



Exploring Students' Cognitive Engagement in English Language Classrooms Through Mobile-Assisted Language Learning (MALL)

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ABSTRACT

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This study aimed to explore students' cognitive engagement during the learning of Passive Voice through Educaplay's Froggy Jump feature within a Mobile-Assisted Language Learning (MALL) environment. A qualitative case study design was employed involving five Grade XI students and one English teacher at a senior high school in Cirebon, Indonesia. Data were collected through semi-structured interviews, classroom observations, and document analysis, and analyzed using the interactive model of Miles, Huberman, and Saldaña, including data condensation, data display, and conclusion drawing and verification. The findings revealed four interconnected dimensions of cognitive engagement: deep learning strategies, self-regulation, mental effort and persistence, and strategic problem solving. Students actively analyzed grammatical structures, monitored their understanding, sustained cognitive effort despite learning difficulties, and developed strategies to solve Passive Voice tasks collaboratively. The study concludes that gamified MALL fosters meaningful cognitive engagement when supported by teacher scaffolding and peer interaction. These findings imply that English teachers should integrate gamified mobile learning with reflective and collaborative instructional practices to promote deeper grammar learning and higher-order thinking.

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INTRODUCTION

The rapid expansion of digital technology has fundamentally transformed educational practices, particularly in English language teaching (ELT), where mobile technologies increasingly complement conventional classroom instruction (Dewi et al., 2026; Zhang & Miao, 2025). Rather than relying solely on textbooks and teacher-centered explanations, English learning has evolved into an interactive process supported by mobile applications, online platforms, and gamified learning environments that allow students to learn anytime and anywhere (Annamalai et al., 2025; Poolamannil, 2025; Sharma, 2024). This transformation is important because English proficiency has become an essential competence for academic achievement, global communication, and workforce readiness in the twenty-first century (Z. Yu et al., 2022; Yuan et al., 2025).

Consequently, educational institutions are expected not only to integrate technology into classroom instruction but also to ensure that technology promotes meaningful learning rather than superficial participation. Research indicates that technology-supported learning environments can foster higher-order thinking, learner autonomy, and active participation when students are cognitively involved throughout the learning process (Amir & Rustam, 2025; Elaish et al., 2022; Shi et al., 2024). Therefore, understanding how digital technologies facilitate students' cognitive engagement has become an important concern for both educators and educational researchers.

Despite the widespread integration of digital technology in English language classrooms, many students continue to experience difficulties in achieving meaningful learning because technology alone does not automatically encourage active cognitive participation (Jeong, 2022; Mohammed, 2025; Sharma, 2024). In many educational settings, mobile devices are frequently used as tools for accessing instructional materials or completing assignments without stimulating students to analyze, evaluate, or reflect on what they learn. This issue is particularly evident in grammar instruction, where learning activities often emphasize memorization of grammatical rules instead of conceptual understanding and authentic language use (Bouzar & Idrissi, 2025; Fadhilawati et al., 2022; Zhang & Miao, 2025). As a result, students may successfully complete classroom exercises while demonstrating only limited comprehension of grammatical concepts. Passive Voice represents one of the grammar topics that requires substantial cognitive processing because learners must identify sentence structures, understand grammatical transformations, and reconstruct ideas accurately in different communicative contexts (Elaish et al., 2022; J. Li & Cui, 2025). These challenges indicate that improving English learning requires instructional approaches capable of promoting deeper cognitive engagement rather than merely increasing students' exposure to digital learning resources.

