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Moodle and Telegram to Develop Students' Language Performance and Knowledge Co-Construction in Technology-Enhanced CLIL

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Abstract

This study compared Moodle and Telegram as mobile-instant messaging (MIM) to understand how the platforms performed in technology-enhanced content and language integrated learning (TECLIL) settings. It involved 68 English for Academic Purpose (EAP) students enrolled in two groups, i.e., Moodle group and Telegram group. Using the mixed-method design, the study garnered quantitative data through pre- and post-tests of language performance coupled with post-tests of spoken presentation, content knowledge, and collective knowledge co-construction. Qualitative data concerning the interaction patterns in online discussion forums were amassed by retrieving students' postings on both platforms. This study garnered additional quantitative data as covariates, which involved a survey of technology acceptance and a survey of teacher evaluation. Upon analysis, paired sample t-test was operative to identify noteworthy differences between groups with respect to technology acceptance, evaluation of teacher performance, language performance, and content knowledge. For the qualitative inquiry, thread analysis on the interaction patterns in both groups was conducted to scrutinize their depth of

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knowledge co-construction. Although the interaction trends in both platforms mark the dominance of knowledge sharing, the findings lend credence to the stronger potential of Moodle to empower students' in-depth knowledge co-construction while exercising their subject-specific language performance. For deep engagement in knowledge co-construction and authentic language use, teachers need to provide appropriate scaffolding through modeling effective collaboration, making explicit the characteristics of quality discussion, and establishing a mutual understanding of what students need to achieve in the online discussion forum.

Keywords: Knowledge co-construction, language performance, Moodle, TECLIL, Telegram.

1. INTRODUCTION

The uprising trend in technology integration into language instruction through computer-assisted language learning (CALL) and mobile-assisted language learning (MALL) has acknowledged the potencies of technology to escalate language performance. Literature involving meta-analyses in these two strands of technology underscores the effectiveness of technology-mediated instruction compared to face-to-face instruction (Kukulska-Hulme & Viberg, 2018). Since different technologies pose distinctive effects on learners' engagement and participation (Andujar & Salaberri-Ramiro, 2019), teachers need to be aware of these technological bearings and accordingly develop relevant instructional strategies to gain the utmost technology integration. As a starting point, recognizing how students take the step to integrate technology into their learning, as measured through the extended technology acceptance model (eTAM), can provide an initial appraisal of their eventual learning engagement. Content and language integrated learning (CLIL) instruction is no exception to this quest for effective technology-mediated instruction. Given the possibility of technology capturing discourse practices mediating language performance and knowledge co-construction (Zhao et al., 2022), technology can help to scrutinize and improve the quality of CLIL. In this direction, technology-enhanced CLIL (TECLIL) affords an empowering context for science and intercultural learning (Garzón-Díaz, 2021), optimizes language use (O'Dowd, 2018), and stimulates knowledge co-construction (Bereiter & Scardamalia, 2016; Porto, 2015).

While flourishing studies have investigated the influence of technology-enhanced language learning, the efficacy of different technologies, i.e., instructional platforms and social media platforms, in developing subject-specific language performance and knowledge co-construction remains scanty. Furthermore, the potential of social media remains under-researched in CLIL settings although it is known to escalate learning performance and motivation (Imamyartha et al., 2021; Ma, 2017; Zhu & Wang, 2020). Given the urgency of investigating how to achieve effective CLIL instruction (Coyle, 2007; Meyer et al., 2015), a close comparison of the two platforms merits equal attention to better understand how different technologies help scaffold effective CLIL instruction in the burgeoning trends of TECLIL. In this scenario, this study delved into the underexplored comparison between an instructional

platform, i.e., Moodle, and a social media platform, i.e., Telegram, for different TECLIL environments, as guided by the following questions.

1. How do the students perceive the quality of the two TECLIL environments based on the extended technology acceptance model (eTAM)?
2. Are there any significant differences between the two TECLIL environments on subject-specific language performance and knowledge co-construction of the students?
3. What differentiates the quality of knowledge co-construction as evidenced by the students' interactions between the two TECLIL environments?

2. LITERATURE REVIEW

2.1 CLIL Pedagogy and Technology-Enhanced Learning

Strategies to elevate students' language performance and conceptual understanding have received strong emphasis in CLIL literature. To that end, multiple instructional methods have arisen as the alternatives to establishing an ideal CLIL, such as scientific citizenship pedagogy (Garzón-Díaz, 2021), intercultural citizenship education (Porto, 2015), and telecollaborative exchange (Porto, 2014). These studies documented how subject pedagogy and technology can lead to the promising growth of knowledge, understanding, and skills within the area of content and language while amplifying students' intercultural awareness.

First, Porto (2014) reported ground-breaking insight into the potency of online intercultural citizenship. Her study recruited 50 English teachers and/or translators aged 18 to 22 in undergraduate studies at Universidad Nacional de La Plata in Argentina. This project implemented a wiki-based virtual classroom, where the Argentinian students uploaded their Autobiography of Intercultural Encounters while the English students shared their posters and presentations. Powered by teleconferencing, both groups invited veteran soldiers involved in the war between Argentina and England to explore the war histories and reflected on how media shaped public perceptions about the war. These media allowed critical reflection and encouraged students to view others' identities from different angles.

Another project by Porto (2015) demonstrated how online ecological and intercultural citizenship actuates effective CLIL instruction. Involving 50 Argentinian and 20 Danish students, this study was devoted to elevating students' awareness of environmental issues and reflecting on these issues at local and global levels. These students managed to develop critical analysis and research skills aided by visual media, texts, and civic actions when engaged in intercultural dialogue. Virtual classrooms through wiki empowered knowledge co-construction as they shared and discussed the images and videos, they produced to perceive the power of media in crafting stereotypical images of environmental problems.

