Received: 4 May 2023 | Revised: 17 November 2023 | Accepted: 4 May 2024

DOI: 10.1111/jcal.13010

ORIGINAL ARTICLE

Journal of Computer Assisted Learning WILEY

Potential of computer-mediated communications in directing communication repair, co-regulation patterns and student engagement

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Abstract

Background study: Although the number of computer-based instruction has increased drastically, the understanding of how design features of learning modality can affect learning remains incompelte. This partly stems from studies' heavy focus on modified output. Therefore, how interactive nature of computer-mediated learning feeds into learning is under examined.

Objectives: This study examined the potentials of multimodal and text-based computer-mediated communication (CMC) to support learner communication repair, co-regulation patterns and engagement dimensions.

Method: To this end, collaborative online writing performance of 30 English as a Foreign Language learners in Moodle and online writing forum was analysed via conversation analysis. Data from stored conversation of Moodle and chat logs of writing forum were coded for communication repair to trace language related episodes (LREs), co-regulation patterns and students' engagement dimensions.

Results: The frequency analysis of coded data on LREs indicated while multimodal CMC involved students in global and organisational and content LREs, text-based computer-mediate communication involved students in morphosyntactic and lexical LREs. Results also indicated significant differences in co-regulation patterns in multimodal and text-based computer-mediated communication. While students enacted planning, monitoring co-regulation practices in multimodal computer-mediated communication, students in text-based CMC executed evaluation and elaboration co-regulation practices. Findings also indicated that students were differentially engaged in learning. Students were more emotionally and socially engaged in multimodal CMC and cognitively and behaviourally engaged in text-based computer-mediated writing.

Conclusions: The results posit dual function for CMCs, as a mean for communication and cognitive co-regulation. However, dynamics of interaction is influenced by the mode of interaction.

KEYWORDS

computer-mediated communication, co-regulation patterns, EFL writing, language related episodes, student engagement

1 | INTRODUCTION

The prevalence of learning theories emphasising communication as the foundation for second language (L2) learning, coupled with advancements in educational technologies and their potential for connectivity, has fuelled a growing interest in computer-assisted collaborative learning within the L2 learning context (Zhang et al., 2021). Computer-mediated collective dialogues enable L2 learners to collectively construct knowledge through interaction and co-regulation. This process provides scaffolding for readers with limited proficiency, helping them address linguistic challenges. The effectiveness of computer-mediated collaborative writing is enhanced by high interactivity and multi-way communication capabilities, offering mutual and equal affordances for collaboration to all users. This contributes significantly to the value and efficacy of collaborative writing in a computer-mediated environment.

Peeters (2024) meta-analyses on computer-mediated communications (CMCs) in education reveal significant variability in research on online educational spaces, making it challenging to provide a definitive answer regarding CMC efficacy. Current efforts often apply established mediated communication principles to digital discourse without recognising the unique affordances of digital modalities and their impact on learner outcomes and interaction. Modality, as defined by Pereira (2010), is the medium or channel used to express communicative intent. It can be categorised based on the type of image or temporality. Regarding image type, modality represents the semiotic realisation of a mode, such as visual modality in videoconferencing. Examples of modalities include written forms like text chats and blogs, and visual and audio forms like podcasts and video conferences. Modalities are further classified based on temporality, with synchronous examples like Google Docs and forums, and asynchronous examples like emails and blog writing. Synchronous modalities involve simultaneous message exchange, while asynchronous modalities involve messages transmitted at different times. The modality and split attention principles of social semiotic theories of communication elucidate the varied potentials of CMCs. These principles posit that, when employing diverse presentation channels and facing constraints in working memory, students tend to prioritise certain learning components over others. As Sundar et al. (2021) indicated processing video content, as opposed to text, can lead to cognitive overload or depletion due to the involvement of multiple modalities, such as audio, video, and graphics. In addition to conveying relevant information, videos also include structural elements like lighting and animation that are peripheral to the core content (Lang, 2000). This results in a higher allocation of cognitive resources to encoding, at the expense of other memory processes like storage and retrieval. Consequently, messages presented through a "richer" modality like video may be encoded more swiftly but may not undergo as systematic processing as text-only messages, which involve the translation of written words. Fisher et al. (2019) discovered a biological basis for this modality-biased processing, demonstrating that the increased consumption of cognitive and perceptual resources by video is more detrimental for systematic processing compared to learner modalities like text and audio.

The variation in cognitive processing across modalities can impact memory and perceptions of content and news stories (Lang, 2000). Research indicates that watching a video news clip, in comparison to reading a text-based article, results in decreased depth of processing (Powell et al., 2018). Text formats, requiring interpretation and imagination, are considered more abstract, associated with higher news recall. Conversely, video modalities are more concrete, directly appealing to visual senses, providing a sensory-rich description of an event that requires less interpretation (Sundar et al., 2021). Elabdali (2021) meta-analysis unveiled a common trend in existing studies, emphasising a singular focus on a specific CMC modality, thereby neglecting thorough cross-modality assessments. This tendency predominantly centres on easily observable aspects, such as student achievement within online learning spaces, while neglecting the documentation of students' personalised strategies for regulating their learning, improving communication repair, and fostering overall engagement with the learning process. Variant social, emotional and cognitive supports that different online collaborative learning platforms provide have varying predictive level in promoting students' noticing, students' co-regulation of learning and engagement and therefore differently affect student learning (Binali et al., 2021; Galikyan et al., 2021). Therefore, studies of cross-comparison modality are invited to have a clear picture of CMCs potentials in optimising learning. Therefore, examining learners adjusting and calibration of their learning behaviour to fit in with The affordances and limitations of communication in text or multimodal CMC can demonstrate how different CMC modalities facilitate learning (Kaliisa et al., 2022).

