of uptake, which indirectly or directly affects learning outcomes (Yamada & Akahori; 2009). It is therefore interesting to examine if there is a differential effect of interlocutor type on SLA in CMC environments. Interlocutor type is coded one of three possibilities: peers, native speakers of the target language, and instructor/tutor/researcher or others.

Research Setting

Research setting refers to the environment in which SLA is taking place, and is broadly divided into learning the target language either as a second language (SL) or as a foreign language (FL). In the former setting, students have the benefits of using and practicing the target language in daily life, both inside and outside the classroom; however, in the latter setting, language learning is mostly limited to within the classroom, and there is little chance to use the language in an authentic environment. The degree of exposure to the target language is different in SL and FL settings both in the nature and amount of SLA, and practitioners tend to design learning activities differently for the two different settings. It is worth investigating if the research setting has an influential effect on how CMC activities are not only designed but also used to reinforce language acquisition.

Learner Education Level

Cognitive development has long been recognized as a significant factor in determining learning outcomes (Geva & Ryan, 1993; Robinson, 1997). The ability to rely on one's cognition to receive and process new information and integrate it with prior knowledge to construct and reflect on new knowledge plays a significant role in all kinds of learning, SLA being no exception. Learner education level generally reflects the degree of cognitive development. It is worth probing if learners' educational level has an impact on SLA in CMC environments. Participants' education level was classified into college and above, middle and secondary school, and primary school and below. No inferences were made regarding studies that did not provide such information. Participants' educational level was coded as reported or labeled by the researcher in the study.

Learners' L2 Proficiency Level

L2 learners' target language proficiency level has been used either as an independent variable or as a covariate in primary SLA studies, proving its importance in SLA. Research has been conducted to close or minimize the gap between high and low proficiency students in SLA by exploring different instructional interventions. Would CMC characteristics, used to supplement or simulate real face-to-face classrooms, scaffold students with limited target language proficiency? This meta-analysis also seeks to answer this question. Learners' initial target language proficiency level was coded as one of the following four levels: elementary, intermediate, advanced, or mixed. The code was determined based on the participants' background information as provided in the primary studies. The original labels used by the researchers to classify participants into different levels were retained and no inferences were made based on this feature. It has to be noted that some primary researchers administered proficiency tests to participants while others did not. The latter's judgment may indicate only an impression of a student's level. It is relevant to note that in the former cases a wide variety of proficiency tests may have been given so the classified proficiency levels may not be comparable across the various studies.

Coding and Inter-coder Reliability

A team made up of four research assistants and the meta-analyst collaborated to code the retrieved studies. Each coded independently 1/5 of all eligible studies and then served as a backup so that each study was actually coded by at least two of the five. They computed inter-coder reliability by calculating the agreement rate for each category and variable. Codes receiving less than 95% agreement went through an additional coding by all concerned, and any disagreements were resolved through discussion. For

codes with extremely high inferences due to limited information available in the study (e.g., task type), a code was given based on the best estimation, but this is noted and discussed in the limitation section. The final agreement rate was 96%. Table 1 presents the final coding scheme with descriptions for each coded feature. Rationales for selecting specific variables for further moderator analysis are provided following

Table 1. *Coding Scheme.*

Features	Descriptors
PUBLICATION	
Publication year	Year of publication
Publication type	Journal article/ Dissertation/ Thesis/Conference paper/ Report/Other
LEARNERS	
L2 proficiency	Learners' initial target language proficiency level Advanced / Intermediate / Elementary
Educational status	Primary school or below/Middle school (or secondary school)/ College or above
METHODOLOGY	
Research setting	FL/SL
CMC platform	E-mail/Chat/Discussion forum/Instant/CMS Messenger/Blog/E-portfolio/Wiki/Other (specify)
Task type	Information gap/Jigsaw/Problem-solving/Decision-making/ Opinion-exchange/Mixed
Interlocutor type	Peers/ native speakers of TL/ Instructor, tutor, researcher/Others
CMC modality	Voice/Text/Both
CMC mode	Synchronous/Asynchronous/Both
Sample size	Number of participants

Effect Size Calculation

The effectiveness of CMC on language skill acquisition was expressed by calculating effect sizes for each study of different learning outcomes. The effect sizes represented as standardized mean difference were calculated by dividing the mean difference in a study by its pooled standard deviation, that is, Hedge's g. The potential outliers were checked for their influence on the overall mean effect. The effect sizes were also weighted and corrected for small sample sizes (Johnson & Eagly, 2000; Penny & Coe, 2004). If a study did not provide descriptive analysis data but did provide F values, effect sizes were calculated using the procedure suggested by Glass, MacGaw, and Smith (1981).