Garzón-Díaz (2021) further extended the literature by investigating how scientific and intercultural learning can be interwoven in a TECLIL setting. As a bottom-up initiative to meet the national curricular mandate on bilingualism, his case study successfully harnessed the CLIL approach with the aid of technology to engage students in deep learning with multiple objectives, from expanding their scientific citizenship to intercultural awareness. The added values of the CLIL lessons, amplified

learning motivation and learning interdependence among students through scientific projects, further acknowledge the substantial values of linking technology and CLIL.

These case studies exemplify how technology can be operated in critical pedagogy to engage learners in subject-specific knowledge, understanding, and skills to design solutions to real-life issues. However, in resonance with other similar works (e.g., Rutta et al., 2021; Wang et al., 2020; Zhao et al., 2022), this cluster of research implied the overemphasis on the computer to sustain learners' participation in active language use and knowledge co-construction. As such, the inquiry for effective CLIL instructions that suit diverse technologies and settings still prevails, one of which is the comparison between Moodle and Telegram as the platforms for developing language performance and knowledge co-construction.

2.2 Knowledge Co-construction as TECLIL Pedagogy

The knowledge-building theory focuses on subject-knowledge creation as a social inquiry and a product of the learning community (Bereiter & Scardamalia, 2016). It underscores the roles of scaffoldings in amplifying the co-construction of subject knowledge (Lei & Chan, 2018). Not only does social inquiry lead to social literacy development (Meyer et al., 2015; Scardamalia & Bereiter, 2006), but it also develops literacy skills, such as vocabulary, reading, and writing skills (Crossman, 2018). According to van Aalst (2009), knowledge co-construction is activated through different discourse modes: knowledge sharing, knowledge construction, and knowledge creation. These modes require students' collaboration in identifying the gaps in collective knowledge, mapping out strategies to close these gaps, planning and organizing inquiries, and evaluating progress. With relevant technology-assisted instructions, knowledge-building theory offers promising opportunities for developing effective CLIL instructions (Scardamalia & Bereiter, 2006).

As CLIL instructions are generally developed in a bottom-up fashion, diverse instructional models have come to the surface, with varying degrees of success in conceptual and linguistic dimensions (Coyle, 2007). Notwithstanding, any CLIL models are almost always anchored in the notion of effective CLIL instruction "through progression in knowledge, skills, and understanding of the content, engagement in associated cognitive processing, interaction in the communicative context, the development of appropriate language knowledge and skills as well as experiencing a deepening intercultural awareness" (Coyle, 2007, p. 550). As a cue to reaching this effective CLIL, Meyer et al. (2015) highlight the importance of identifying cognitive discourse function (CDF), defined as the subject-specific way of handling and acting upon curricular concepts, contents, and skills. A clear formulation of CDF can help determine conceptual and linguistic repertoires that students need to excel in knowledge creation and make this process accessible intersubjectively. Meyer et al. (2015) further acknowledge that technology is crucial in providing rich input and authentic activities for demonstrating CDF. Yet, how well different technological platforms serve the quest for effective CLIL instruction remains under-explored.

2.3 Knowledge Co-Construction via Moodle and Telegram

Two platforms have been reported to scaffold knowledge co-construction, Moodle and Telegram. Moodle offers flexibility in managing and criticizing learning

resources while improving students' creativity and problem-solving skills (Kisaka, 2017). When socio-constructivist learning dictates course design, Moodle helps students develop problem-solving skills and research skills by improving their awareness of problems, information literacy, and reasoning skills (Gu et al., 2020). Similarly, MIM, such as Telegram, creates an inviting environment where students can share and reflect on collective ideas and give feedback to each other in a timely fashion (Sun, Lin, et al., 2017). Furthermore, Telegram stimulates a realistic English learning environment and fosters students' language development and self-regulation (Haghighi et al., 2019). Students reported positive attitudes toward both platforms and suggest integrating social media platforms to complement the instructional platform due to its asynchronous communication (Zou et al., 2018). However, these platforms generate distinctive discourse styles.

Moodle is characterized by academic-style communication, presumed to be a barrier to students' engagement and knowledge co-construction. By contrast, Telegram was reported to scaffold learners' knowledge co-construction by sharing, critiquing, and evaluating ideas in a friendly environment (Imamyartha et al., 2021). It allowed a less-threatening atmosphere for collective scaffolding among students, leading to better engagement with course materials and activities (Amiryousefi, 2019). Telegram's potency to intersect cultural, social, and epistemic resources coincides with knowledge creation as the product of social inquiry (Zhao et al., 2022). Considering these reports, the present study examined Moodle and Telegram as TECLIL platforms in light of students' acceptance of the platforms and how the platforms influenced resultant interaction patterns, language performance, and depth of knowledge co-construction.

3. METHODOLOGY

3.1 Research Context and Participants

This research was conducted in an EAP course for one semester in the Biology Education department at an Indonesian university. As an introductory English course, it emphasized language mastery more than subject mastery. Three topics were covered throughout the semester: environmental issues, natural resources, and biodiversity. These topics corresponded to three research groups in the department (further details available at https://biologi.fkip.unej.ac.id).

