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Enhancing Metacognitive Awareness in English Reading Through Collaborative Learning with Periodical Texts and Online Workspace

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Abstract
The use of simplified text in English reading textbooks is crucial for teaching language features, building a sense of familiarity, and improving comprehension skills. However, exclusive dependence on such texts may encourage passive reading practices and engagement with content at a surface level, thus limiting the development of metacognitive awareness in reading. This study proposed the intervention of periodical texts within an online collaborative workspace to promote more active reading practices. Through this approach, this study examines its effects on learners' metacognitive awareness. Adopting a mixed-methods quasi-experimental design and think-aloud protocol, the study involved foundation students at a public university in Malaysia. The experimental group demonstrated significant improvements in seven strategies namely declarative knowledge, procedural knowledge, conditional knowledge, planning, comprehension monitoring, information management, and evaluation. The qualitative findings further revealed that students applied strategies such as task division, exchanging opinions, directing focus, pausing to think, rereading, relating to their own experience, and comparing understanding. Moving beyond text simplification as a dominant scaffold in reading, this study empirically demonstrates the value of enhancing metacognitive knowledge and regulation as a dynamic and socially responsive strategy. The proposed intervention is significant for pedagogical practice as it foregrounds constructivist, collaborative and reflective practice, promote learner-centered reading activity, and facilitates learner engagement. Dissemination of these findings is expected to offer evidence supporting the application of the intervention as part of reading development.

Keywords: Collaborative reading, English reading, English textbook, metacognition, mixed methods, online workspace, periodical text

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Introduction

Simplified texts in English reading textbooks are widely used to make content accessible for language learning and the development of comprehension skills (Crossley et al., 2014). A simplified text in a reading textbook indicates that the original material, like a story or article, has been rewritten or adapted in simpler language to facilitate comprehension by using simpler vocabulary, crafting shorter sentences, and simplifying complex ideas, while maintaining the main message or story (Arfé et al., 2018). These texts are used by language learners, younger readers, and students who are developing their reading skills because they support language learning using simpler vocabulary and grammatical structures, allowing learners to focus on understanding the meaning without becoming distracted by unfamiliar words (Crossley et al., 2014). In Malaysia, simplified text in reading textbooks is commonly used to prepare for important examinations such as the Malaysian Certificate of Education (MCE) or the Malaysian University English Test (MUET). It takes the fundamental role as the first approach in fulfilling the learning objectives (Solumuthu et al., 2023).

Although simplified texts support comprehension process, they may unintentionally limit opportunities for students to explore higher-order thinking skills (Rand & Rand, 2022). By reducing linguistic and conceptual demands, such texts often exclude complex issues, multiple viewpoints, or ambiguous elements that require critical skills such as analysis, evaluation and synthesis (Rand & Rand, 2022). For more proficient learners, simplified text can reduce cognitive challenge and engagement, particularly when paired with traditional tasks such as multiple-choice questions, which further promote passive rather than active learning (Abd Latip et al., 2026; Arfé et al., 2018; Tortorelli, 2020). Relying solely on textbooks may limit readers' opportunities to develop critical comprehension skills and engage in meaningful interaction.

In reality, reading activities involving simplified texts often occur in isolation because reading is commonly viewed as an individual and passive task, which may limit opportunities for interaction and deeper engagement (Amjadi & Talebi, 2021; Tomlinson, 2012). This approach contrasts with the view of reading as a social and communicative process, where learners construct meaning through sharing thoughts, discussing interpretations, and collaborative exchange (Joo et al., 2026; Tomlinson, 2012). With the rapid adoption of technology in education, there is growing potential to transform reading into a more engaging experience through online platform that support communication and collaboration (Shamshul et al., 2024). This shift is highly relevant in this digital era, as students may become disengaged from traditional practices such as completing the same worksheet, using printed version of books, and experiencing a less interactive learning environment (Shamshul et al., 2024).