RESULTS

The Research Synthesis

In total, 59 studies published between 2000 and 2012 were included in this meta-analysis. Data collection was completed by March 2012. The 59 studies included 3,562 participants in Lee's study (2009) involving the smallest sample size (N=12), with Blake, Wilson, Pearson, Cetto, and Pardo-Ballester (2008) being the largest (n=334). Among the 59 studies, 5 were conference papers, 12 were dissertations, 11 were theses, and 31 were journal articles. Approximately one fifth of the studies (K=13) generated negative effect sizes. Among the remaining 46 studies, the effect sizes range between 0.01 and 2.17. Based on Cohen's interpretation of size of effect (i.e., ES<.02 is regarded as small, between .02 and .05 is medium and >.08 is large), 44% of the included studies (K=25) generated large, one fifth generated

medium (*K*=12), and 12% generated small effect sizes (*N*=9). Appendix A displays the effect sizes each study contributed, the standard error, and the 95% confidence interval [CI] of each effect size, its associated upper and lower limit and the p value. The number of studies included in this meta-analysis by year is displayed in Figure 1. As indicated, there has been a growth in the number of studies on CMC since 2000, with the majority of included studies appearing between 2004 and 2010.

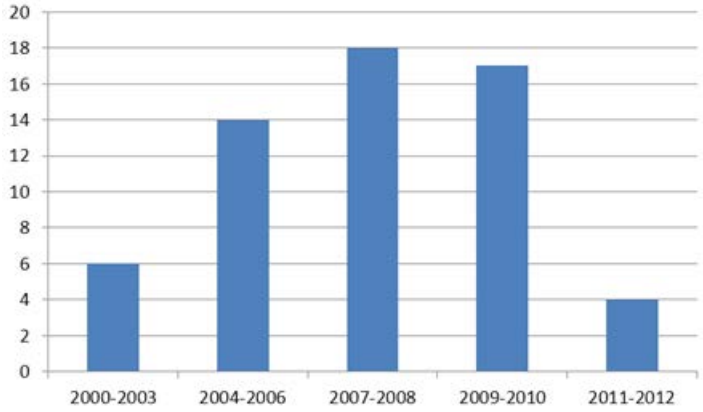

Figure 1. Distribution of included studies by year

Among the 31 journal articles, more than half (*K*=20) were published in five major journals (see Figure 2): Computer-assisted-language-learning (CALL), Modern Language Journal (MLJ), Language Learning & Technology (LLT), Foreign Language Annals (FLA) and CALICO Journal.

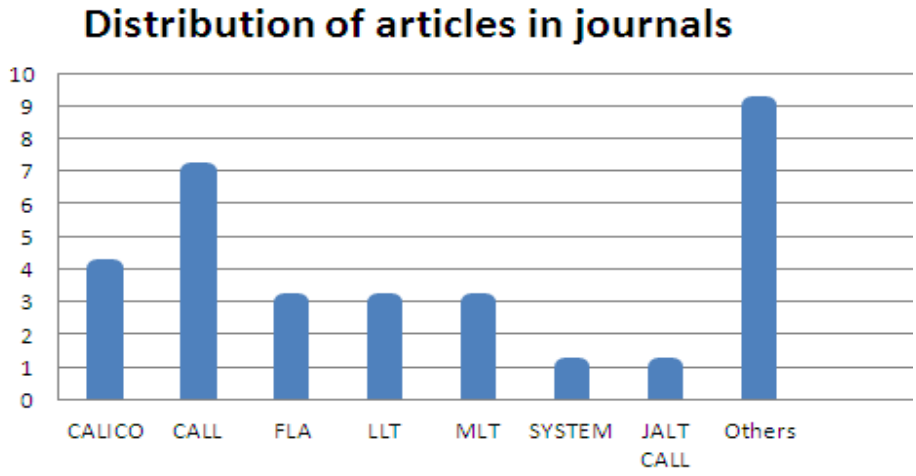

Figure 2. Distribution of articles in journals

Summary of Learner and Methodological Characteristics

Table 2 summarizes the learner characteristics of the included studies. As shown, the majority of the studies did not report the learners' initial target language proficiency; however, for those which did, a slightly higher ratio can be found for elementary-level participants followed by the intermediate level. Not many CMC studies recruited participants whose target language proficiency was advanced. More than two thirds of the studies recruited college students as participants while only three involved primary school students.

Table 2. *Learner Characteristics of Included Studies*

L2 Proficiency*	*K*	Education Level	*K*
Advanced	4	College & above	45
Intermediate	7	High (Secondary) school	10
Elementary	8	Primary	3
Mixed	7	Mixed	1
N/A	33		

*Note. *The initial target language proficiency level as defined in each primary study*

Table 3 summarizes the methodology characteristics of the included studies. As shown, 28 studies employed a synchronous mode of communication. The predominant tool of communication was text rather than voice-based. With respect to the tasks carried out making use of CMC tools, more than 50% of the studies employed performance-based tasks, while only slightly more than one-third adopted communicative tasks. Detailed coding of the learner and methodological features of the primary studies can be found in Appendix B.