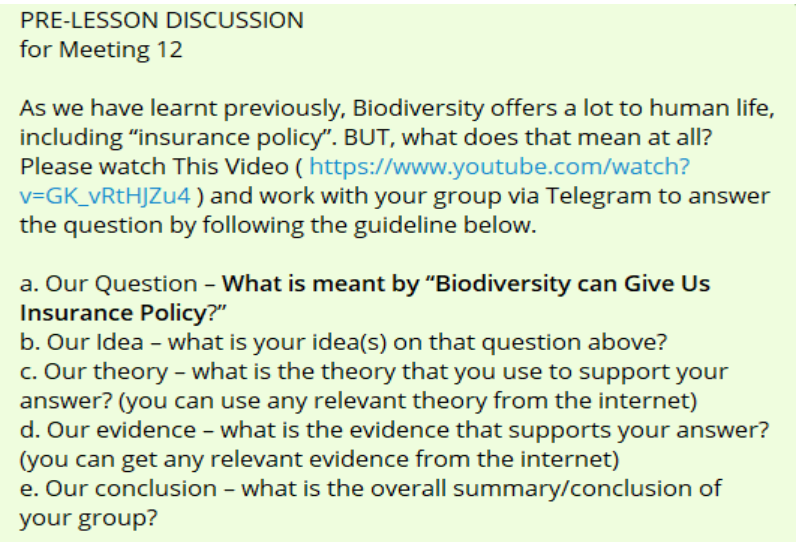
Two classes, each of which consisted of thirty-four students, were recruited randomly out of four classes and differentiated in terms of their compulsory learning platforms, i.e., Moodle group and Telegram group. Students were familiar with both platforms since these were generally used during emergency online learning. Students in each class worked in groups of four or five to manage interaction and discussion more efficiently. Their English proficiency was between A2 and B1 levels of the CEFR scale (Council of Europe, 2001). Both groups were taught by two language teachers and a content teacher. The language teachers taught both groups separately, while the content teacher helped validate the disciplinary content of course materials and subject knowledge tests. Initially, a Kolmogorov-Smirnov analysis was conducted and ensured the homogeneity between Moodle group (M=68.973, SD=6.095, SEM=1.112)

and Telegram group (M=66.65, SD=10.162, SEM=1.855) through a pre-test on subject-specific English proficiency, with p-value 0.77.

3.2 Research Design

This mixed-method study applied Fraenkel et al.'s (2012) triangulation design to address the quantitative and qualitative natures of the research inquiries. The design put equal emphasis on both strands of inquiries for a fine-cut understanding of how the two TECLIL platforms performed and influenced different dimensions of students' performance, i.e., subject-specific language performance, content knowledge, and depth of knowledge co-construction.

The first half of the course focused on task-based language teaching, e.g., describing the natural resources on campus and proposing strategies to protect these resources in collaborative writing mediated by the two platforms. In the second half, the course deployed knowledge co-construction forums. This division aimed at a seamless transition from language-oriented discussions to knowledge co-construction forums. In the forums, students shared their analysis of real-life issues, discussed the results of online research, and criticized emerging ideas on workable solutions. The forums were guided by several scaffolding questions, as exemplified in Figure 1.


PRE-LESSON DISCUSSION
for Meeting 12

As we have learnt previously, Biodiversity offers a lot to human life, including "insurance policy". BUT, what does that mean at all? Please watch This Video (https://www.youtube.com/watch?v=GK_vRtHJZu4) and work with your group via Telegram to answer the question by following the guideline below.

a. Our Question – **What is meant by "Biodiversity can Give Us Insurance Policy?"**
b. Our Idea – what is your idea(s) on that question above?
c. Our theory – what is the theory that you use to support your answer? (you can use any relevant theory from the internet)
d. Our evidence – what is the evidence that supports your answer? (you can get any relevant evidence from the internet)
e. Our conclusion – what is the overall summary/conclusion of your group?

Figure 1. Samples of scaffolding questions**.**

The questions were used in either pre-lesson or post-lesson discussion within one unit which was covered in two meetings. The pre-lesson discussion aimed at triggering students' discussions and preparing them for more in-depth discussions during the class, while the post-lesson discussion was meant to extend their discussion following comprehension questions in the unit. The teacher only guided and monitored the discussions in both halves of the course.

3.3 Data Collection and Analysis

To gain balanced and in-depth insights into the research inquiries, the researchers garnered quantitative and qualitative data. The design of data collection and analysis are hereby presented.

3.3.1 Quantitative data

Addressing the first research question, a five-scale questionnaire with 33 items was used to gain comparative data on students' perceptions of the two TECLIL platforms and the rate of their online learning engagement. The questionnaire was adapted from four measures of technology acceptance and online learning engagement. Table 1 shows sample items in the survey.

Table 1. Sample survey items of eTAM.

Constructs	N of items	Sample items	References
Perceived usefulness (PU)	4	Using the system enables me to learn more quickly.	(Teo et al., 2019)
Perceived ease of use (PEU)	3	It is easy for me to use the system in learning to do what I want to do.	
Attitude (ATU)	3	Once I start using the system in learning, I find it hard to stop.	
Subjective norms (SN)	2	People who influence my behavior think that I should use the system in learning.	
Perceived behavioral control (PBC)	4	I have control over the system of learning.	
Output performance (OUT)	3	Compared to what I had done, using the system has improved the quality of learning.	
Perceived enjoyment (PE)	2	I find using the system to be enjoyable.	(Venkatesh & Bala, 2008)
Perceived self-efficacy (PSE)	2	I feel confident using the system.	(Liaw, 2008)
Perceived self-satisfaction (PSS)	2	I am satisfied with using the system as a learning-assisted tool.	
Behavioral intention (BI)	3	I intend to use the system to assist my learning.	
Online learning skills (S)	2	I looked over the responses and feedback in the online discussion to make sure I understand the material.	(Dixson, 2010)
Participation (P)	3	I participated actively in online discussion.	