Equally important, effective readers should be aware of and regulate their own thinking processes. This concept, known as metacognition, was coined by psychologist John Flavell in 1976 and refers to the capacity to reflect on, comprehend, and regulate one's own learning processes (Schraw & Dennison, 1994). Metacognition allows students to become strategic and self-directed, improving both comprehension and learning efficiency (Stanton et al., 2021). Concurrently, if reading occurs in collaborative settings, students can stimulate and influence their peers in using different strategies, thereby enhancing metacognitive awareness and overall learning outcomes (Stanton et al., 2021).

The current research proposed the use of periodical texts in combination with an online workspace as an alternative to the conventional use of simplified texts in the reading classroom. In the Malaysian context, material selection in the reading classroom remains imperative in

shaping students' reading engagement and learning outcomes (Solumuthu et al., 2023). Periodical texts, which offer real-world and timely content, may provide greater cognitive challenge and relevance for learners (Chi, 2019). When integrated with an online workspace, these texts also create opportunities for collaboration and strategic engagement (Chan et al., 2023). There is limited empirical evidence examining how this combination influences students' metacognitive awareness, particularly in comparison with simplified texts from a reading textbook. Furthermore, little is known about how students actively regulate and monitor their comprehension when engaging with such texts in a technology-mediated environment. This study addresses the following research questions:

i. What are the differences in students' metacognitive awareness between those using simplified texts and those using periodical texts with an online workspace?
ii. How do students demonstrate metacognition when engaging with periodical texts through an online workspace?

Literature Review

Learning is increasingly understood as a social process rather than an individualistic mindset (Amjadi & Talebi, 2021). Approaches that treat learning as an individualized process may limit interaction opportunities and collective problem-solving (Joo et al., 2026). When learners articulate their ideas, respond to peers, and justify their interpretations, they engage in metacognitive regulation by monitoring their understanding, evaluating their approaches, and reflecting on their strategy use (Kielstra et al., 2022). In the classroom, learning can be facilitated collaboratively to create a more effective learning environment that encourages active participation. This perspective is grounded in constructivist and social constructivist theories. From a constructivist perspective, learners actively engage in cognitive processes and problem-solving to construct knowledge rather than absorbing information from teachers (Nie & Lau, 2010). Social constructivism further emphasizes that learning is developed through collaboration processes and social interaction where learners co-construct knowledge with others (Kielstra et al., 2022). Through collaborative interaction, learners can externalize, monitor, and regulate their thinking, contributing to the development of metacognitive awareness of how they learn (Iiskala et al., 2011). As learners engage in dialogue and reflection, they become more conscious of their decisions and comprehension processes (Le & Nguyen, 2024).

In a constructivist reading classroom, students are not passive recipients of information but actively construct knowledge through summarizing, questioning, reasoning, and critically interpreting text (Le & Nguyen, 2024). It refers to active learning that promotes high-order cognitive functioning by leveraging peer interaction to accomplish task. Collaborative reading involves interaction through the analysis and problem-solving of a text to build comprehension, as it allows students to explore different interpretations (Dallacqua, 2020). Treating reading exclusively as an individual activity disadvantages students who thrive on social interaction and require discussion to support their learning (Le & Nguyen, 2024). The goal is to improve and advance their reading comprehension by encouraging the students to actively engage with the text, working together on a shared task, and interact with their peers (Dallacqua, 2020). It is based on the idea that learning is a naturally social act in which students communicate with one another, and learning occurs through these interactions (Laal & Laal, 2012).