Table 3. *Methodology Characteristics of the Included Studies*

Mode	*K*	Modality	*K*	Task Type	*K*	Setting	*K*	Interlocutors	*K*
Asynchronous	23	Text	40	Decision-M[a]	1	FL	43	Peers	47
Synchronous	28	Voice	16	Information G[b]	5	SL	11	Teachers	5
Both	8	Both	3	Jigsaw	2	Mixed	3	Native S[d]	4
				Opinion E[c]	44	N/A	2	Mixed	2
				Mixed	2			N/A	1
				N/A	5				

Notes. [a]decision-making; [b]Information gap; [c]opinion exchange; [d]native speakers

As shown in Table 4, computer-mediated communication, in general, has a small to medium effect on language learning (Hedge's g=0.461). Studies that employed an asynchronous mode of communication produced the largest effect (g =0.610) followed by both modes (g=0.460). Synchronous CMC produced the smallest effect (g= 0.313). The lower and upper limits at the 95% confidence interval do not include zero meaning as such an effect does not happen by chance. The Q-test, however, revealed that the difference between the three levels of CMC is non-significant.

Table 4. *Effects of Computer-mediated Communication by Independent Variable*

Independent variable	*K*	Hedge's *g*	Standard Error	95% Confidence Interval	
				Lower	Upper
Overall Effect[a]	59	0.441	0.074	0.296	0.587
Mode		$Q(2)=2.312$, $p=.315$			
Asynchronous	23	0.610	0.118	0.378	0.842
Synchronous	28	0.313	0.157	0.006	0.621
Both	8	0.460	0.218	0.032	0.888

Note. [a]The overall effect (Hedge's g) is computed based on the principle of "one study, one effect size" (Li, 2010).

Moderator Variable Analysis

Six moderator variables were further analyzed to explore their possible impact on the overall effectiveness of CMC. To achieve this aim, a series of Q-tests were performed, and the obtained *Q* statistics and associated p value (set at the .05 level) were used to examine if a certain variable is a significant moderator. The results, shown in Table 5, indicated that research setting, learners' language proficiency level, and interlocutor type were significant moderators.

Table 5. *Moderator Analysis Results*

Moderators	K^a	Hedge's *g*	SE	95% CI		Q^b
				Lower	Upper	
CMC modality						
Text	40	0.438	0.104	0.233	0.642	0.130
Voice	16	0.491	0.173	0.151	0.830	
Both	3	0.605	0.614	-0.599	1.809	
Research setting						
FL	43	0.610	0.100	0.414	0.805	13.049***
SL	11	-0.038	0.149	-0.330	0.254	
Task Type						
Opinion Exchange	45	0.616	0.116	0.388	0.844	8.483*
Information gap	5	-0.158	0.374	-0.890	0.574	
Jigsaw	1	-0.322	0.775	-1.841	1.197	
Decision making	1	1.943	0.766	0.442	3.444	
Educational level						
College & above	45	0.432	0.101	0.233	0.631	0.529
High (Secondary) school	10	0.615	0.241	0.143	1.086	
Primary	3	0.426	0.138	0.156	0.697	
L2 proficiency						
Advanced	4	0.403	0.112	0.184	0.622	9.048*
Intermediate	7	0.393	0.125	0.148	0.638	
Elementary	8	0.782	0.097	0.593	0.971	
Interlocutor type						
Peers	47	0.495	0.105	0.290	0.700	7.095*
Teachers	5	0.031	0.154	-0.270	0.333	
Native speakers	4	0.487	0.119	0.255	0.720	

Notes: [a] This moderator analysis included only studies from which the data for the certain variable was available.[b] indicates significance at the .05 level; ** at the .01 level; *** at the .001 level.*

Follow-up pairwise comparisons were conducted for the significant moderators identified above. Table 6 provides the results of the pair-wise comparisons, and a brief summary of the results follows.

Table 6. *Follow-up Pairwise Comparisons of Significant Moderators*

Pairwise comparisons	*Q* statistics[a]	Results
Research Setting		
FL vs. SL	13.049***	FL>SL
L2 Proficiency		
Advanced vs. Elementary	6.596*	Elementary > Advanced
Advanced vs. Intermediate	0.003	
Intermediate vs. Elementary	6.062*	Elementary > Intermediate
Interlocutor Type		
Peer vs. Native speakers	0.02	
Peers vs. Teacher	6.200*	Peers > Teacher
Native speakers vs. Teachers	5.507*	Native speakers > Teacher
Task Type		
Opinion exchange vs. Information gap	3.913*	Opinion exchange> Information gap
Opinion exchange vs. Jigsaw	1.407	
Opinion vs. decision-making	2.863	
Decision vs. Information gap	15.213***	Decision-making>Information gap
Decision vs. Jigsaw	1.112	
Information gap vs. Jigsaw	0.140	

*Notes:*indicates significant at the .05 level; ** at the .01 level; *** at the .001 level.*

Research Setting

Research setting is found to be a significant moderator of CMC effectiveness. The mean effect size calculated for studies conducted in foreign language settings is significantly greater than that of studies conducted in second language settings, (Q(1)=13.049, p=.000).