This situation is increasingly evident in Indonesian senior high school classrooms, where teachers have begun integrating Mobile-Assisted Language Learning (MALL) into English instruction to create more interactive learning experiences (Hamed & Arabpour, 2025; Mislawiyadi & Bari, 2025). Various digital platforms, including Educaplay, are employed to provide quizzes, games, and collaborative activities intended to increase students' participation during classroom learning (S. Li & Lajoie, 2021a; Maharani et al., 2024). Among its gamified features, Froggy Jump combines instructional content with competitive gameplay, encouraging students to answer grammar questions accurately while progressing through successive levels (Liu & Zhou, 2026; Vargas-Saritama & Espinoza Celi, 2024). Although students generally demonstrate enthusiasm and active participation when using this application, classroom engagement is not always accompanied by meaningful cognitive processing (Lai et al., 2022; Sutrisna, 2025). Some learners remain focused primarily on completing the game quickly or obtaining high scores rather than understanding grammatical concepts and reflecting on their learning strategies. Consequently, observable behavioral engagement may not necessarily represent genuine cognitive

engagement. This phenomenon suggests the need to investigate how students actually think, regulate their learning, and solve grammatical problems while participating in gamified MALL activities (Alda, 2023; Saputri, 2025).

Previous studies have consistently reported the positive educational impacts of Mobile-Assisted Language Learning (MALL) on English language learning (Paulus, 2025). Numerous studies have demonstrated that mobile technologies improve students' grammar achievement, vocabulary acquisition, language proficiency, learning motivation, and classroom engagement by providing flexible and interactive learning opportunities (Cuenca & Pila, 2025; S. Li & Lajoie, 2021b). Likewise, Educaplay has been recognized as an effective gamified learning platform capable of creating enjoyable learning environments and encouraging greater student participation through game-based activities. Nevertheless, these studies predominantly evaluate instructional effectiveness using learning outcomes, academic achievement, or motivational indicators, while providing relatively limited explanation of the cognitive processes that occur during learning (Chen & Zhao, 2022; Paulus, 2025). Consequently, although previous research confirms that MALL supports English language learning, considerably less is known about how students employ deep learning strategies, regulate their own learning, invest mental effort, and develop strategic problem-solving skills while interacting with gamified mobile learning applications.

Although previous studies have established the pedagogical benefits of MALL, several important gaps remain unresolved. First, relatively few studies have examined cognitive engagement as a multidimensional construct encompassing deep learning strategies, self-regulated learning, mental effort and persistence, and strategic problem solving, as proposed by Chen and Zhao (2022). Instead, cognitive engagement is often represented indirectly through achievement scores or students' perceptions of motivation (Chen & Zhao, 2022; Pan et al., 2026). Second, while Educaplay has been widely implemented in English language learning, empirical investigations have primarily evaluated its effectiveness in improving vocabulary, grammar performance, or classroom participation rather than examining the cognitive processes occurring during gameplay (Hamedi & Arabpour, 2025). Furthermore, the specific use of Educaplay's Froggy Jump feature for teaching Passive Voice has received little scholarly attention, particularly in Indonesian senior high school contexts. Addressing these gaps is important because understanding learners' cognitive engagement provides deeper insights into how gamified MALL facilitates meaningful learning beyond observable academic performance or behavioral participation.

Building upon these limitations, the present study offers both theoretical and practical contributions by positioning cognitive engagement as the central focus of investigating Mobile-Assisted Language Learning in English grammar instruction. Guided by the integrative framework of Elaish et al., (2022), this study conceptualizes cognitive engagement as a multidimensional process involving students' use of deep learning strategies, regulation of their own

learning, persistence in overcoming learning difficulties, and strategic problem-solving during grammar activities (Elaish et al., 2022; J. Li & Cui, 2025). Rather than merely examining whether Educaplay improves learning outcomes, this research seeks to explain how students cognitively interact with the Froggy Jump feature while learning Passive Voice in an authentic classroom setting. Such an approach extends the current body of MALL research by integrating gamified learning with a comprehensive cognitive engagement framework, thereby providing richer evidence regarding the mechanisms through which mobile technology supports meaningful English language learning in secondary education.