Collaborative reading can be facilitated by using tools to allow for commenting and interaction on texts, fostering deeper comprehension and engagement. One emerging tool for supporting collaborative reading is the online workspace. Online workspaces are designed to facilitate

collaborative behaviours, such as sharing ideas in real time, by allowing readers to comment directly on pages or sections of a text (Chan et al., 2023). These features enable readers to engage in documented and citable conversations around a text through annotation tools, allowing them to highlight, add notes, and share their thoughts directly within the text (Chan et al., 2023). The use of online workspaces for brainstorming and sharing ideas can make collaborative reading more interactive and meaningful, as research has shown that these tools also foster social interaction and reduce feelings of isolation during reading activities (Chan et al., 2023; Hernández-Sellés et al., 2019). Although online whiteboard technologies have been examined in Malaysian higher-education contexts, existing studies have largely focused on technology acceptance, students perceptions, or general language learning experience (Abd Halim et al., 2025; Muda & Goh, 2024). Nevertheless, the potential of online collaborative workspaces to support learners' metacognitive awareness during reading, particularly through engagement with periodical texts, remains underexplored. Online workspaces offer a modern approach in reading by extending learning beyond individual goals and the conventional use of static textbooks.

Methodology

A mixed-method research design was used to attain a stronger and broader evaluation (Onwuegbuzie & Leech, 2004). Mixed methods research involves the collection or analysis of quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially (Teddlie & Tashakkori, 2003). To enhance the validity and depth of the findings, this study employed a quasi-experimental design with a qualitative think-aloud protocol (TAP), allowing for a more comprehensive understanding and deeper meaning (Sun, 2011). Patterns were identified using a paired-samples t-test to test the effect (difference) of the factors after the intervention. The TAP functioned as a qualitative data collection method that facilitated interpretation of the results (Sun, 2011). A deductive coding approach was used to analyze the TAP, with codes established prior to the analysis process (Sun, 2011). Deductive codes were developed based on the metacognitive awareness framework proposed by Brown (1987), aligned with the constructs of the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), prior to the analysis process (Sun, 2011). A theory-driven coding framework ensured construct validity in the study. Participants were instructed to verbalize their thoughts while reading the periodical texts. Prior to data collection, a short session was conducted to familiarize the students with the procedure. The process was recorded using a recording feature on a mobile phone. The recording was transcribed verbatim and segmented into idea units, defined as the smallest units representing a single cognitive or metacognitive act, to structure the data and facilitate the development of possible subcategory coding (Sun, 2011).

Instruments

A total of nine texts were used in the intervention, taken from weekly news magazines. To improve the validity of the text selection, a checklist of material criteria comprising program and course, subject and content, layout and physical, and skill was used in this study. This checklist was adapted from studies on material selection and textbook evaluation by Nimehchisalem and Mukundan (2015) and Shak et al. (2022). Five foundation English teachers were involved in this process. Feedback was taken to improve the overall implementation. Two methods were employed to ensure the readability of the study: the Common European Framework of Reference for Languages (CEFR) vocabulary profile checker and the Flesch-Kincaid readability score. The proportion of high-frequency vocabulary at the A1, A2, B1 and B2 levels ranged from 90% to 93%,

indicating substantial coverage of high-frequency vocabulary, which is relevant to the lexical accessibility of the texts (Masrai 2019; Odo, 2023). Accordingly, the amount of C1 and C2 words must not exceed 10% of the total words. The Flesch-Kincaid readability score has been found to be a reliable measure for determining the readability of texts for English as a second language (ESL) learners (Miller, 2011). All the texts used in the research were briefed on the source and purpose before the intervention. Students in the control group used the simplified text from the reading textbook provided by the center.

During the intervention, the experimental group used the Miro online workspace to facilitate idea sharing. This platform allows students to easily generate ideas and exchange information in real time using a range of different media such as words, diagrams, and mind maps (Chan et al., 2023). Students can type, draw, share images, attach files or links, chat or talk with collaborators on a shared screen, and even save work as a file to review (Rojanarata, 2020). The efficiency of the interaction between peers and instructors can be improved with its communicative and collaborative purpose (Li et al., 2021). In a reading activity, an online workspace can be utilized to share files and multimedia related to the reading topic. Students were also able to share their discussion using a readily available template or expand their idea maps. The online workspace was used a week before the implementation to build a sense of familiarity.