L2 Proficiency

A significant difference was detected among the three different levels of L2 proficiency (Q(2)=9.048, p=.011). Studies with elementary level students generated a significantly larger effect size than those with advanced (Q(1)=6.596, p=.010), and with intermediate level students (Q(1)=6.062, p=.014).

Interlocutor Type

Regarding the interlocutor type, it was found to be a significant moderator (Q(2)=7.095; p=.029). Pairwise comparisons showed that having peers as interlocutors generated a larger effect size than having teachers (Q(1)=6.200, p=.013). Having native speakers as interlocutors also generated a larger effect size than having teachers (Q(1)=5.507, p=.019). No significant difference was found between peers and native speakers as interlocutors.

Task Type

Task type was found to be a significant factor that moderated the effectiveness of CMC, (Q(3)=8.483, p=.037). A pairwise comparison indicated that opinion exchange, the most overwhelming task adopted in

most CMC studies, produced the largest effect size and is more effective than the information gap. Furthermore, decision-making is also significantly more effective than the information gap task. However, there was no significant difference between decision-making and opinion exchange.

DISCUSSION

This meta-analysis aimed to systematically examine empirical studies that investigated the use of CMC tools in SLA contexts and calculate an overall effect size to quantitatively encapsulate the effect of such tools on SLA. The results showed a medium but positive effect of CMC on SLA over face-to-face or no communication. Following are plausible explanations for the findings.

First, two variables associated with the methodology features did not turn out to be significant moderators, as was expected. These variables are CMC mode and CMC modality. In empirical studies, researchers tend to manipulate the independent variables to examine their relative effects on the learning outcomes. Most of the methodological features identified in this meta-analysis were the independent variables examined in the primary studies. For example, CMC mode, either asynchronous or synchronous, was compared in Abrams's (2003) and Hirotani's (2009) studies. Cross-tabulation analysis of the effect sizes incorporating outcome skills found that, almost exclusively, writing tasks were carried out either asynchronously or synchronously, while speaking tasks were almost exclusively conducted synchronously, with few exceptions. For example, Sun (2012) used voice-blogs (asynchronous CMC) to provide extra practice for speaking. The largest negative effect sizes were generated by studies employing the synchronous mode (Coniam & Wong, 2004; Fuente, 2003; Loewen & Erlam, 2006; Pyun, 2003; Zheng, 2010), while effect sizes generated by asynchronous studies were quite evenly distributed in terms of magnitude. A further observation indicated conflicting results. Studies employing synchronous communication for speaking generated both the largest positive, i.e., Xiao (2007), Chen (2008), Satar & Ozdener (2008), and the largest negative effect sizes, i.e., Loewen and Erlam (2006), Pyun (2003), and Zheng (2010). While this study found no conclusive preferences for either mode of communication in SLA, and the nature of each mode lends itself to a preferred language skill development, it has to be noted that the effectiveness of each mode needs to be examined by taking into consideration other essential factors such as task design and the language skill that is targeted.

With respect to CMC modality, the results showed no significant difference in effect sizes generated between text-based (0.417) and voice-based CMC studies (0.346). Among these studies, voice-based CMC was almost exclusively used to develop speaking skills, with few exceptions (e.g., Kost, 2004; Sun, 2010), while text-based CMC was more spread out across all four skills, though the majority was used to develop writing skills (N=27). Close examination of the data showed that the largest negative effect sizes were associated with text-based CMC (e.g., Fuente, 2003; Loewen & Erlam, 2006; Pyun, 2003; Zheng, 2010), while the largest positive effect sizes were associated with voice-based CMC (e.g., Chen, 2008; Xiao, 2007). Cross-tabulation revealed a thought-provoking finding: both negative and positive effect sizes were associated with the measurement of speaking. This suggests that when text-based CMC is employed to develop oral skills, the results can be expected to be negative; on the other hand, when voice-based CMC was employed, the results were positive. Previous studies have examined the communicative features that are unique to each mode of communication (Jepson, 2005; Sauro, 2004). The technological affordances of voice-based CMC seem to be able to engage students more in self-repair and self-correction than do those of text-based CMC. Communication in the former, being slower than in the face-to-face mode, gives students opportunities to monitor their interactions. They are able to correct their pronunciation problems so as to produce comprehensible output while employing various communication strategies in rapid turn-taking (Jenks, 2009), which is likely to put them more at ease and improve their oral proficiency. In text-based CMC, however, students may be given the choice to retype their utterance only when there is a communication breakdown.

Nonetheless, the discussion might also be taken up from the perspective of working memory. Previous

studies have examined the hypothesis that L2 oral proficiency can be indirectly developed via text-based synchronous chat-room interaction. In text-based chat interaction, the rate of conversation is slower and learners are given opportunities to refresh their memory by re-reading messages. Both processes significantly reduce working memory load, which has an impact on L2 performance and acquisition (Payne & Whitney, 2002). It should be noted, however, that most primary studies relied on printed chat log files as the sole data to interpret chat interactions–files which might not be able to capture all the repairs that go on. This data collection method may have rendered the results severely flawed and not comparable (Smith, 2008). Additionally, the discussion above is limited to synchronous interaction since only three studies employed asynchronous communication, and all three studies were voice-based.