Anchored on social constructivist theories, this study calls attention to the potentials of these modalities and their value in sponsoring learning through facilitating students' collaborative and dynamic management of conversation and joint regulation for knowledge construction and engagement. This study compares the efficacy of text-based and multimodal CMC modalities in promoting collaborative learning and dynamic management of conversations among students. As technology continues to shape learning experiences, educators need a comprehensive understanding of how to integrate these tools into educational spaces. The research makes significant contributions by addressing the limited exploration of technology-enhanced curriculum in mediating students' communication and negotiation repair, offering insights into the diverse potentials of e-learning environments. Additionally, it provides valuable perspectives on how different e-learning modalities can engage students in varied co-regulation patterns. Notably, the study employs an emic perspective through conversation analysis, avoiding reliance on questionnaires and self-reports susceptible to reliability and social desirability issues. The research aims to investigate the potential of synchronous multimodal and text-based CMC modalities in guiding students' communication repair, including language-related episodes, co-regulation patterns, and unfolding dimensions of student engagement.

1. How multimodal and text-based CMCs direct learner communication repair in the form of language related episodes (LREs)?
2. How multimodal and text-based CMCs differ sponsoring student co regulation patterns?
3. How multimodal and text-based CMCs differ in engaging students with the learning task?

2 | LITERATURE REVIEW

2.1 | Theoretical framework

Social constructivism emphasises learner interaction and co-regulation in L2 development, requiring individual and collective agency in knowledge construction. This approach emphasises the creation of a collaborative study environment, motivating students to collaboratively regulate the learning process (Yücel & Usluel, 2016). The renewed focus on social constructivism underscores the importance of computer collaborative learning in integrating critical elements of L2 learning, including peer interaction, co-construction of knowledge, scaffolding, co-regulated learning, and pooling resources to modify output (Zhang et al., 2021). CMC provides social and cognitive supports, allowing learners to benefit from personalised interactive and regulative support (Hernández-Sellés et al., 2019). Technologies like Google Docs, wikis, and forums offer ample opportunities for collaboration, influencing the development of learners' social and interactional characteristics (Lei & Liu, 2019). These technologies play a crucial role in structuring collaboration, enabling students to engage in, reflect on, and regulate the learning process for successful outcomes (Saqr et al., 2022).

2.2 | Computer supported collaborative learning (CSCL)

The prominence of computer-supported collaborative learning (CSCL) in second language education, particularly in writing, has sparked discussions in higher education. CSCL ensures optimal collaboration for knowledge construction by facilitating group activities in work teams (Järvelä et al., 2023). Research in CSCL focuses on understanding the dynamics of student collaboration and the role of technology in social interactions. Collaborative computer-mediated writing in L2 learning involves students engaging in computer-mediated verbal or non-verbal interactions for co-constructing a text. This requires shared responsibilities among learners for problem-solving, constructing new knowledge, and extending existing knowledge to enhance collective understanding and writing development (Lei & Liu, 2019). Li (2018) analysis of empirical studies on computer-mediated writing in the L2 context identified three research strands: writing process, writing outcome, and student perceptions in a solo modality-learning context. Exploring different affordances of computer-mediated collaborative writing can contribute to understanding how various computer-mediated communications optimise students' communicative efforts, co-regulation, and engagement, all of which are essential for writing development.

2.3 | Communication repair and learning

Socio-constructivism has advocated mutual accountability and shared leadership as prerequisites for learning, which can be established by students 'cooperative efforts to remedy communication breakdowns and failure as prerequisites for learning. Interaction through communication remains crucial in socio-constructivism. According to Manila et al. (2022), in interactions, communication breakdown is unavoidable. It is more inevitable in virtual spaces if not appropriately treated. Communication problems or breakdowns occurred in academic discourses as a result of disruptions in flow of conversations.

When learners collaborate to create multimodal texts, they engage in languaging, a process of making meaning through language. Previous research emphasised languaging's role in resolving lexical or grammatical issues. Recent studies revealed differences in online languaging, with participants focusing more on negotiating writing content than resolving language problems (Cheung, 2022; Mohamadi Zenouzagh, 2022). Languaging is students' efforts in repairing communication through Language-related Episodes (LREs), instances where participants collaboratively address communication breakdowns at phonological, semantic, and discursive levels. LREs involve negotiation and interaction, resulting in modified output. Depending on language item, LREs are classified to lexical LREs (originated by a misunderstanding of a lexicon), morphosyntactic LREs (originated by misuse of morphology or syntax, organisational and content LREs) (problems emerged from aspects of discourse) and global LREs (problems whose source cannot be detected) (Bueno-Alastuey, 2013). Previous studies in classroom contexts have highlighted the positive role of LREs in optimising learning, including phonology, syntactic performance, and discourse knowledge. Limited research has explored LREs in online learning contexts, but a meta-analysis by Lin et al. (2013) suggested higher LRE levels in online text chat compared to oral CMCs. Loewen and Wolff (2016) found mode-dependent differences, with fewer LREs in oral communication. Learning modality effects on LREs have been explored in face-to-face and synchronous CMC, showing differences favouring synchronous CMC. The inconsistencies in reported research on learning modality effects make investigating how online learning platforms engage learners with LREs a promising research area. In addition, unique functions of online languaging include negotiating meaning, discussing content and organisation, and mediating social relationships. However, as existing studies only analysed text-based records, it remains to be explored if these findings apply to verbal exchanges in multimodal collaborative writing.

2.4 | Student co-regulation and learning

According to Allal (2020), "all theories of learning attribute learning or failure to learn to learner regulation behaviours towards a learning

goal. For example, reinforcement regulates learning in behaviourism. Equilibration does the same in constructivism. In cognitive approaches towards learning, feedback regulates learning. Social interactions play the same role in constructivism. Despite slight differences among these theories, there is a central idea that regulation evolves in cyclical and linear sequence and involves planning, executing, monitoring, evaluation, orientation and elaboration is essential for learning.