The Metacognitive Awareness Inventory (MAI), developed by Schraw and Dennison (1994), was designed to measure adults' metacognition under two categories: knowledge of cognition and regulation of cognition. MAI has 52 items and is rated on a 5-point Likert scale where 1 means "I never or rarely do this", 2 means "I do this only occasionally", 3 means "I sometimes do this" (about 50% of the time), 4 means "I usually do this", and 5 means "I always or almost always do this." There are three subscales in cognition of knowledge, namely declarative (8 items), procedural (4 items), and conditional (5 items). Subsequently, there are five subscales in cognition of regulation, namely planning (7 items), comprehension monitoring (7 items), information management strategies (10 items), debugging strategies (5 items), and evaluation (6 items). Prior to administering the research instruments, the students were informed of the purpose of the study, including the definition of metacognition and its associated factors, to ensure that they understood the relevance of their participation (Head, 2020).

Participants and Setting

The participants were learners aged 18 and 19 years who were enrolled in a pre-university level prior to entering a degree program. A sample size of sixty students was involved in the quantitative research (Cohen et al., 2007). The study was conducted at a foundation center that provides pre-university education at a public university in Sabah, Malaysia. The control and experimental groups were chosen randomly from the 14 groups of language classes using a website, namely Wheel of Names. Additionally, the participants for the qualitative part were all thirty students in the experimental group, divided into small groups of three to four students (Cohen et al., 2007). All the procedures done were thoroughly explained to students before the intervention started (Head, 2020). Students were briefed about the overall process of the data collection procedures (Cohen et al., 2007). The researcher received written permission from the center and later executed the research at the course level with the cognizance of the course coordinator. A written consent form was given to students, and their signature was obtained. Before any procedure, the researcher read the consent form again to confirm the process and responsibilities of participants (Head, 2020). The participants were ensured anonymity throughout the procedure (Head, 2020).

Procedures

A nine-week quasi-experimental design was used to evaluate the effects of an intervention, or in other words, to establish a cause-and-effect relationship between independent and dependent variables (Cohen et al., 2007). The experimental group was using periodical text and an online workspace. Meanwhile, the control group used the simplified text provided in the textbook. The instructors were involved in the course meeting to ensure transparency in administering the quasi-experimental design. Improvements on the practicality of the instruments were made after the pilot study. Intervention started when all instruments were administered. The intervention was conducted over nine weeks, followed by two weeks dedicated to the TAP. Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 29, while qualitative data were analyzed using NVivo 14.

Results

Students' Metacognitive Awareness between Simplified Texts and Periodical Texts with an Online Workspace

Students in the experimental group demonstrated significant improvements across all knowledge-of-cognition components, namely declarative, procedural, and conditional knowledge. In contrast, students who relied on the textbook showed no significant changes in any of these components. The declarative factor for the experimental group also showed a statistically significant difference, $t(29) = -4.86$, $p < .007$, with a 95% confidence interval ranging from −0.63 to −0.26. The procedural factor for the experimental group was statistically significant, $t(29) = -4.23$, $p < .001$, with a 95% confidence interval ranging from −0.79 to −0.28. The conditional factor showed a statistically significant difference, $t(29) = -3.82$, $p < .001$, with a 95% confidence interval ranging from −0.68 to −0.21. Table 1 details the results of paired sample t-tests.