Teachers' performance was measured by students' responses through the university's evaluation survey involving 11 seven-scale items concerning time management, teacher feedback, content knowledge, pedagogical competence, class interaction, communicative competence, and assessment practices. This data enriched the analysis by taking into account the teachers' performance as a covariate upon comparing the effectiveness of both TECLIL platforms. In total, 41 items were translated into Indonesian and trialed to twenty students, with the resultant Cronbach's α of 0.927.

Subject-specific language performance was measured by pre-and post-tests developed by the language teachers. Each test comprised 40 multiple-choice questions (MCQ). These were equally distributed across vocabulary sections, grammar sections, writing sections, and reading sections. Students' subject knowledge was assessed at the end of the course through 40 MCQ items. MCQ helped to anticipate plagiarism and test security issues in online learning during the Covid-19 outbreak. The statistics

of students' participation were garnered through the Telegram application named Combot and Moodle's built-in log activity records.

In the course's final examination, recorded video presentations were assessed to measure subject-specific language use. Both test developers scored the presentations, with a fairly high inter-rater agreement, marked by Cronbach's α 0.837 and intraclass correlation coefficient of 0.829 based on average measures. The scoring criteria involved coherence and fluency, lexical resources, grammatical range and accuracy, and pronunciation. For assessing collective performance in knowledge co-construction, another inter-rater scoring was performed by involving the first researcher and a subject teacher from the Biology Education Department. This teacher accomplished a three-year overseas study during his Ph.D. The scoring rubric evaluated students' points of view, explanations of issues, evidence, and conclusion as well as implication. This inter-rater scoring achieved Cronbach's α 0.8 and intraclass correlation coefficient of 0.80 based on average measures. Paired sample tests were administered to identify significant differences between groups concerning technology acceptance, teacher's performance, subject-specific language performance, and subject knowledge co-construction. Involving two environments (i.e., Moodle group and Telegram group) and two teachers as covariates, MANCOVA was employed to re-examine significant differences in students' language performance, content knowledge, and knowledge co-construction.

3.3.2 Qualitative Data

Qualitative data on students' interactions on both platforms were collected by retrieving their posting archives throughout the second half of the course. Upon analysis, this study deployed the online learning interaction model designed by Ke and Xie (2009) to identify the interaction patterns in both environments. This model divides learning interaction into social dimensions, knowledge construction, and learning regulation. Table 2 describes the model guiding the interaction analysis.

Table 2. The interaction model for technology-mediated collaborative learning.

Dimensions	Codes	Sub-dimensions	Definitions and Examples
Socialization	S	_	Interactions that do not involve knowledge co-construction. For example, this includes greetings, sharing emotions or feelings, and giving comments without any further elaboration.
Knowledge construction	K1	Knowledge sharing	Adding facts with no elaboration (e.g., sharing references or hyperlinks), comments (e.g., "I am in line with you"), and raising questions.
	K2	Egocentric responses	Extending individual's concepts, problems elaboration, or arguments with details, or citing personal experience or knowledge learned previously.
	K3	Allocentric responses	Based on the information provided, students compare and synthesize information, which includes providing judgments (e.g., "I agree with that because …"), summarizing (e.g., "I like that idea, but perhaps …"), and elaborate understanding (e.g., "based on the information, I wonder if it has any drawbacks").
	K4	Application	Applying newly learned knowledge to hypothetical or future scenarios, or offering application strategies.

Table 2 continued…

Regulation of learning	R1	Learning coordination	Teamwork planning and coordinating for a collaborative project, (e.g., "Liz, can you do task 1 and I will do task 2?").
	R2	Reflection	Self-evaluation and self-regulation on the learning process (e.g., "I am not familiar with that") or self-regulation (e.g., "I had better find more references on that").
	R3	Technical issues	Questioning and answering on technological problems or assignment clarification, (e.g., "Anyone knows how to quote a message?").

The first researcher invited the teacher in the Moodle group to administer multiple coding on the threads or postings extracted from each platform. An initial coding from a sample group was performed to reach a coding agreement. Higher agreement between coders, as indicative of minor discrepancies such as codes assigned to threads, evinces a trustworthy and robust analysis. Furthermore, both coders kept an audit trail through a continuous exchange of raw data, which were revisited and refined regularly as the analysis proceeded.

4. FINDINGS AND DISCUSSION

The following sub-sections elaborate on the analysis results followed by discussions interpreting these results in linkage to the research inquiries.

4.1 The eTAM Survey Results on Two TECLIL Environments

Table 3 describes the high rate of technology acceptance across dimensions in both groups, yet no significant difference is identified. Both groups also demonstrate equally high-rate online learning engagement as evidenced by highly intensive online learning skills and participation.

Table 3. Paired sample statistics.