Co-regulation's interdependence and reciprocal influence causes joint development and learning (Hendriks et al., 2020). Different studies have delineated different sources of regulation that optimise learning. For example, instructional design, such as task-based interaction versus shared socially regulated learning approved the facilitative role of the later in student participation (Isohätälä et al., 2017). Likewise, interaction dyads such as teacher/student interaction (Bourgeois, 2016), student/student interaction (Fernandez-Rio et al., 2017) differ in the quality of regulated learning. Among sources, tools are gaining new attention with the advancement of technology, and scholars are wondering how technology, with its multiple idiosyncrasies, can impact student co-regulation in different ways (Chan, 2012). The value of technology in the form of synchronous and asynchronous lessons and its supporting role in enhancing self-regulation strategies in in-class and out-of-class settings were explored (Blau & Shamir-Inbal, 2017). High academic failures rates in online higher education could be lessen by enhancing learner autonomy through self-regulated and co-regulated learning mediated by technology enhanced teaching context, such as e-Simprogramming approach (Pedrosa et al., 2020). Online environments require higher levels of learner autonomy among learners by monitoring and managing cognitive abilities (Cho & Heron, 2015) or emotion and enjoyment as well as self or co regulation to achieve group level engagement in shared regulation processes (Zhang et al., 2021). Temporality (synchronous vs. a synchronous) and type of image for encoding information text, audio, or multiple mode in online learning may result in varied learning experiences which worth investigation. (Colson & Hirumi, 2018). This study is intended to investigate the potentials of different CMCs; multimodal and text-based, on co-regulation patterns.

2.5 | Student engagement and learning

Students' active involvement in a learning task to achieve a desirable outcome is conceptualised as student engagement, which is seen to be a predicting, factor in student learning (Abbasi et al., 2023; Guo et al., 2021). Student engagement is of many dimensions. For example, active participation and persistence in complying leaning context is characterised as behavioural engagement. Emotional engagement is illustrated as students' excitement in learning task. Cognitive dimension is displayed as students' active involvement in information storing and retrieval as well as organisation. Social engagement is exemplified as a sense of belonging to a community of learners and teachers. (Mulia, 2020; Pilotti et al., 2017).

Recent research has investigated how student engagement is context specific (Hutain & Michinov, 2022). With the advancement of technology various studies have investigated how different technology enhanced educational contexts such as game-based language learning (Eltahir et al., 2021), filliped classroom (Dellatola et al., 2020), Facebook social network (Akbari et al., 2016), blended learning (Sanjeev & Natrajan, 2019), and computer mediated discussion in online Forum (Mohammadi Zenouzagh et al., 2023) affected potential levels of student engagement; almost all reporting positive effect. According to Aubrey (2022), exclusive focus on written CMCs had let to call in to more divers collaboration channels that involve verbal interactions.

Several insights are gained from studies that compared text-based CMCs with face-to face learning environment. Research highlighted text-based potentials in creating a less stressful environment and greater engagement and its limiting potential in engaging students in LREs because of non-contingent nature of turn taking (Cho, 2017). Multimodal CMC also supported high levels student engagement compared to text-based CMC because of inducing social presence what support feeling of immediacy, intimacy and sociability that can feed into more interactions (Shearer & Park, 2019). Majority of the related studies and all the reported ones here inspected student engagement in technology enhanced curriculum compared with face-to-face counterpart leaving comparison of potential of different CMC modalities such as multimodal versus text in engaging students riveting area of research.

3 | METHOD

3.1 | Participants

3.1.1 | Student participants

A total of 30 EFL students aged from 18 to 22 were recruited to participate in this study. They were all Ph.D. students working on their writing skills. The key to their inclusion in the research data collection was their homogeneity in terms of their proficiency level assessed via Oxford Placement Test. Participants were randomly assigned into two research groups of multimodal ($N = 15$) and text-based ($N = 15$) CMCs. In each research group, participants were further assigned into five groups of three students.

3.1.2 | Teacher and rater participants

Two female EFL teachers who were also qualified IELTS examiners with the same teaching and examining experience volunteered to play role as raters too. They were briefed about their teacher roles and rater roles. They were also instructed about coding schemes of the constructs under study.

3.2 | Treatment procedure

Students were tasked with collaborating on their assignments in two distinct online contexts: the text-based CMC group and the

multimodal CMC group. To ensure uniformity across both groups, students first participated in a tutorial session that acquainted them with the Moodle and Writing Forum platforms. During this session, they received their login credentials and detailed instructions regarding the structure of the collaborative writing assignment. Everything, from the writing tasks and topics to the teachers' explicit teaching and scoring methods, was standardised across both groups.

The procedure adopted in both groups followed the same steps: (1) Students were free to choose their partners; (2) Teachers facilitated brainstorming sessions on the writing topics; (3) Students conducted research and gathered information from various sources; (4) Students drafted an outline, which was then returned to the teacher for relevant feedback; (5) Subsequently, students planned and composed the first draft; (6) Students cross-checked the first draft using a pre-provided checklist; (7) Each student individually edited the essay using different highlight colours to enable tracking of each other's ideas, providing justifications for any necessary revisions; (8) Students submitted their writing to the teacher, who offered feedback on language, content, and organisation; (9) Finally, students received the teacher's comments and collaborated on revising the paper together.

For the multimodal CMC group, we employed the Modular Object-Oriented Dynamic Learning Environment (Moodle). Multimodal CMC platforms are versatile communication tools that encompass a variety of communication modes or channels. They provide a flexible and interactive environment for users engaged in educational activities. One key feature of Multimodal CMC is its support for both synchronous and asynchronous communication. Synchronous communication allows users to interact in real-time, facilitating live discussions and collaboration. In contrast, asynchronous communication enables users to participate at different times, making it convenient for learners with diverse schedules. Textual communication is a fundamental aspect of Multimodal CMC, offering chat, discussion forums, and text messaging options. Users can engage in written discourse, ask questions, and provide responses. Additionally, Multimodal CMC often incorporates audio communication features, such as voice chats or audio messages, allowing users to communicate using their voices. Video communication, another feature, enables users to engage in video conferencing and webinars. This enhances the learning experience by providing face-to-face interactions through live video streams. Multimedia sharing is also supported, enabling users to share documents, images, videos, and links, making it suitable for collaborative assignments and project-based learning. Collaborative tools, such as wikis and shared documents, enable multiple users to work together on projects in real-time, facilitating content creation and editing. Tracking and feedback mechanisms record user actions and contributions, aiding instructors in monitoring progress and providing tailored feedback. Multimodal CMC platforms are typically accessible on various devices, including computers, smartphones, and tablets, allowing users to engage in learning from anywhere with an internet connection. Customization features empower users to tailor their interactions and experiences. Furthermore, these platforms often allow for the recording and archiving of communication sessions, discussions, and collaborative work. Interactivity is a core aspect of Multimodal CMC platforms. They incorporate features like polls, quizzes, breakout rooms, and interactive whiteboards to enhance engagement and participation. These platforms offer a comprehensive communication environment suitable for various learning contexts and objectives, supporting discussions, group work, multimedia presentations, and interactive sessions.