Table 1. *Paired samples t-test of cognition of knowledge by groups*

	Paired Differences							Significance	
				95% Confidence Interval of the Difference					
Pair	Mean	Std. Deviation	tStd. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Experimental Declarative	-0.44	0.50	0.09	-0.63	-0.26	-4.86	29	<.001	<.001
Control Declarative	-0.13	0.39	0.07	-0.27	0.02	-1.81	29	0.040	0.080
Experimental Procedural	-0.53	0.69	0.13	-0.79	-0.28	-4.23	29	<.001	<.001
Control Procedural	-0.10	0.58	0.11	-0.32	0.11	-0.97	29	0.169	0.338
Experimental Conditional	-0.45	0.64	0.12	-0.69	-0.21	-3.82	29	<.001	<.001
Control Conditional	-0.18	0.51	0.09	-0.37	0.01	-1.92	29	0.032	0.064

Regarding regulation of cognition, students exposed to the intervention exhibited significant

positive gains in four out of five components: planning, comprehension monitoring, information management strategies, and evaluation strategies. The p-values for these components were less than 0.05. Subsequently, there was no significant improvement for both groups in debugging strategies. Other factors were also statistically not significant for control group strategies, as the p value was higher than 0.05, indicating there was no difference for these factors after using the simplified text. Table 2 details the results of paired sample t-tests for the cognition of regulation. The control group showed only two significant changes in planning and comprehension monitoring.

Table 2. *Paired samples t-test of cognition of regulation by groups*

	Paired Differences							Significance	
				95% Confidence Interval of the Difference					
Pair	Mean	Std. Deviation	tStd. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Experimental Planning	-0.53	0.75	0.14	-0.81	-0.25	-3.90	29	<.001	<.001
Control Planning	-0.20	0.46	0.08	-0.37	-0.03	-2.39	29	0.012	0.023
Experimental Comprehension	-0.56	0.75	0.14	-0.84	-0.28	-4.07	29	<.001	<.001
Control Comprehension	-0.20	0.52	0.09	-0.39	-0.004	-2.09	29	0.023	0.045
Experimental Information	-0.40	0.57	0.10	-0.61	-0.19	-3.84	29	<.001	<.001
Control Information	-0.02	0.37	0.07	-0.16	0.11	-0.35	29	0.366	0.732
Experimental Debugging	-.012	0.49	0.09	-0.29	0.07	-1.31	29	0.101	0.201
Control Debugging	0.01	0.55	0.10	-0.20	0.21	0.07	29	0.474	0.948
Experimental Evaluation	-0.52	0.77	0.14	-0.80	-0.24	-3.83	29	<.001	<.001
Control Evaluation	-0.14	0.63	0.11	-0.38	0.09	-1.26	29	0.108	0.217

Students' Metacognitive Awareness During Engagement with Periodical Texts Through an Online Workspace

The students engaged in a series of actions to complete their tasks using the periodical text and online whiteboard. The process, from receiving the text to completing the online editing, showed that students generally began by dividing the tasks among group members. Each member was assigned a specific responsibility, such as answering a particular question or fulfilling a specific role. Throughout the process, students exchanged opinions and shared information derived from the text and the online whiteboard. In many instances, one member took the lead by providing instructions to others or directing the group's focus towards particular aspects of the task. There were also group

that took the initiative to check the overall work after completing their task. All these strategies reinforce what was found earlier in the quantitative findings. During the reading task, several strategies were evident in the think-aloud protocol, including reading slowly and carefully, rereading difficult sections, pausing occasionally to reflect, and directing attention to key information. A few groups also demonstrated the strategy of relating the information presented in the articles to their own experiences. Students also discuss their ideas with others and use secondary sources such as the Internet. Table 3 details the action codes shown by students during TAP.

Table 3. *Action codes for metacognition*

Group	Action Code
1	Dividing the tasks, exchanging opinions, directing focus and brainstorming, studying the picture, directing focus, reading slowly and carefully, questioning oneself or others, and studying the statistic, checking the overall work.
2	Dividing the tasks, exchanging opinions, directing focus, brainstorming, questioning oneself or others, reading aloud, reading slowly and carefully, using the Internet to search for meaning, creating context out of the topic, explaining to others, relating to one's experience, relating to background knowledge, guessing the meaning, and comparing understanding,
3	Dividing the tasks, instructing the others, using the template to guide workflow, setting the time limit, reading slowly and carefully, stop and think, explaining to others, highlighting key points of question, using the Internet to search for meaning, rereading, and relating to one's experience, taking turn to edit, explaining each other's findings, using template, comparing understanding, and checking the overall work.
4	Dividing the tasks, reading aloud, reading slowly and carefully, relating to one's experience, explaining to others, summarizing and checking the overall work
5	Dividing the tasks, brainstorming the question, reading slowly and carefully, relating to one's experience, stop and think, translating meaning to Malay language, rereading and comparing understanding.
6	Brainstorming the question, instructing the others, reading slowly and carefully, stop and think, relating to one's experience, explaining to others, asking lecturer, and comparing understanding.