Aspects	**Mean**		**Std. deviation**	**Std. error mean**
	Moodle group	**Telegram group**		
Perceived usefulness	4.1417	4.3083	1.08344	0.19781
Perceived ease of use	4.1778	4.2556	1.00833	0.18410
Attitude	3.8444	4.0778	1.18467	0.21629
Subjective norms	4.1333	4.2667	1.02498	0.18713
Perceived behavior control	4.5333	4.5167	0.77385	0.14129
Output	4.3111	4.4333	0.98449	0.17974
Perceived enjoyment	4.0833	4.1833	1.00344	0.18320
Perceived self-efficacy	4.4167	4.4333	0.93295	0.17033
Perceived self-satisfaction	4.1500	4.4000	0.92615	0.16909
Behavioral intention	4.0778	4.2444	0.85657	0.15639
Online learning skills	4.2167	4.3833	1.00287	0.18310
Online learning participation	4.4333	4.3667	0.74997	0.13692

The students' familiarity with both technologies since the outset of the Covid-19 pandemic might account for their equal acceptance of both technologies. As they

had been extensively accustomed to the technologies, they had been familiar with their functionalities, affordances, and drawbacks along with how to deal with these throughout their two-year online learning. The university's policy also required the use of Moodle to keep all records of instructional activities. In addition, teachers' discretion to opt for the MIM, such as Telegram and WhatsApp, to help them administer their instruction and communicate with the students was responsible for this general acceptance. In coherence with Teo et al. (2019), these political and personal factors eventually form a subjective norm to the use of Moodle and Telegram indeed lend credence to growing students' familiarity with the functionalities of both technologies, along with their positive attitude to remain active on their online learning.

In terms of affordances, both technologies can offer similar supports for students' CLIL learning where they need to collaborate with their peers, share learning artifacts, and organize these artifacts on their devices. Despite different synchronousness, they report a similar extent of control, perceived ease of use, and perceived usefulness to both technologies. This affirms previous work by Sun, Lin, et al. (2017) which documents similar learning affordances of online discussion forum platforms and mobile chat platforms in an academic context. The fact that knowledge forums in both platforms require only moderate technological affordances, as in multidimensionally communicating with their peers, contributes to the substantial control, behavioral control, and learning output in these environments. The possibility to access their learning at their disposal through each app enables an equal opportunity for consolidating, evaluating, and refining collective knowledge. This also accounts for why both groups report equally high scores in online learning skills and participation. Overall, both groups also grow similar magnitude of learning enjoyment, satisfaction, and efficacy.

The possibility to use Moodle and Telegram across different devices, i.e., computer and smartphone, blurs the differences between the two and enables students to gain similar learning experiences. Integrating knowledge forums in CLIL instruction allows teachers to engage students in nurturing environments for the consolidation of knowledge. As communication tools, Moodle and Telegram are proven suitable for CLIL learning where students need to engage in subject-specific discourses using multimodal resources (Meyer et al., 2015), such as text, pictures, video, and hyperlinks. The students-generated content in a knowledge forum involving scientific texts stimulates meaningful discussions of different complexity and meaningful outputs concerning content and language learning (Coyle, 2007; Meyer et al., 2015). Specified scaffoldings, either through task design or teacher direction in the knowledge forum, can aid students to engage in knowledge co-construction mediated by authentic language use. Attending to Coyle (2007), this students-centric learning makes content and language accessible to the students and therefore enculturates positive habits of refining and enhancing knowledge by and for students (van Aalst, 2009). What matters most is how teachers can harness different technologies to suit a specified purpose in CLIL learning or any language learning in general. In this regard, Moodle and Telegram offer similar architecture supportive of knowledge co-construction forums. The findings acknowledge the bearing impacts of relevant learning activities and learning content on students' enjoyment and behavior in using technology (Lai, 2019; Zou et al., 2018).

4.2 The Extent to Which the Moodle Group Outperformed Counterparts in Knowledge Co-Construction

The first paired samples test demonstrated that both groups gained significantly higher scores (p<0.05) in the post-test in subject-specific English proficiency, as shown in Table 4.

Table 4. Paired samples test on pre- and post-test of language performance.

Score comparison (max score:100)		Mean	Std. deviation	Std. error mean	Sig. (2-tailed)
Moodle group	Pre-test score	68.5206	7.96276	1.36560	0.001
	Post-test score	73.5441			
Telegram group	Pre-test score	67.2118	11.67292	2.00189	0.008
	Post-test score	72.8706			

This analysis was followed up by another paired samples test on the group's gains in subject-specific English tests, comparing the gap between post-test and pre-test scores, and the scores in the subject knowledge test. The results in Table 5 report no significant difference between groups in these respects.

Table 5. Paired sample t-test.

Variables	Mean		Std. deviation	Std. error mean	Sig. (2-tailed)
	Moodle group	Telegram group			
Gains in subject-specific English test score	5.0235	5.6588	14.47300	2.48210	0.129
Subject knowledge test score	67.9394	71.7335	14.21866	2.43848	0.800

Another paired samples test was performed on the collective performance in the group project focusing on the recorded spoken presentation and knowledge co-construction. As presented in Table 6, while no significant difference is evident in recorded spoken presentation, Moodle group outperformed their counterpart in knowledge co-construction (p<0.05).

Table 6. Paired sample t-test on collective performance.

Variables (max score:10)	Mean		Std. deviation	Std. error mean	Sig. (2-tailed)
	Moodle group	Telegram group			
Recorded spoken presentation score	7.5	7.68	0.74999	0.12862	0.104
Knowledge co-construction score	6.9418	6.1329	0.98518	0.16896	0.000

A MANCOVA was employed to re-examine the superiority of Moodle group in knowledge co-construction involving 2 environments (i.e., Moodle group and Telegram group) and two teachers. The teachers' performance served as the covariate in the model at a score of 4.5692 (max score: 5). The analysis result demonstrates that only group difference (p=0.000) poses a significant impact on the knowledge co-construction, regardless of the teachers' decent performance (p=0.694).