Within the multimodal CMC group, students utilised Moodle for negotiation and collaboration while working on their writing assignments. They shared ideas related to the writing task, generating and negotiating ideas with audio conference writing to create their first drafts. Negotiations and collaborations continued until a shared understanding of the final draft was achieved, with students being instructed on how to work with Moodle.

A text-based CMC was established on http//e-writingforum.ir by the researchers. In this setting, students used the writing, commenting, and response features of the forum to provide feedback on each other's writing performance. Participants were required to collaborate on writing assignments, create accounts on the website, and were paired with partners. Students logged into their accounts on the forum, accessed their group threads, and posted their ideas, responding to their peers' contributions via the toolbar, which allowed for posting ideas, editing posts, providing comments, replying to comments, and responding with quotes.

In both groups, groups were made by three students in each. Totally, there were five groups in each group. In both groups, students were asked to collaboratively write five- paragraph essay on topics such as divorce, unemployment and so forth. In both groups, explicit teaching technique was utilised for instructing how to write different genres of writing and how to avoid common student writing problems. In both research groups, student writing performances were rated using holistic rating approach. In both groups, students received feedbacks on language and organisation and content of their writing. Writing tasks' attributes were kept equal in both research groups. Students in the text-based CMC group and multimodal CMC group collaboratively wrote their writing task. The participants were encouraged to choose their partner. The teachers conducted brainstorming on writing tasks. The students searched for information to write their writing task using variety of sources. The participants completed the outline and returned it to the teacher for feedback. Then the first draft was organised and written by students. The first draft was crossed checked by the student using a checklist provided by the teacher. Students were asked to provide their comments in different colours so that tracking individual commenting and revising performances would be possible. Students submitted their essays to the teacher, who provided feedback on the language, content, and organisation. Finally, students got the teacher's feedback and worked together to improve the paper.

3.3 | Data collection and analysis procedure

Meetings in Moodle were recorded to enrich the data collected from this platform, which entailed both text chatlogs and video screens of student participation in collective writing made the data collected

from multimodal CMCs. Data on discussion logs of the Forum in which students enacted on post threads on their collective writing made the text-based CMC data. Fifty recorded meeting and 50 printed discussion logs made the data set from both research groups. Transcriptions were segmented into fifty 30-m episodes. This allowed to establish a consistent unit of analysis to examine students' unfolding interactions that could contain LREs and regulation activities and student engagement behaviours. As Törmänen et al. (2021) stated that this amount of contexts is long enough to allow instantaneous assessment of learning behaviour and short enough to include multiple conversations or activities between students in which different elements of learning behaviour occurred within one episode length.

Raters coded LREs, co-regulation patterns and student engagement according to coding schemes discussed in the subsequent sections. Raters were trained on coding scheme. They worked collaboratively on the evidence and counter evidence of what contributes to consideration, differentiation, and specification of excerpts to LREs, co-regulation patents and student engagement dimension. In case of multiple coding (where one statement could be assigned to multiple codes), they were calculated more than once.

3.3.1 | Coding scheme for LREs

Open coding procedure was used to identify LREs. LREs were characterised by communication breakdown and students' interactions towards communication repair through modifications on their language as a result of cross-checking smooth communication flow via comprehension and confirmation checks as well as clarification requests. The LREs are those instances of conversation in which learners collaboratively repair communication breakdowns marked by self or other corrections on language items of various types of semantics, syntax and discursive. The unit of analysis for identification of each LREs is composed of four turns of communication.

1. *Trigger* (i.e., the turn that creates a communication breakdown).
2. *Indicator* (i.e., the turn that sets off an action).
3. *Response* (i.e., students' consideration of a repair).
4. *Reaction* (i.e., indicator of communication flow).

Transcription analysis of stored conversations of Moodle and log analysis of text-based CMCs to find out how differently these CMCs led students' communication repair. The sample coding and episodes with displayed in Table 1. A total of 410 codes of different LREs across research groups were identified. Inter-coder agreement was also calculated to ensure reliability of coding procedure (Kappa = 0.826, $Z = 5.42$, $p < 0.05$).

3.3.2 | Coding procedure for co-regulation patterns

In this study, coordination of two or more peers in regulating their writing process through co-managing writing task is operationally defined as co-regulation. The unit of analysis was a speaker turn. Each speaker turns in which students were engaged in coregulation strategies depicted in Table 2 was coded as one coregulation loop. The frequency of the occurrences of co-regulation strategies in each turn was calculated. If more than one co-regulation strategies occurred in a turn, that turn was calculated more than once. A total of 1080 co-regulation codes were detected across research groups. Inter-coder agreement was calculated to ensure reliability of coding procedure (Kappa = 0.834, $Z = 5.40$, $p < 0.05$).

TABLE 1 Conversation and transcription analysis descriptors.

LRE types	Episodes
Global When the source of the communication breakdown cannot be recognised	S1: divorce is the last solution S2: what? S1: problem of divorce S2: …"*hesitations*" S1:… "*no further contribution*"
Lexical When misunderstanding of a lexical item creates problems	S1: booming or enhancing? S2: I suppose with skills we should you enhance. We enhance marital skills and not booming
Morphosyntactic When misuse of morphology or syntactic aspects crease problems	S1: sometimes children more enjoy from divorce S2: mean children? S1; children no longer hear struggles at home S1: yes
Organisational and content When discursive aspects create LRE	S1: unemployment is very important S2: yes, we have to show its importance in some way. S2: sorry? S1: we should locate this idea to the beginning of our sentences S2. Yes, to highlight we move it to the beginning of sentences we should put it at the beginning. To highlight. S2: we can also write at the end

3.3.3 | Student engagement

Studies on theoretical and operational definitions of different dimensions of student engagement have been studied to prepare the scheming coding system of student engagement (Table 3) (Guo et al., 2021; Lee & Hannafin, 2016; Silvola et al., 2021; Stephenson et al., 2020). Transcription analysis of stored conversation and text-based log analysis of learner engagement dimension were conducted using open coding. The coding unit was defined as students' contributions that show their involvement in the learning task. For example, students actual talk on task rather that procedure talk, less hesitations, less appeal for help as were taken as signs of behavioural engagement. Students' self or co-regulating learning problems, such as coining of words to solve communication problem, using metacognitive linguistic knowledge, suggestions for cross check of multiple resources were identified as cognitive engagement codes. Students' emotional feedbacks to the learning tasks and students' desire and invitations for group unity and

TABLE 2 Co regulation patters coding scheme.