With respect to task type, this meta-analysis found that opinion-exchange was the most favored task (*k*=45) researchers chose to engage students in meaningful interactions in the CMC environment, with information-gap tasks ranking second (*k*=5). A very small number of studies adopted jigsaw (*k*=1) or decision-making *(k*=1) in such an environment. Students' learning outcome was found to be significantly better when engaging in opinion exchange than in information gap activities. Furthermore, tasks such as jigsaw and information-gap could actually produce negative effects on language learning. This result is counter-intuitive, belying previous research results. According to the interactant relationships and requirements in communicating information to achieve task goals as proposed by Pica et al. (1993), both jigsaw and information gap required interactants to be information suppliers and/or holders, thus exchanging or sharing information is a must for achieving a convergent goal for a task with only one outcome option. These two tasks are able to maximize opportunities for comprehensible input, promote feedback on production, and enhance modification of the output. Such experiences are required for language learning to take place. On the other hand, for opinion exchange and decision-making tasks, the individual students would have access to information needed to complete a task so he/she could work independently to solve a problem or make a decision without interaction with others. When there is more than one possible outcome and when learners do not need to complete a task with a convergent goal, opinion-exchange and decision-making are least facilitative for SLA compared to the other tasks (Smith, 2003). Further cross-tabulation analysis revealed that decision-making, information gap, and jigsaw tasks were all carried out synchronously mostly for speaking purposes; on the other hand, opinion exchanges were performed both synchronously and asynchronously, covering a wider range of language skills. Considering language outcome and task type, it was found that large effect sizes (i.e., *ES*>=1) were exclusively associated with opinion-exchange used to facilitate writing skill. When opinion-exchange was performed in speaking practice, it actually produced a negative effect. For studies that used the information gap, positive effects were associated with speaking, while the negative effect sizes were associated with writing skill. In this meta-analysis, opinion exchange was found to be almost exclusively positive for the development of reading and writing while it may be either positive or negative for speaking depending on the task design. It has to be noted, however, that the above findings have to be interpreted with great caution given that there was only one single study that employed either decision-making or problem-solving while a good number adopted opinion-exchange. The big gap in the number of studies among categories renders the question of which task type is most effective for SLA in CMC environment open for further research. Furthermore, in this meta-analysis, acquisition was defined as short-term gains measured by varying types of tests. It's also possible that the primary researcher did not employ the most appropriate post-test to the nature of the task, which would then show negative results in the outcome.

Interlocutor type turned out to be a significant moderating variable. Having peers as interlocutors generated a larger effect size compared with native speakers followed by teachers, which generated the smallest effect. Although the difference in the size of effects was minimal, the results are contrary to our expectation that, with native speakers as interlocutors providing authentic input, the amount of negotiation between ESL students and native speakers would most likely be greater than that between

peers due to the larger language proficiency gap, which would provide more chances for negotiation and the possible transfer of the negotiated input into intake. As one would expect, when the teacher is the sole interlocutor, opportunities for interaction are split among learners and thus the effect of such communication on language acquisition may be expected to be less observable. The plausible explanations above, though, would have to be considered against the fact that in this meta-analysis, the number of studies employing peers as interlocutors (*K*=47) was overwhelmingly larger than those with native speakers (*K*=4) and teachers (*N*=5). Thus, the native-speaker and teacher-as-interlocutor samples are under-representative and thereby render the discussion of the effect of this variable tentative.

With regard to research setting, a tentative finding revealed a much larger effect for studies in which the target language was a foreign language than for studies in which it was a second language. A more striking observation is that studies conducted in SL contexts actually generated a negative effect on SLA, while those in FL contexts generated a moderate positive effect. One plausible explanation may be that learners in FL contexts are more enthusiastic about making use of the opportunities offered for the simulated communication afforded in the CMC environment than those in SL contexts, in which such opportunities are also available to them beyond the classroom. That CMC actually had a negative effect on SLA in second language contexts deserves special attention. Cross-tabulation indicated that the majority of studies (7/11; 64%) conducted in SL contexts employed short treatments of less than 10 weeks, while the majority of studies conducted in FL contexts employed medium-length treatments (26/40; 65%) lasting for a period of 11-24 weeks. The difference in length of treatment is another speculation as to why studies conducted in SL contexts produced a much smaller (or even negative) effect than those in FL contexts. The fact that the wider social context might interact with the duration of the study/treatment render the finding that context plays a role in CMC effectiveness tentative.