At the beginning of the task, students distributed the reading responsibilities among group members. Each group adopted a distinct approach to initiate the task. For example, one group used guiding questions to structure their work: one member was focused on identifying similarities between the two texts, while another concentrated on noting the differences. Another group began by taking turns reading the text slowly and carefully, prioritizing thorough understanding rather than immediately answering the question. The excerpts below are drawn from their discussion.

"(dividing the task) We need to follow this question based on the article. We will share the similarities and differences of what we have read. We read first, and then we do the searching." (G2)

"(dividing the task) We must find the author's intention, tone, and style. To make it easy, we divide two points for each of us." (G3)

During the activities, noticeable differences in strategies emerged across groups. Given the complexity and number of tasks involved, students attempted to guide their peers and redirect group focus when necessary. Beyond reading, they were required to interpret the questions, organize the template within the online workspace, and ensure that all required information was completed. Students also engaged in collaborative discussion to develop a shared understanding of the questions and the expected responses. Selected excerpts from the group conversations are presented below.

"What is imposter syndrome... uh no clue. (instructing others) Shall we Google? I think we can read the article first." (G3)

"(brainstorming the question) Expository is the most common style. But it does not include the author's opinion… so descriptive?" (G6)

Each group demonstrated a distinctive approach to constructing reading comprehension with periodical texts. Most students read slowly and carefully, pausing periodically to reflect on and absorb the information presented to them. Students redirected their focus and reread the text during the reading process to resolve confusion and confirm their understanding. The use of typographical cues, such as boldface and italics, to identify key information was particularly evident in texts featuring images and varied layouts. Notably, students in the second group discussed themes they found personally relatable, including feelings of inadequacy, jealousy towards more confident individuals, experiences of being judged, and fear of rejection. This personal connection appeared to support their deeper understanding of the material.

"Look at the huge word (use typographical aids of italics) (redirecting focus) let us continue our work." (continue reading slowly and carefully) (G5)

"Why bother trying if I am going to be rejected? If I reject myself, then others cannot reject me, like lowkey feeling afraid. (stop and think). The fear of rejection and fear of judgment. She judges herself first, because she is afraid of others' judgment." (continue reading slowly and carefully) (G5)

"(relating to background knowledge) (stop and think) Actually, I am so jealous of other people who are confident and love themselves." (G2)

The use of secondary sources, such as online dictionaries and websites, was also evident. Students in the second group used Google Translate to determine the meanings of unfamiliar words and attempted to pronounce them using the audio feature. Summarization strategies were also visible, as students reflected on key information while reading. In addition, students relied on peers and the teacher to confirm their understanding. For example, the sixth group consulted the teacher to clarify whether an article could employ two different writing styles. This interaction suggests that, rather than seeking a direct answer, students actively engaged in evaluating possibilities and validating their interpretations.

"I think we can read the article first. Oh wait, I do not think it explains. I think we can Google it." (searching for meaning on the Internet) (reading aloud the definition) (G3)

(summarizing) "What can you summarize from this… basically this paragraph says it is okay not to be perfect and try to accept perfectionism." (G4)

(asking lecturer) "Miss, is it possible for one article to include both styles?" (G6)

Students further interacted with their peers by explaining their understanding to one another. For instance, a student in the third group articulated her interpretation of the author's idea and related it to the concluding paragraph of the article. Meanwhile, a member of the sixth group shared her perspective on perfectionist behavior. A student reflected on her own experience of Imposter Syndrome, describing how she continued to doubt her abilities and attributed her achievement of obtaining 4.0 CGPA and participating in sports as luck rather than competence. Another student

agreed with the article by connecting its content to her own experience of burnout, drawing links between her personal situation and the evidence presented in the text.