	Types	Sample episodes
Planning	Evidence on students' goal setting and planning to reach the goals	A. it is better to write about the reasons and then their effects B. the consequences are more important than we can relate them to reasons A. we must start with causes because the causes can explain the consequences B. ok let's start, I think we can later see how to organise ideas either cause and effect or effect and reasons C. I agree
Executing	Evidence on arrangement of instructional materials to improve learning and overt and covert practices in providing task related information	A. Based on what I found from internet; unemployment has several causes. To my surprise, higher education was not among them, there was also interesting point that rich people who run their own business quitted schools. B. high education c and be considered as minor reason. C. we can write it in red and then refer to it if we can find a space to include it. B. but it should be included in some way because it is very important at least in our country A. what other things come you your mind ....
Monitoring	Evidence on students' attempts in recording events and resulting results	A. This consequence was mentioned earlier. I think it should be replaced here so that we can connect couple conflicts to cultural issues, which is the topic on next paragraph. in this paragraph B. I don't think it is good idea, because cultural issues have been already writing and this may distract readers. C. So, let's read again to see where to put it
Evaluation	Evidence on quality control of students work progress	A. look, guys, this is pointless, we are moving away from the main topic. B. But I think the sentence on the statistics on divorce can show the importance of it. C. do you think it is not necessary? A. yes, I think too much detail is not needed. It can distract readers' mind
Orientation	Evidence on students' awareness of learning setting and their attempt to select or rearrange it	A.I cannot open the chat section B. Do you see the box at the top right C.I cannot open the chat section too B.I think you should log out and log in again
Elaboration	Evidence on students' solicitation for help from peers, teachers, and adults and their initiated assistance	A. I don't remember what was reminder? B. Pardon? C. reminder? A. Yes C. where is it? A. reminder we should use it a lot when we want to introduce new supporting idea B. I don't know, we should write it at the beginning of each paragraph. C. uh. No it is in the topic sentence of each paragraph A. I think it should start it B. I checked it, it is .....

coherence were coded as emotional and social engagements. After open coding, the coded data in previous stage were further analysed via axial coding to find categories of student agentive engagement practices that can be linked together. The codes were clustered into behavioural, cognitive, and emotional. The beginning and ending of a coding unit is characterised by turns in which any of indicators in coding system in Table 3 could be identified. A total of 740 codes that represent student engagement dimensions were found across research groups. Inter-coder agreement was calculated to assure reliability of coding procedure (Kappa = 0.877, Z = 5.71, $p < 0.05$).

4 | RESULTS

4.1 | LREs in multimodal and text- based CMCs

The descriptive statistics in Table 4 showed that multimodal CMCs used significantly more global LREs than the text-based group. Multimodal synchronous CMCs also used significantly more organisational and content LREs than the text-based group. On the other hand, text-based CMC used significantly more lexical LREs than the multimodal CMC group. They also used

TABLE 3 Student engagement levels coding.

Types	Indicators
Behavioural engagement	• Observable actions and a willingness to participate actively in studies s. Students' not being distracted and not being delayed in their study works
Cognitive engagement	• Students' mental effort to finish tasks utilising a profound, self-regulated, and planned learning approach rather than superficial learning techniques efforts to form questions and hypotheses, as well as the monitoring of the thinking process in order to construct knowledge. • Psychological investment such as strategic regulations and efforts to improve professional abilities • Flexibility in dealing with learning problems • Exchange of information from different sources • Proposing ideas, managing time and task and task procedure • Making connections, integration and synthesis of Information from various sources. • Suggest solutions for problems and justifications for why specific solution was suggested.
Emotional engagement	• Expressing emotions, self- expressions of likes, dislikes, and personal values and attitudes • Willingness to do the work enthusiastically.
Social engagement	• Addressing group using inclusive such as we, us and etc., (or calling the group by names • Salutations and greetings acted only as social functions • Sharing unrelated information with each other.

significantly more morphosyntactic LREs than the multimodal CMC group.

The results of the chi-square in Table 5 (χ^2 (3) = 232.47, $p < 0.05$, Cramer's $V = 0.753$ representing a large effect size) indicated that there were significant differences between the multimodal and text-based CMCs in directing learner communication repair in the form of LREs. As it was discussed above; the multimodal CMC used significantly more global, and organisation and content LREs; while text-based CMC used significantly more lexical, and morphosyntactic LREs. Figure 1 indicates percentages of LREs in multimodal and text-based CMCs.

4.2 | Co-regulation patterns in multimodal and text-based CMCs

Descriptive statistics on student co regulation patterns of planning, executing, monitoring, evaluation, orientation, and elaboration was depicted in Table 6. The multimedia CMC had higher percentages on planning than the text-based CMC. The text-based CMC had higher percentages on executing than the multimedia CMCs. The multimedia CMC had significantly higher percentages on monitoring than the text-based CMCs. The multimedia CMC indicated that the frequencies of monitoring were significantly higher than the text-based CMC. The text-based CMC had significantly higher percentages on evaluation than the multimedia CMCs. Results indicated that in the text-based CMC, the frequencies of evaluation were significantly higher than the multimedia CMC. The multimedia CMC had higher percentages on orientation than the text-based CMC. And finally; the text-based CMC had higher percentages on elaboration than the multimedia CMC. Results also indicated that, in the multimedia CMC, the frequencies of elaboration were significantly lower than those in the text-based CMC.

Table 7 displays the results of the chi-square. The results (χ^2 (5) = 78.67, $p < 0.05$, Cramer's $V = 0.302$ representing a moderate effect size) showed significant differences were found between the multimodal and text-based synchronous CMC in terms of their regulation patterns. Figure 2 indicates percentages of regulation patterns in Multimodal and text-based CMCs.