Reminiscent of similar technology acceptance in both groups, different architectures between the two platforms pose no bearing impacts on students' performance in subject-specific English use. Given the values of intensive dialogic collaboration in knowledge co-construction forums, both platforms have been proven decent to initiate and sustain quality discussion, while at the same time ensuring high exposure to the target language and a high degree of negotiation of meaning. With the possibility of shifting between mobile devices, i.e., smartphones and laptops, the students can experience fairly similar interactions in the online forum. As such, when deployed in a knowledge co-construction forum, both platforms allow students to extensively use the target language to express and refine their ideas in a series of meaningful discourses. These discourses constitute language-related episodes that draw students' attention to their language features along with respective inaccuracies, leading to the acquisition of the target language (Kukulska-Hulme & Viberg, 2018). Although Moodle lacks the rapidity valuable for intensive language learning (Zou et al., 2018), it still affords similar features supporting the integration of reading and writing skills and enhanced communication through the use of multimodal features.

The fact that social interaction takes place at a nearly equal extent in both environments demonstrates the presence of a liminal zone. Widely associated with social media, the liminal zone is known to generate a friendly atmosphere and a higher degree of emotional intelligence (Imamyartha et al., 2021, 2022). In this study, similar to students in the Telegram group, those in Moodle group use stylized language features, composite characters (i.e., 3), repeated letterings (i.e., Nysss), and emojis (i.e., 😊) to enliven their interaction, as exemplified in Figure 2.

This friendly environment helps to escalate the interest, willingness, and motivation to initiate language learning sessions (Kukulska-Hulme & Viberg, 2018). Considering the cognitive load that may adversely impact learning engagement (Coyle, 2007), the affective bearings of social interaction encourage active language use in the knowledge co-construction forum by growing stronger motivation, self-regulation, and collectivistic learning. Concerning the barrier to students' engagement in Moodle-mediated instruction due to its strong instructional orientation (Pérez-Pérez et al., 2020), the findings show that Moodle can offer the social adhesive of communication. Although socialization does not directly contribute to students' academic performance, it remains a vital element of sustained and quality academic discourse (Imamyartha et al., 2022).

The findings also evince the value of employing a specific instructional framework to amplify subject knowledge learning. The correlation between the post-test score and subject knowledge test score (r=0.399, p=0.002) accounts for the increment of language performance which accompanies the growth of content knowledge (Meyer et al., 2015). The present study supports the previous report on equally intensive deep learning in mobile chat platforms and instructional platforms (Sun, Lin, et al., 2017). The fact that deep learning can also persist in a Telegram group demonstrates that MIM can be just as effective as an instructional app in scaffolding resource-rich discussion, providing that students have the scaffolding to initiate and sustain study-related technology use (Sun, Lin, et al., 2017). Equally important is that the connectivity and rapidity of MIM can guide and extend students' online discussions. In online learning, having timely feedback determines students' satisfaction and learning performance as it helps monitor their learning (Elshami et al., 2021). Deployed in the knowledge co-construction forum, the connectivity and

rapidity of Telegram aid students in exchanging, criticizing, and refining ideas. As MIM encourages students that are struggling, shy, and antisocial to share their ideas and receive learning materials from colleagues, they can better engage in knowledge co-construction (Sun, Liu, et al., 2017).

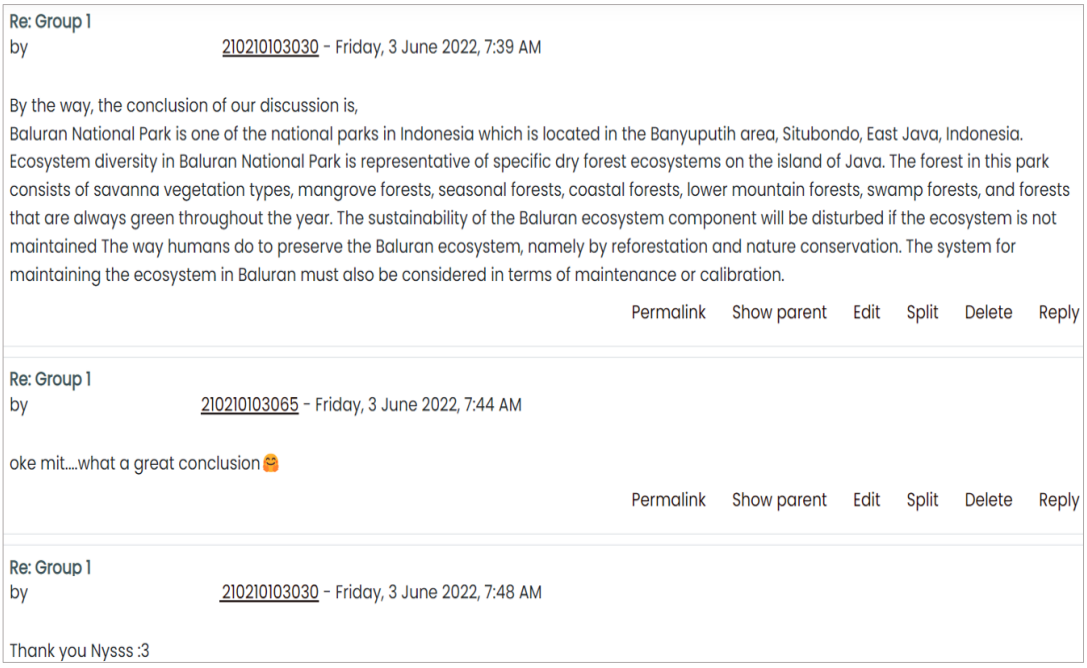


Figure 2. Students' discussion in Moodle.