(explaining to others) "In my opinion, the author wants to help people with perfectionist behavior not to become perfectionists because somehow there is a consequence to the individual." (G6)

(relating to one's experience) "Okay, this is an example that I experienced myself. I got

4.0 CGPA recently, but I do not think I deserved it. This is imposter syndrome. (relating to one's experience) I always feel like that. I play sports and win sometimes, but I do not think I am good. I am just lucky." (G2)

(relating to one's experience) So, I agree with this. If you do not want to burn out, do your work early." (G6)

Towards the end of the activities, students engaged in self-regulation by reviewing their overall work. They confirmed their understanding by accentuating key information during group discussions. One group redirected their peers' focus to the final paragraph of the text to verify a shared interpretation. The third group referred to their earlier template when transferring information to the online workspace, ensuring consistency and accuracy. Selected excerpts from the group conversations are presented below.

"Both touch on perfectionism… imposter syndrome also talks about perfectionism. (checking the overall work) The last paragraph… it is about learning to face challenges." (G3)

"(using template) Let us put on the template later. I am drawing a table." (G3)

Throughout the activity, students actively exchanged perspectives on the information presented in both the texts and the online workspace. In many instances, one group member assumed a guiding role by offering instructions and helping to maintain the group's focus. Students also took the initiative to review their overall work upon completing their task. Rather than focusing solely on answering the reading questions, groups were responsible for communicating their ideas and presenting them to others, highlighting the collaborative nature of the activity.

Discussion

Students' autonomy was evident in their ability to sustain discussions with their peers and persist in their efforts to understand the article (Mohseni et al., 2020). The sustained interaction was not merely social but functioned as a catalyst for metacognitive engagement. Through their collaborative exchanges, students demonstrated awareness of their thinking processes by selecting and evaluating effective strategies, such as interpreting evidence, evaluating information, and inferring the authors' viewpoints (Mohseni et al., 2020). Students also employed problem-solving strategies, such as reading carefully and slowly, pausing to reflect and connect the information, and rereading the key information when they encountered difficulties. When encountering unfamiliar vocabulary, students strived to use secondary sources or deduce the meaning from contextual clues (Mokhtari & Reichard, 2002). Students attempted to relate their own experience when reading new information, further indicating active monitoring and regulation of comprehension (Schraw & Dennison, 1994). These behaviors reflect not only individual cognitive effort but also socially mediated metacognitive processes, as learners co-constructed meaning through shared discussion. In this sense, collaboration acted as a platform through which metacognitive awareness was externalized and refined.

The findings from the experimental group reinforce the relationship between collaboration and metacognitive development. Students showed statistically significant changes in using seven out of eight of the strategies, including both knowledge (declarative, knowledge, conditional) and regulation (planning, comprehension monitoring, information management, and evaluation). This

suggests that the integration of periodical texts explored with an online workspace created conditions that supported both awareness and self-regulation. The collaborative nature of the tasks contributes to their metacognitive regulation through shared reasoning (Haataja et al., 2022). This finding resonates with previous research demonstrating that technology-enhanced peer learning can promote students' metacognitive awareness while supporting collaborative interaction (Carvalho & Santos, 2022).

In the technology-mediated learning environment, the online workspace and periodical texts functioned as cognitive and social anchors. The students engaged with the texts by discovering problems, negotiating meanings, and testing various solutions collaboratively, rather than passively receiving information (Al-Hunaiyyan et al., 2017). This process required them to continuously monitor and adjust their understanding, thereby strengthening their metacognitive awareness. The consciousness of their knowledge acquisition, strategy building, and regulation of learning was consistent when enhanced with technology (Al-Hunaiyyan et al., 2017).