4.3 | Student engagement in multimodal and text-based CMCs

Table 8 displays descriptive statistics learner behavioural, emotional, cognitive, and social engagement in text and multimodal CMCs. The text-based CMC had higher percentages on behavioural tasks than the multimedia CMC. The multimedia CMC had higher percentages on emotional tasks than the text-based CMC. The text-based CMC had significantly higher percentages on cognitive tasks than the multimedia CMC. Results indicated that in the text-based CMC that the frequencies of cognitive tasks were significantly higher than those in the multimedia CMC. And finally; the multimedia CMC had higher percentages on social tasks than the text-based CMC.

Table 9 displays the results of the chi-square. The results (χ^2 (3) = 21.34, $p < 0.05$, Cramer's $V = 0.170$ representing a weak effect size: 0.170) showed that significant differences between were found between the multimodal and text-based synchronous CMC in engaging students in learning tasks. As it was discussed earlier, among the four learning tasks, the cognitive engagement showed significant difference between the two CMCs. Figure 3 indicates percentages of student engagement dimensions in multimodal and text-based CMCs.

5 | DISCUSSION

This study investigated the capabilities of multimodal and text-based CMC in supporting learner communication repair, co-regulation patterns, and engagement dimensions. The frequency analysis revealed that multimodal CMC engaged students in global, organisational, and content-based language-related episodes (LREs), whereas text-based CMC involved students in morphosyntactic and lexical LREs. Additionally, significant differences were observed in co-regulation patterns between multimodal and text-based CMCs. Multimodal CMC

TABLE 4 Frequencies, Percentages and Std. Residuals; Synchronous CMCs use of LREs.

		LREs				
		Global	Lexical	Morphosyntactic	Organisation & Content	Total
Multimodal	Count	66	11	9	84	170
	%	38.8%	6.5%	5.3%	49.4%	100.0%
	Std. Residual	5.5	−5.0	−5.9	6.8	
Text Based	Count	16	96	114	14	240
	%	6.7%	40.0%	47.5%	5.8%	100.0%
	Std. Residual	−4.6	4.2	4.9	−5.7	
Total	Count	82	107	123	98	410
	%	20.0%	26.1%	30.0%	23.9%	100.0%

TABLE 5 Chi-Square Tests; Synchronous CMCs use of LREs.

	Value	Df	Asymptotic significance (2-sided)
Pearson Chi-Square	232.470[a]	3	0.000
Likelihood Ratio	259.772	3	0.000
Linear-by-Linear Association	1.448	1	0.229
N of Valid Cases	410		
Cramer's V	0.753		0.000

[a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 34.00.

FIGURE 1 Percentages of LREs in multimodal and text-based CMCs.

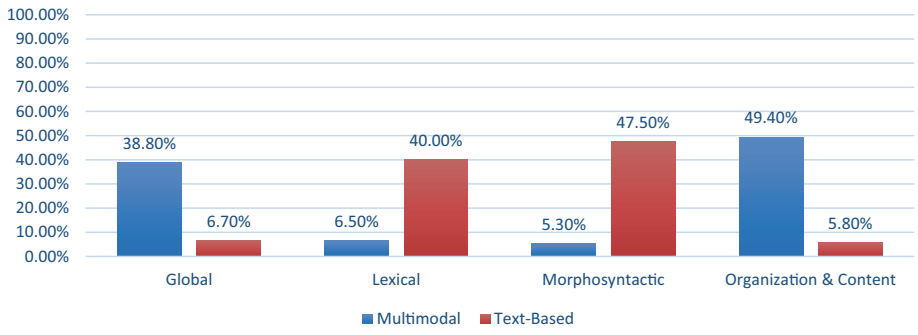

TABLE 6 Frequency distribution and Std. residuals of co-regulation patterns among multimodal CMC and text-based CMC.

		Regulation patterns						
		Planning	Executing	Monitoring	Evaluation	Orientation	Elaboration	Total
Multimodal	Count	60	40	120	60	30	40	350
	%	17.1%	11.4%	34.3%	17.1%	8.6%	11.4%	100.0%
	Std. Residual	1.0	−1.8	5.5	−2.8	0.3	−2.2	
Text based	Count	70	90	60	150	40	100	510
	%	13.7%	17.6%	11.8%	29.4%	7.8%	19.6%	100.0%
	Std. Residual	−0.8	1.5	−4.5	2.3	−0.2	1.9	
Total	Count	130	130	180	210	70	140	860
	%	15.1%	15.1%	20.9%	24.4%	8.1%	16.3%	100.0%

primarily involved planning and monitoring co-regulation practices, while text-based CMC focused on evaluation and elaboration co-regulation practices. The findings also highlighted differential engagement among students, with greater emotional and social engagement in multimodal CMC and increased cognitive and behavioural engagement in text-based CMC writing. Overall, the study suggests that multimodal and text-based CMCs have distinct potentials in guiding student communication repair, co-regulation patterns, and

	Value	Df	Asymptotic significance (2-sided)
Pearson Chi-Square	78.670[a]	5	0.000
Likelihood Ratio	78.799	5	0.000
Linear-by-Linear Association	10.333	1	0.001
N of Valid Cases	860		
Cramer's V	0.302		0.000

[a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 28.49.

TABLE 7 Chi-square analysis of co-regulation patterns among multimodal CMC and text-based CMC.

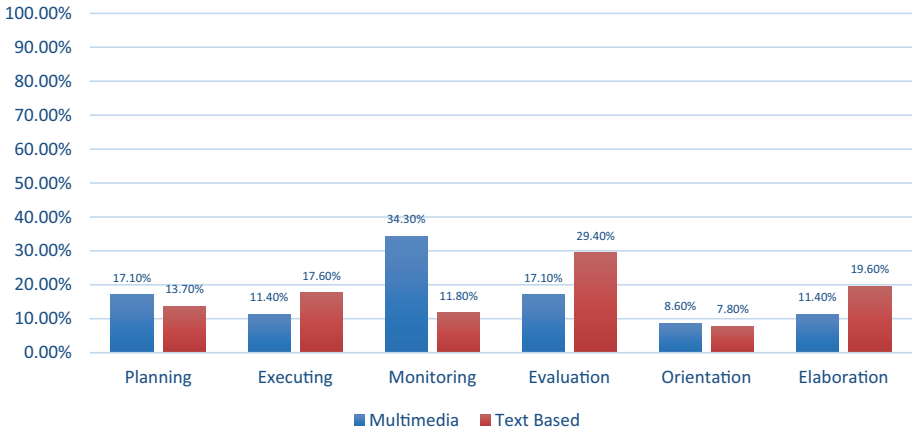

FIGURE 2 Percentages of regulation patterns in multimodal and text-based CMCs.