Therefore, this study investigates students' cognitive engagement during the implementation of Educaplay's Froggy Jump feature in learning Passive Voice in a senior high school English classroom. It is argued that gamified MALL environments have the potential to foster meaningful cognitive engagement when students actively construct understanding, regulate their learning, invest sustained mental effort, and employ appropriate strategies to solve grammatical problems. Nevertheless, the extent to which these cognitive processes emerge during classroom implementation remains insufficiently understood. Accordingly, this study addresses the following research questions: (1) How does the use of MALL, specifically Educaplay's Froggy Jump feature, influence students' cognitive engagement in learning Passive Voice? (2) What challenges do students encounter while using Educaplay's Froggy Jump feature, and how do these challenges affect their cognitive engagement during English grammar learning? Answering these questions is expected to contribute to the development of more cognitively engaging MALL-based instructional practices and provide empirical evidence for integrating gamification into English language teaching.

RESEARCH METHODS

This study employed a qualitative case study design to explore how students' cognitive engagement emerged during the implementation of Educaplay's Froggy Jump feature in English grammar instruction. A qualitative approach was selected because the purpose of this study was not to measure cognitive engagement as a quantifiable variable but to obtain an in-depth understanding of students' cognitive processes, learning experiences, and interactions within an authentic classroom setting. The case study design was considered appropriate because it facilitates intensive investigation of a bounded phenomenon situated within its real-life context, particularly when the boundaries between the phenomenon and its context are not clearly distinguishable.

The case was bounded by a single English grammar lesson on Passive Voice, implemented through Educaplay's Froggy Jump feature in one senior high school classroom. Five students collaboratively completed the learning activity using a single mobile device, allowing the researcher to examine not only individual cognitive engagement but also collaborative decision-making,

strategic negotiation, and shared problem-solving during gamified Mobile-Assisted Language Learning (MALL). This bounded case enabled a rich contextual understanding of cognitive engagement as it naturally occurred during classroom instruction.

This study was conducted at a senior high school in Cirebon, West Java, Indonesia, during the second semester of the 2025/2026 academic year. The school was purposively selected because it had integrated mobile technology into English language instruction, providing an appropriate setting for investigating Mobile-Assisted Language Learning (MALL). Furthermore, the English teacher had previously incorporated digital learning platforms into classroom activities, ensuring that students were familiar with technology-supported instruction while still experiencing the Froggy Jump activity as a structured classroom intervention. Participants consisted of five Grade XI students and one English teacher. Student participants were selected through purposive sampling based on three criteria: (1) active enrollment in the selected English class, (2) participation in all Froggy Jump learning activities, and (3) willingness to participate in interviews. The English teacher served as a supporting informant by providing professional observations regarding students' learning behaviors and cognitive engagement throughout the instructional process.

Data were collected in June 2026 using three complementary techniques to obtain comprehensive evidence of students' cognitive engagement during the implementation of Educaplay's Froggy Jump feature in learning Passive Voice. The researcher, who also acted as the classroom instructor, observed the learning process while maintaining the natural classroom environment. First, semi-structured interviews were conducted individually with five students and one English teacher after the learning session to explore students' learning experiences, cognitive strategies, perceived challenges, and reflections on using Froggy Jump. The teacher interview focused on observed patterns of students' engagement and instructional responses. Second, classroom observations documented students' interactions, collaborative behaviors, and learning processes using an observation guide developed from the four dimensions of cognitive engagement proposed by Li et al., (2024) (X. Li et al., 2024). Third, document analysis examined screenshots generated from Educaplay, including question displays, answer feedback, completion screens, score summaries, and review pages to complement the interview and observation findings.

The collected data were analyzed using the interactive model of Miles, Huberman, and Saldaña (2014), consisting of data condensation, data display, and conclusion drawing/verification (Laia et al., 2025). During the data condensation stage, interview transcripts, classroom observation notes, and document analysis results were selected, simplified, organized, and coded according to the four dimensions of cognitive engagement: deep learning strategies, self-regulated learning, mental effort and persistence, and strategic problem solving. The condensed data were subsequently organized into thematic matrices and narrative displays to facilitate comparison across participants and data sources while identifying recurring patterns and relationships. In the final

stage, conclusions were drawn and continuously verified through cross-checking evidence from interviews, observations, and documents. This iterative analytical process ensured that the findings accurately represented students' cognitive engagement during the implementation of Educaplay's Froggy Jump feature in English grammar learning.