Furthermore, to investigate if learners' target language proficiency has an impact on the effect of CMC, effect sizes were calculated for three levels of proficiency: elementary, intermediate and advanced. The results show that elementary-level students benefit more from CMC than both intermediate- and advanced-level students. The level of proficiency was determined by the primary researchers, who employed various types of measurements or who simply made such judgments based on their understanding of the students, and thus this variable is by no means to be taken as valid. However, since the moderator analysis showed differences significantly favoring elementary-level proficiency learners, the meta-analyst decided to report this finding, but without subjecting it to further interpretation. That said, it still merits attention, as one reviewer pointed out, that beginning level learners may progress at a much faster rate than either intermediate or advanced learners; it is therefore too soon to conclude that CMC indeed has a larger impact on beginners, unless CMC is compared with non-CMC for beginning level students.

Our answer to the question of overall effectiveness of CMC compared to F2F is consistent with the main findings reported by Lin et al. (2013), who included only SCMC studies in their meta-analysis. Synthesizing 10 eligible studies, Lin et al. found a small but positive overall effect (*d*= .33) of SCMC on SLA. Similarly, the tentative answers gleaned for research questions 3 and 4 in this meta-analysis are comparable to findings reported in Lin et al. In both meta-analyses, contextual variables such as L2 learners' language proficiency and learning conditions were identified to be significant factors that would influence the effect of CMC on SLA. Among them, lower proficiency students were more likely than advanced learners to benefit from CMC interaction and CMC employed in a foreign language context seems to be more advantageous than in a second language environment for learning to take place.

CONCLUSION AND PEDAGOGICAL IMPLICATIONS

This meta-analysis revealed several tentative findings with respect to the effectiveness of CMC on various aspects of second language acquisitions. Computer-mediated communication has been used extensively both in and out of the classroom to deliver and supplement instruction. In recent years, there has been a

rapidly increasing number of empirical studies investigating the use of CMC tools in second language education. In response to the proliferation of research studies on this topic, this meta-analysis was undertaken to investigate whether interactions conducted in computer-mediated environments would induce equal or even superior communication performance compared to those carried out in face-to-face contexts, and thus would be more effective in facilitating second language acquisition. Overall, the evidence is encouraging; computer-mediated environments can serve as a site for communicating in a second/foreign language when the traditional classroom-based face-to-face alternative is unavailable or as an alternative to it.

This meta-analysis also identified four significant contextual factors that may impact the effectiveness of CMC in SLA, including research setting, learner proficiency level, interlocutor type and task type. Specifically, effective pedagogical features in CMC environments, as derived from the current meta-analysis, would suggest communication tasks that involve classmates/peers, rather than native speakers or teachers, as interlocutors. Additionally, language acquisition may be facilitated through learners' engagement in either asynchronous or synchronous interaction. Another finding is that CMC can possibly close, or at least reduce, the gap between low and high proficiency learners. While, overall, language learners may benefit more from CMC environments compared to the face-to-face mode, it is the low proficiency learners in particular who performed better than the high proficiency learners in this environment, suggesting that the unique features affordable in online environments do have the potential to remedy some learners' shortcomings, such as their low language proficiency.

Furthermore, although a variety of task types can be performed by taking advantage of technology affordances, opinion-exchange is a more flexible task that can be performed either online or offline to facilitate the four language skills, particularly reading and writing. In contrast, the information gap may be more appropriate for the development of speaking, as opposed to writing. Communication taking place in a virtual environment is mediated through computers and/or other technology and the features or affordances of a medium seem to determine the "discourse patterns and communicative behaviors" of interactants (Zhao, Alvarez-Torres, Smith, & Tan, 2004, p. 30). Tasks designed for a traditional F2F environment might need to be modified in order to accommodate technological features.

Although the CMC mode and modality did not turn out to be variables that differentiated CMC effectiveness, the related findings are equally valuable as they suggest that language practitioners have more flexibility in determining real-time vs. delay and voice vs. text communication. The above results, however, are tentative due to the small n-size in some categories of variables under comparison (e.g. interlocutor type), which calls for further research to establish and confirm such a causal relationship. Furthermore, the results in which a greater effect for CMC was found were limited by the measures of learning that were used in the studies included in this meta-analysis.

LIMITATIONS AND FUTURE RESEARCH SUGGESTIONS

The conclusions that can be drawn from this meta-analysis are tentative due to its several limitations; nevertheless, several future research directions emerged. Firstly, we strongly suggest that researchers provide as much detailed information as possible with respect to important variables and outcome measures. Information such as experimental procedures, communication task features, and how learning is measured is important not only for the purpose of synthesizing research but also for future research replications. In this meta-analysis, the number of studies that could be consistently and, more importantly, precisely classified into specific categories was small and, most of the time, relied on the meta-analyst's best guesses due to insufficient information given in the primary studies. Secondly, we would encourage more studies in second language contexts and with more participants from secondary and primary school levels. The majority of studies included in this meta-analysis were conducted in foreign language contexts with participants in higher education. The glaring difference in the number of studies on each level makes one level over-represented and the other under-represented and thus precludes firm conclusions. Thirdly,

the effects of CMC, compared to face-to-face, need to be evaluated as to how it is used, the skills it intends to facilitate, and specifically the tasks that accompany its use (Rodriguez, Nussbaum, & Dombrovskaia, 2012). The studies included in this meta-analysis are highly diverse with respect to learners' background, research design, instructional context, targeted linguistic features, outcome measures, and level of measurements, etc. Although the results found a greater effect for CMC on the measures of learning that were used in the studies included in this meta-analysis, the vast variability greatly limits the generalizability of the findings. We need to understand how learners co-construct meanings in online (and offline) environments, in what ways this impacts their language learning and acquisition, both during the process and following (Warschauer, 1997).