		Student engagement				
		Behavioural	Emotional	Cognitive	Social	Total
Multimodal	Count	100	80	80	100	360
	%	27.8%	22.2%	22.2%	27.8%	100.0%
	Std. Residual	−0.7	1.4	−2.2	1.9	
Text Based	Count	120	60	130	70	380
	%	31.6%	15.8%	34.2%	18.4%	100.0%
	Std. Residual	0.7	−1.4	2.1	−1.9	
Total	Count	220	140	210	170	740
	%	29.7%	18.9%	28.4%	23.0%	100.0%

TABLE 8 Frequency Distribution and Std. Residuals of Student Engagement Patterns Among Multimodal CMC and Text-Based CMC.

	Value	Df	Asymptotic significance (2-sided)
Pearson Chi-Square	21.349[a]	3	0.000
Likelihood Ratio	21.489	3	0.000
Linear-by-Linear Association	1.572	1	0.210
N of Valid Cases	740		
Cramer's V	0.170		0.000

[a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 68.11.

TABLE 9 Chi-Square Analysis of Student Engagement Patterns Among Multimodal CMC and Text-Based CMC.

engagement dimensions, indicating varied preparation for writing processes and outputs.

Both learning modalities have been shown to be beneficial, each in its own way. For instance, regarding LREs, both modalities guide learners to pool their linguistic and ideational resources. This aligns with Jianling (2018) study, advocating peer languaging through text-chatting and speaking as a process that encourages learners to utilise collective resources for subsequent individual learning and knowledge construction. Other studies, such as those by Mostovaia (2021), and Oviedo and Tree (2021) also confirmed the role of languaging in assisting learners in bridging the gap between collaborative and self-regulated writing.

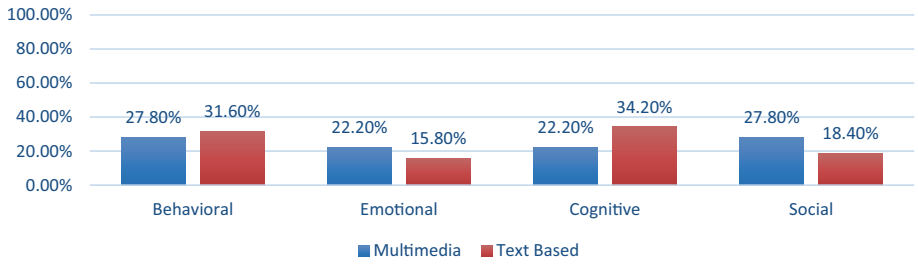

FIGURE 3 Percentages of student engagement dimensions in multimodal and text-based CMCs.

The present study's results are consistent with Manila et al. (2022), approving differences in the number of communication repairs in chat and multimodal discussion online communication modalities. There were fewer corrections in chats compared to multimodal discussions because, in text chats, students could type and review their messages simultaneously, enabling constant self-repair. Furthermore, the study indicated qualitative differences in communication repairs between text and multimodal CMCs. In text chat, students have more time to plan, unlike multimodal CMC discussions where students are under pressure to maintain the flow of conversation.

With respect to co-regulation patterns, the current study indicated that students spent much of their time on planning and monitoring in multimodal CMC, which is confirmed in the study of Kim and Kang (2020). Their study of multimodal composition of Korean EFL learner indicated that learners co-managed content development through planning and monitoring. Results also were confirmed by similar study in which voice based telecollaboration was investigated and its efficacy on topic management was affirmed (Barron & Black, 2015). Metacognitive regulation involves managing cognitive resources actively and coordinating these resources with affective and social ones towards achieving a goal. In line with Allal (2018)'s affirmation of cognitive and social processes' predominant role in collective writing, the present research suggests that multimodal CMCs' interactive character involve affective and social processes therefore, it affects monitoring metacognitive strategy more than the other ones.

The results of the present study can also be explained by social presence that is created in multimodal CMCs. As suggested by Alanazi (2017) when social presence is built by online community, students' learning path can be monitored towards positive learning. However, in text-based CMCs students rely more on conceptual, linguistics and meta linguistic knowledge; therefore, metacognitive regulation such as elaboration and evaluation were appeared more frequently in text-based collaborative writing modalities.

As far as student engagement was concerned, the current research indicated both CMCs have potentials in engaging students with learning but in different dimensions. Students were more engaged cognitively and behaviourally in text-based CMC whereas in multimodal CMC students are engaged social and emotionally. Several studies supported the findings of the present study. Student cognitive engagement in learning via technology is also supported with Pineda-Báez et al. (2019). In a similar study, it was revealed that the in *text-based CMC students were more cognitively engaged whereas in visual CMC students were more engages socially* (Traphagan et al., 2010). In line with cognitive learning theories, the results indicated that multimodal representation of information help students to be more cognitively engaged because there is a lower cognitive load and more working memory processes to integrate new knowledge to previous ones. Besides, in line with what Kehrwald (2008) research, the social presence created in multimodal online foreshadows human agency in online learning environments and enhances student engagement. As confirmed by Ngoyi and Malapile (2018), the online learning environments that build social presence would lead to greater student engagement. Social presence, characterised by personal/affective elements, open communication, and group cohesion, significantly contributes to student engagement. The findings contradict existing literature, suggesting that text-based modalities have higher potential in engaging students compared to multimodal learning. While some studies support this perspective, others indicate the opposite, emphasising more cognitive engagement in multimodal learning. The study provides insights into the complex relationship between learning modalities and learner engagement, challenging prevailing notions in the field.