In contrast, the control group demonstrated limited development, with significant improvement observed in only two out of eight of the strategies (planning and comprehension monitoring), and no significant changes in metacognitive knowledge. This suggests that the use of simplified texts, when implemented in more traditional and individualized ways, may not sufficiently support the development of deeper metacognitive processes. As noted in previous research, simplified texts often restrict opportunities for engagement beyond surface-level language features and lack of cognitive challenge for more advanced learners (Arfé et al., 2018).

Debugging strategies did not show significant improvement in either group. Since debugging involves revising and adapting strategies during reading, its limited development may indicate students' hesitation to modify their strategies when approaching an unfamiliar context. This is consistent with the findings of Poh et al (2016), in which debugging strategies were the only factor that declined after several weeks of intervention among foundation students. This decline was attributed to students' unfamiliarity with the knowledge presented, particularly when the content involved theoretical concepts (Poh et al., 2016). This highlights the need for more explicit support in fostering adaptive strategy use, which is a critical component of metacognitive regulation.

Reading in this intervention did not occur in isolation but as a collaborative and participatory process. Students engaged in active learning through intrapersonal aspects, such as assigning responsibilities, interacting through the online workspace, and jointly constructing responses (Kabil & Ilyas, 2023; Shwartz-Asher et al., 2022). While comprehension remained an individual cognitive task, the collaborative structure distributed responsibility among group members. This collective engagement transformed reading from a passive activity into an interactive process, allowing students to engage in higher-order cognitive functions (Le & Nguyen, 2024).

Overall, the combination of periodical texts and an online workspace foster a learning environment where collaboration and metacognition are mutually reinforcing. This collaborative engagement fosters greater autonomy, deeper comprehension, and more meaningful learning experiences, while providing opportunities for collaboration, and supporting the development of students' knowledge (Abdelshaheed, 2024; Kabil & Ilyas, 2023). In line with previous research, technology-supported and collaborative reading environment can enhance learners' engagement, self-esteem, and language achievement, while constructivist approaches to reading can promote higher-order thinking and critical engagement with texts (Ibrahim & Basim, 2024; Le & Nguyen, 2024).

Conclusion

The findings contribute to new knowledge by demonstrating that the combined use of periodical texts and an online collaborative workspace not only support comprehension but shapes the students' metacognitive engagement, particularly in the regulation of cognition. Importantly, the study extends existing metacognitive theory by illustrating how regulatory strategies are not solely enacted at the individual level but can also be collectively constructed through interaction and shared control of the reading task. This noteworthy pattern was further evidenced by the strategies observed during the TAP. Students were observed brainstorming, distributing tasks, giving instruction, directing focus, pausing occasionally to reflect, relating ideas to their own experience, checking the overall work, and explaining their findings to one another. The inclusion of an online workspace in reading provided room for students to guide workflow by using the template, setting the time limit, and taking turns to edit. The use of periodical texts and an online collaborative workspace provide students with opportunities to exercise autonomy in selecting, using, and regulating strategies to achieve their reading goals, thereby making their metacognitive awareness more evident.

This study makes a clear contribution to the literature on metacognition in reading by providing empirical evidence that challenges the dominant reliance on simplified texts as the primary means of reading comprehension. The present study highlights the importance of material selection while offering new insights and practical implications for teachers seeking to enhance the quality of students' cognitive engagement. Moving beyond the conventional reliance on text simplification as a scaffold for comprehension, the findings reconceptualize the development of metacognition as a dynamic, socially shaped process mediated by technology. Concurrently, the intervention proposed exposed students to real-world issues, enabling critical thinking and perspective-taking activities, preparing them for degree study where academic reading can be demanding. As this study was focused on metacognition, further research is needed to examine other effects such as willingness, motivation, and anxiety.

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