Appendix A. Effect Sizes for Each Included Study

Primary Studies		Hedges's *g*	S.E.	95%CI		*p*-value
Author(s)	Year			Lower	Upper	
Abrams	2003	0.153	0.247	-0.331	0.637	0.536
AbuSeileek	2007	0.878	0.183	0.519	1.237	0.000
Ahn	2006	0.117	0.345	-0.559	0.793	0.735
Alastuey	2010	0.525	0.22	0.094	0.956	0.017
Alastuey	2011	-0.098	0.285	-0.657	0.461	0.293
Arslan & Sahin-Kizil	2010	1.595	0.322	0.964	2.226	0.000
Blake et al.	2008	-0.322	0.314	-0.937	0.293	0.305
Blake	2009	0.369	0.403	-0.421	1.159	0.360
Camacho	2008	1.533	0.203	1.135	1.931	0.000
Chang	2007	-0.255	0.280	-0.804	0.294	0.362
Chang	2008	0.109	0.195	-0.273	0.491	0.000
Chang et al.	2008	1.311	0.215	0.890	1.732	0.000
Chen	2008	1.943	0.290	1.375	2.511	0.000
Chiang	2007	0.472	0.143	0.192	0.752	0.001
Chung	2004	0.374	0.223	-0.063	0.811	0.094
Coniam & Wong	2004	-0.417	0.388	-1.177	0.343	0.282
Fellner & Apple	2006	1.737	0.361	1.029	2.445	0.000
Fitze	2006	-0.167	0.269	-0.694	0.360	0.535
Fuente	2003	-0.859	0.449	-1.739	0.021	0.056
González-Bueno & Pérez	2000	0.812	0.370	0.087	1.537	0.028
Huang & Chang	2009	1.311	0.215	0.890	1.732	0.000
Huang et al.	2008	0.697	0.355	0.001	1.393	0.050
Huang et al.	2010	0.661	0.365	-0.054	1.376	0.070
Hung	2007	0.788	0.298	0.204	1.372	0.008
Jian	2005	0.927	0.280	0.378	1.476	0.001
Jou	2008	0.489	0.200	0.097	0.881	0.014

Kost	2004	0.050	0.260	-0.460	0.560	0.477
Lee	2009	-0.213	0.631	-1.450	1.024	0.736
Lee & Liou	2009	1.399	0.597	0.229	2.569	0.019
Li	2008	0.505	0.259	-0.003	1.013	0.051
Li	2009	0.122	0.298	-0.462	0.706	0.682
Liang	2006	0.517	0.268	-0.008	1.042	0.267
Lin	2009	0.712	0.392	-0.056	1.480	0.069
Liu	2007	0.959	0.231	0.506	1.412	0.000
Loewen & Erlam	2006	-0.527	0.450	-1.409	0.355	0.242
Lord	2008	0.936	0.364	0.223	1.649	0.010
Lu & Liou	2004	0.225	0.186	-0.140	0.590	0.226
Payne & Whitney	2002	0.668	0.369	-0.055	1.391	0.070
Peng & Hsu	2006	0.779	0.280	0.230	1.328	0.005
Pérez	2000	0.466	0.201	0.072	0.860	0.020
Pyun	2003	-1.382	0.423	-2.211	-0.553	0.001
Sanders	2005	0.014	0.118	-0.217	0.245	0.082
Satar & Ozdener	2008	1.703	0.299	1.117	2.289	0
Sequeira	2009	0.853	0.276	0.312	1.394	0.002
Shang	2007	-0.248	0.222	-0.683	0.187	0.264
Simsek	2010	0.468	0.240	-0.002	0.938	0.051
Song & Usaha	2009	1.233	0.471	0.310	2.156	0.009
Sun	2010	0.417	0.299	-0.169	1.003	0.163
Sun	2012	-0.284	0.125	-0.529	-0.039	0.023
Thurston et al.	2009	0.402	0.314	-0.213	1.017	0.522
Tsai	2007	0.125	0.279	-0.422	0.672	0.654
Volle	2005	0.193	0.318	-0.430	0.816	0.544
Wang	2010	0.460	0.279	-0.087	1.007	0.099
Xiao	2007	2.167	0.554	1.081	3.253	0
Yang	2006	0.015	0.243	-0.461	0.491	0.951
Yang	2011	0.008	0.091	-0.170	0.186	0.930
Yanguas	2012	-0.592	0.353	-1.284	0.100	0.094
Zheng	2010	-1.749	0.366	-2.466	-1.032	0
Zhou	2009	1.427	0.277	0.884	1.970	0