Although lacking the promptness of communication, the asynchronousness of Moodle is more supportive of knowledge co-construction as students generally struggle with the linguistic and cognitive demands of learning tasks. With Moodle, structured forums offer easier access to retrieve and grasp learning materials since students have more time to absorb the information and thoughts posted by their partners (Teo et al., 2019). The time gaps between postings allow reflection periods in which students criticize, refine, and formulate their profound thoughts in the target language before sharing them in the forum. These affordances mean more opportunities to probe further into the subject matter. By contrast, the discussions in Telegram are presented chronologically, which requires students to carefully sort 'occasionally' unnecessary postings to keep up with ongoing discussions and make meaningful contributions.

4.3 Different Trends of Interaction Types in the Two TECLIL Environments

Table 7 demonstrates a higher rate of interaction in Moodle group with 1.577 posts, compared to 1.267 posts in the Telegram group. Knowledge sharing dominates the interaction in both groups, followed by egocentric elaboration and allocentric elaboration. Based on the total postings in all three components of knowledge co-construction, i.e., knowledge sharing, egocentric elaboration, and allocentric elaboration, the interactions between groups demonstrate similar trends, with an aggregate of 48.64% knowledge construction in Moodle and 40.02% in Telegram. Knowledge sharing is dominant, which makes up 27.2% and 28.41% of total

interactions in Moodle and Telegram, respectively. Although both groups document a lower rate of egocentric and allocentric elaborations, Moodle group documents 10.65% egocentric elaborations and 10.78% allocentric elaborations, compared to 7.02% and 4.58% in the Telegram group in the very respects. The learning regulation in both environments takes place at a fairly similar rate with students in Moodle group managing 36.40% interaction, while those with Telegram demonstrate 39.07% interaction in learning regulation. Socialization occurs at a lower rate in Moodle environment, at 14.97%, compared to 20.92% of socialization in the Telegram group. Based on individual students' posting frequency, we identified significant differences between groups (p=0.000, SD=58.02510, SEM=9.95122) by paired samples test. The students in Moodle group documented an average frequency of 95.6176 (SD=41.8446, SEM=7.17629), compared with those in the Telegram group with an average frequency reaching 44.8529 (SD=35.41797, SEM=6.07413). Further analysis scrutinized whether this frequency correlated with students' online learning engagement and resultant performance in English proficiency and subject knowledge. The results demonstrated that only posting frequency in Moodle group held a significant correlation with online learning skills (r=0.369, p=0.032) and learning participation (r=0.356, p=0.039).

Table 7. The interaction types in Moodle group and Telegram group.

Dimension	**Sub-dimension**	**Moodle group**		**Telegram group**	
		N	**%**	**N**	**%**
Knowledge Construction	Knowledge sharing (K1): Guys, how about we get straight to the question? Starting with the first one, namely "Where is Papuma Beach?" Yes, I think so. Because Meru Betiri is a fairly large national park	429	27.20	360	28.41
	Egocentric elaboration (K2): Okayy, answer from "where is papuma beach?" is Papuma Beach is one of the white sand beaches in the south of East Java. Tanjung Papuma Beach is located in Lojejer village, Wuluhan, about 45 minutes from the center of Jember Regency. In Banyuwangi, many people say that if someone destroys nature there or takes species or objects, that person will never come back, or disappeared, that's why Alas Purwo is famous for being haunted and horror.	168	10.65	89	7.02
	Allocentric elaboration (K3): I think, if coral reef species are not protected, coral reefs will be damaged. this will have an indirect impact on the Papuma coastal ecosystem. If the damaged coral reef is a gathering place for fish, the fish will leave and the income of the surrounding community will decrease. What do you think guyss? Wow, it turns out that there are many examples of animals and plants that are almost extinct😣 but their sustainability is maintained with this ex situ conservation as you mentioned earlier.	170	10.78	58	4.58

Table 7 continued…

	With the existence of ex situ conservation such as zoos, safari parks, botany can make animals that initially had a small population can still exist in the world by doing captivity and providing a breeding ground.				
Learning Regulation	Learning coordination (R1): hi guys, we have a new project in English, it is about local biodiversity and its effect, i want to suggest for a local biodiversity, what about papuma (beach)?	558	35.38	470	37.10
	Reflection (R2): Okay guys, let's move, oh my God, we don't have much more time for this discussion. if I.. I use a descriptive method by reading references from journals…	8	0.51	17	1.34
	Management of technical issues (R3): we have a little difficulty in summarizing the words, khul	8	0.51	8	0.63
Socialization	Socialization (SC): hai anava, it's still fine right now. let's discuss	236	14.97	265	20.92
Total		1.577	100	1.267	100

The interaction patterns in both groups resonate with previous works that document the prevalence of knowledge sharing over the more cognitively-demanding knowledge construction (Nor et al., 2012; Sun, Liu, et al., 2017). Although associated with the surface-level thinking process, knowledge sharing is a vital foundation for reaching deeper knowledge construction by allowing interactants to use shared resources to negotiate meaning, construct new ideas, and consolidate newly constructed knowledge with prior knowledge (Hou et al., 2015; Sun, Liu, et al., 2017). Also, the findings acknowledge Sun, Lin, et al. (2018) who argued that Moodle and MIM effectively engaged students in knowledge co-construction. However, their study documents a higher rate of egocentric and allocentric elaborations than what is found in the present study. One rationale for that is that the participants were at the developing stage of English language learning, as indicated by the course requirement of A2 and B1. As a knowledge co-construction forum engages diverse language properties to express, criticize, and refine complex concepts (van Aalst, 2009), suboptimal language performance may pose challenges to more in-depth knowledge construction. By contrast, Sun, Lin, et al. (2017) involved students in a knowledge forum with the aid of their mother tongue, implying wider discourse access to engage in a more in-depth discussion. These findings substantiate the role of collective discretion to share knowledge and control over relevant discourse access as the springboard to reach in-depth discussion. Teachers, therefore, need to deploy appropriate content and language scaffolding that allows students to shift from the surface-level to deep-level thinking in knowledge co-construction forums (Hou et al., 2015).