6 | CONCLUSION AND IMPLICATIONS

The study investigated the potentials of multimodal and text-based CMC in supporting learner communication repair, co-regulation patterns, and engagement dimensions. Analysis revealed that multimodal CMC engaged students in global, organisational, and content-related LREs, whereas text-based CMC focused on morphosyntactic and lexical LREs. Co-regulation patterns varied, with multimodal CMC emphasising planning and monitoring, while text-based CMC emphasised evaluation and elaboration. Students exhibited distinct engagement levels, with more emotional and social engagement in multimodal CMC and increased cognitive and behavioural engagement in text-based CMC writing.

As the social semiotic theories of communication, particularly the modality and split attention principles suggested varied potentials of CMCs. These principles suggest that when diverse presentation channels are used, students prioritize certain learning components due to constraints in working memory. Video content, compared to text, may lead to cognitive overload, as indicated by Sundar et al. (2021), because of involvement with multiple modalities. However, this richer modality may result in faster encoding, but less systematic processing compared to text-only messages (Sundar et al., 2021).

In line with the social semiotic theories of communication, our study's results propose a dual role for social interaction, serving both as a means of communication and as a cognitive mechanism for co-regulation in co-regulated learning, which is deemed essential for L2 development. However, the dynamics of interaction are influenced by the mode of interaction. The practical implications of these findings suggest that teachers can employ text-based CMC when real-time on-task learner behaviour is essential, as it engages learners more in actual performance. On the other hand, multimodal CMC can be integrated when scaffolding through emotions and collaborations is necessary, providing richer cues, instant feedback, and the use of natural languages. The study further suggests that multimodal CMCs serve as a platform for co-constructing meaning, while text-based CMCs are more suitable for form-focused co-construction. Text-based CMCs offer a different level of flexibility and accessibility compared to Multimodal CMCs. Chat logs, a characteristic feature of text-based CMCs, can be saved and serve as a valuable repository of students' course activities. This feature enables students to revisit their interactions for further inquiry and reflection. Additionally, text-based CMCs generally have the advantage of being less dependent on internet bandwidth, making them a more equitable and inclusive choice for student participation. It is worth noting that in regions like Iran, where internet distribution can be irregular, this flexibility becomes especially important. Students may find text-based CMCs more reliable in ensuring their participation, as they may need to be selective in utilising the functional options of Multimodal CMCs due to potential connectivity issues. This context underscores the importance of considering the accessibility and reliability of CMC platforms in various educational settings.

Therefore, the results imply that teaching professionals must make principled considerations about which CMC medium to use and choose based on priorities of outcome, patterns of co-student management and regulations, and student engagement dimension in main, complementary, and remedial curricula. The findings of the study suggest that development of interactional practices is variant with respect to the learning context. Instructional designs that maxim learning opportunities through establishment of learning context that sponsors co-regulated learning is essential. Interactional features of CMCs and their structural affordances can help teachers to make decisions that best fit their instructional purposes. Learning environments that embrace technological interfaces, provide resources, enable peer interaction, and include a variety of means to create communities that can foster knowledge construction are highly valuable. The practical implications drawn from the findings suggest that teachers should consider the choice between text-based and multimodal CMC based on specific instructional needs. Text-based CMC is advantageous when real-time, on-task learner engagement is a priority, as it tends to more effectively involve learners in actual performance. In contrast, multimodal CMC is valuable when scaffolding through emotional engagement and collaboration is required. Multimodal CMC offers benefits such as richer communication cues, instant feedback, and the use of natural language.

Despite interesting findings, this study is limited on several grounds, this study fails to account for learner profiles. Therefore, future research should include learner profiles (e.g., Proficiency level, learning styles) and study setup (e.g., grouping size and unity) teacher impact (teachers' digital literacy and ecological agency) and reliability and validity estimates in codification context in qualitative research. text-based, multimedia and hybrid CMCs can create inclusive curriculum that appeals to visual and auditory learners to overcome learning challenges arising from different learning styles (Tangirov et al., 2021). There are several studies that indicate it is not the digital technology itself but how teachers and learners perceive it that affects learning. Teacher beliefs, classroom process quality, teacher education level are among many factors that affect student engagement in smart learning environments, which are deemed to be taken into account (Wang et al., 2022; Xu et al., 2020). Besides, while literature including the present research has documented how regulated learning is created in collaborative learning and how affected by external artefacts, such as instruction modality, research has paid scant attention on how learner factors, such as learner profiles and attitudes can mediate co-regulated learning. mediate regulated learning, such as learners' personal learning styles and attitudes.

In addition, since regulation processes are cyclical and dynamic, and contingent to other students, analysing evolving regulatory practices can provide insights into effective learning environment. However, teaching practitioners are interested to know how co-regulations construct individual's regulation of learning for accountability purposes. This requires new methods of analysis, such as learning analytics that can account simultaneously for both collaborative regulation of learning and individual accountability (Zhang et al., 2021). As mentioned earlier research explained variations in learner performances in CMC modalities with respect to the different cognitive load, they impose on students and the degree of mutual interactions they foster. Therefore, it is not clear if the results were confounded with reduced cognitive load, mutual interaction and students' personal appeal for these CMCs promoted learning in this study. Therefore, further multidimensional research and analyses are needed to consider investigate validity of the results.

AUTHOR CONTRIBUTIONS

Zohre Mohammadi Zenouzagh: Conceptualization; investigation; writing – original draft; methodology; software; formal analysis; project administration; data curation; validation; visualization; writing – review and editing. **Wilfried Admiraal:** Conceptualization; validation; writing – review and editing; supervision; resources. **Nadira Saab:** Conceptualization; validation; writing – review and editing; supervision; resources.

FUNDING INFORMATION

There is no funding with this research.

CONFLICT OF INTEREST STATEMENT

This is no financial interest or benefit that has arisen from the direct applications of this research.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CODE AVAILABILITY

Atlasti and SPSS entry were used.

ETHICS STATEMENT

Research ethical issues were established and acknowledged in this research.

INFORMED CONSENT

This research involves Human Participants and Informed consent was recognised and acknowledged in this research.

CONSENT FOR PUBLICATION

Authors adhere to the Journals Copy Right and publication policies.

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How to cite this article: Mohammadi Zenouzagh, Z., Admiraal, W., & Saab, N. (2024). Potential of computer-mediated communications in directing communication repair, co-regulation patterns and student engagement. *Journal of Computer Assisted Learning*, 1–14. https://doi.org/10.1111/jcal.13010