Appendix B. Learner and Methodology Characteristics of the Included Studies

Authors	Year	Task[a]	Setting	IOR[b]	ME[c]	MO[d]	EDU[e]	L2[f]
Abrams	2003	OE	FL	P	B	B	CG	IN
AbuSeileek	2007	M	FL	P	V	B	CGe	N/A
Ahn	2006	N/A	SL	P	V	S	CG	N/A
Alastuey	2010	OE	N/A	P	V	S	CG	M
Alastuey	2011	IG	FL	P	V	S	CG	M
Arslan & Sahin-Kizil	2010	OE	FL	P	T	A	CG	IN
Blake et al.	2008	JI	SL	P	T	S	CG	N/A
Blake	2009	IG	SL	P	T	S	M	IN
Camacho	2008	OE	FL	P	T	S	CG	M
Chang	2007	OE	FL	T	V	S	HS	N/A
Chang	2008	OE	FL	P	T	S	CG	ELE
Chang & Hsu	2008	N/A	FL	P	T	S	CG	N/A
Chen	2008	DM	FL	P	V	B	HS	ELE
Chiang	2007	OE	FL	P	T	B	CG	ADV
Chung	2004	OE	FL	P	T	A	HS	N/A
Coniam & Wong	2004	OE	FL	M	T	S	HS	N/A
Fellner & Apple	2006	OE	FL	P	T	A	CG	ELE
Fitze	2006	OE	SL	P	T	S	CG	ADV
Fuente	2003	IG	SL	P	T	S	CG	ELE
González-Bueno & Pérez	2000	OE	SL	T	T	A	CG	IN
Huang & Chang	2009	OE	FL	P	T	S	CG	N/A
Huang & Hung	2008	OE	FL	P	T	S	CG	N/A
Huang & Hung	2010	OE	FL	P	V	A	CG	N/A
Hung	2007	OE	FL	NS	T	A	CG	ELE
Jian	2005	OE	FL	P	T	A	CG	N/A
Jou	2008	OE	FL	NS	T	A	PS	N/A
Kost	2004	OE	FL	P	V	S	CG	M
Lee	2009	IG	SL	P	B	S	CG	IN
Lee & Liou	2009	OE	FL	P	T	S	CG	N/A
Li	2008	OE	FL	P	V	S	CG	N/A
Li	2009	OE	FL	P	T	A	HS	N/A
Liang	2006	OE	FL	P	T	B	CG	N/A
Lin	2009	OE	SL	P	T	A	CG	N/A
Liu	2007	OE	FL	P	T	A	CG	N/A
Loewen & Erlam	2006	IG	M	T	T	S	CG	M
Lord	2008	OE	NA	P	V	A	CG	N/A

Lu & Liou	2004	OE	FL	P	T	A	HS	N/A
Payne & Whitney	2002	OE	M	P	T	S	CG	N/A
Peng & Hsu	2006	OE	FL	P	T	A	CG	N/A
Pérez	2000	OE	FL	NS	T	A	CG	ELE
Pyun	2003	OE	M	P	T	S	CG	N/A
Sanders	2005	OE	SL	P	T	B	CG	IN
Satar & Ozdener	2008	M	FL	P	B	S	HS	M
Sequeira	2009	OE	FL	P	T	S	HS	ELE
Shang	2010	OE	FL	P	T	A	CG	N/A
Simsek	2010	N/A	FL	N/A	T	A	PS	N/A
Song & Usaha	2009	OE	FL	P	T	A	CG	ADV
Sun	2010	OE	FL	P	V	A	CG	N/A
Sun	2012	OE	FL	P	V	A	CG	N/A
Thurston et al.	2009	OE	SL	NS	T	A	PS	N/A
Tsai	2007	N/A	FL	T	T	A	HS	M
Volle	2005	OE	FL	P	V	B	CG	ELE
Wang	2010	OE	FL	P	V	S	CG	ADV
Xiao	2007	OE	FL	M	V	S	CG	IN
Yang	2006	OE	FL	P	T	S	CG	N/A
Yang	2011	OE	FL	T	T	B	CG	N/A
Yanguas	2012	JI	SL	P	V	S	CG	N/A
Zheng	2010	OE	FL	P	T	S	CG	N/A
Zhou	2009	N/A	FL	P	T	A	HS	N/A

Notes: N/A: Data is not available from the study; M: Mixed; [a]Task type (OE- Opinion-exchange; IG- Information-gap; JI-Jigsaw; DM- Decision-making; [b]Interlocutor(P-Peers; T-Teacher; NS-Native speaker); [c]Modality (T-text; B-text and voice; V-voice); [d] Mode (S-synchronous; B-Synchronous and asynchronous; A-Asynchronous); [e] Education (CG-College and above; HS-High school; PS-Primary school); [f] L2 Proficiency (ELE-Elementary; IN-Intermediate; ADV-Advanced

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