The fact that socialization takes place nearly at the same rate between groups highlights the equal potential to foment group cohesion. In an online forum, positive bonding and atmosphere stem from social interaction, and occasionally off-topic discussion, yet this does not mean that such interaction is detrimental to the academic discourse (Hou et al., 2015). Social interaction is a critical element to successful

collaboration where the willingness to share is valued and collective support is sought. Although students' contributions vary to a large extent, the analysis results have demonstrated that productive language use in technology-mediated forums affords exposure to subject-specific discourses and guides the students to use newly acquired terminologies and language features during knowledge co-construction (Zhao et al., 2022).

The findings from both TECLIL environments have corroborated that Moodle and Telegram can support knowledge co-construction. However, due to the stage-managed features to manage learning resources and discussions, Moodle needs to be given more priority if knowledge co-construction and subject-specific English use constitute primary concerns. Moodle organized discussions based on topics, which helped students keep up with and update the interim discussions easily. This is aligned with Agustina et al. (2022) who document the value of providing organized discussions and reflection in a mobile app. This affordance grants the time students require for refining their understanding through reflecting on peers' comments and views, extensive reading, online research, and self-reflection before sharing their ideas. The present study coheres with Sun, Lin, et al. (2017) who document students' preference for Moodle over social media for organizing discussion and learning artifacts, without necessarily searching through bundles of posts. Nor et al. (2012) also argue that Moodle asynchronous communication gives students ample time for thinking through and editing their responses before taking part in a discussion. By extension, students are encouraged to make more relevant evaluative comments and constructive contributions to the discussion, compared to the Telegram group forum which tends to be quickly saturated with postings generally associated with surface-level thinking skills. This lower rate of in-depth discussion in the Telegram group can be associated with the screen limitation and the hassle of posting and reading extensive content (Sun, Lin, et al., 2017), which would otherwise become valuable inputs for the contrivance and refinement of egocentric and allocentric elaboration. Finally, the worthy correlation between students' posting frequency in Moodle groups and their online learning engagement substantiates Moodle's potential to grow a fertile ground for students to co-construct ideas while exercising their language in a subject-specific discourse extensively.

5. CONCLUSION

This research demonstrates that Moodle and Telegram can operate equally effective in mediating TECLIL environments as corroborated by the students' positive appraisals through the eTAM survey. Both platforms also offer similar supports as knowledge co-construction platforms for developing language performance and content knowledge as no significant difference is identified in both regards. Nevertheless, marked differences in the interaction patterns between the two are worthy of further scrutiny. Compared to Telegram, Moodle can better encourage in-depth knowledge co-construction in CLIL settings, due to its stage-managed discussion features and asynchronousness.

This study documented the potential of integrating structured online discussion forums to maximize CLIL learning. Knowledge co-construction as TECLIL pedagogy directs students' collaborative learning across different levels of knowledge

construction within a subject-specific discourse. Notwithstanding, distinctive infrastructures between the platforms play pivotal roles in different learning dimensions. Telegram offers connectivity and rapidity through multimodal communication, essential for accessing learning artifacts and the learning community instantly. This accrues stronger engagement in content-related discussions mediated by a foreign language and more cohesive interaction, yet it may not be as effective as Moodle in terms of scaffolding intensive and in-depth knowledge co-construction. The higher rate of egocentric and allocentric elaboration in Moodle accentuates the values of its topical division and asynchronousness. Overall, Telegram is useful to establish prompt interaction and discussion with stronger group cohesion. Moodle, however, is more convenient for building quality group discussions where elaborate responses and complex information are expected to refine collectivistic understanding and reach deeper knowledge co-construction.

For the knowledge co-construction forum to reach its utmost impact on TECLIL, the teacher should help students develop collaborative skills mediated by technology. In so doing, teachers need to provide hands-on experience in knowledge-building forum and invite students to co-create a rubric to help them consistently reflect on their posting quality. The teacher needs to clarify the goals of knowledge co-construction forum, with specified expectations, regulations, and deadlines. Given the general predominance of knowledge sharing in this study, teachers need to consistently harness guidance strategies, such as elaboration, clarification, and exemplification to engage students in deeper learning. Equally important is that teachers need to help students acknowledge the values of knowledge construction to escalate their subject-specific performance. Such preparation takes place in class and serves as the precursor to an in-depth knowledge co-construction. Finally, teachers can perform a timely intervention to address repetitive surface-level postings to help students diversify the depths of their knowledge co-construction while monitoring their language use.

As the participants are freshmen in the non-English education department without prior experience in English-mediated instruction, the knowledge co-construction forums with content-oriented discussion were limited to the last six of twelve weeks of instruction in consideration of acclimating the students to an actual knowledge-building forum in English. By implication, the utmost impact of a technology-mediated discussion forum can be achieved after a more extensive knowledge-building forum throughout a semester. Also, this study only involved multiple-choice questions, therefore limiting the possibility to capture complex language performance and content knowledge mastery. Future studies are also suggested to administer more authentic language assessment, i.e., essay writing assessment, to investigate the impact of technology-mediated discussion forums on the range and appropriateness of language use and the depth of content knowledge.

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