RESULTS AND DISCUSSION

Results

This section presents and analyzes the findings on students' cognitive engagement during Passive Voice learning through Educaplay's *Froggy Jump*, drawing on classroom observations, interviews, and triangulated interpretations across four cognitive engagement dimensions.

Deep Learning Strategies

Deep learning strategies refer to students' ability to develop meaningful understanding by connecting new knowledge with prior learning, analyzing concepts critically, and applying them in authentic contexts. In this study, students demonstrated these strategies by identifying Passive Voice patterns, particularly the use of *to be* and Verb 3, relating the concept to previous grammatical knowledge, and explaining the reasoning behind their answers during the Froggy Jump activity. As one student stated, *"I looked for to be and Verb 3 first because Passive Voice always uses those patterns."* Similarly, the English teacher observed that students analyzed sentence structures collaboratively rather than guessing and frequently connected grammar examples with everyday situations. These findings indicate that students actively constructed conceptual understanding through grammatical analysis, knowledge integration, and contextual application, reflecting meaningful cognitive engagement rather than surface memorization.

Table 1. Initial Coding: Deep Learning Strategies

Data Source	Representative Quotation	Initial Code	Category
S1	"Passive Voice uses <i>to be</i> and Verb 3... that made it easier to distinguish."	Identifying grammar pattern	Understanding grammar concept
S2	"I looked for <i>to be</i> and Verb 3."	Using grammatical clues	Conceptual understanding
S3	"I don't think I've learned Passive Voice before."	New learning experience	Prior knowledge activation
S2	"I remembered active and passive sentences in Indonesian class."	Connecting previous learning	Linking prior knowledge
T1	"Students tried to identify <i>to be</i> and Verb 3 instead of simply guessing the answers."	Applying grammar rules	Conceptual understanding
T1	"Some students related the examples to their daily activities."	Relating learning to experience	Applying knowledge in context

Table 1 explains the initial coding process derived from interview and observation data related to students' conceptual understanding of the Passive Voice. The table shows how representative quotations from students and the teacher were transformed into initial codes and subsequently grouped into broader analytical categories. The findings indicate that students developed conceptual understanding by identifying the grammatical pattern of *to be* followed by Verb 3, using these linguistic features as cues to recognize passive constructions rather than relying on guessing. The data also reveal the activation of prior knowledge, as students either connected the new concept with previously learned active and passive sentence structures or encountered Passive Voice as a new learning experience. Classroom observations further support these findings by demonstrating that students systematically applied grammar rules and related learning materials to their everyday experiences, reflecting meaningful contextual understanding.



Figure 1. Questions in Froggy Jump

Figure 1 demonstrates how Froggy Jump promotes deep learning by requiring students to identify passive voice sentences through analysis of the grammatical pattern (*to be* + Verb 3) rather than guessing. Immediate feedback encourages students to evaluate and refine their understanding throughout the game. Triangulated evidence from interviews, classroom observations, and document analysis indicates that students actively connected new grammatical concepts with prior knowledge and applied them in meaningful contexts. These findings align with previous studies showing that gamified learning enhances analytical and experiential learning. However, because Passive Voice was a new topic for several students, teacher guidance remained essential to support conceptual understanding and facilitate knowledge transfer.

Self-Regulation

Self-regulation refers to students' ability to monitor, control, and evaluate their own learning processes while completing instructional tasks. In this study, it was identified through students' efforts to reread questions, evaluate alternative answers, monitor their understanding, discuss uncertainties with peers, and seek teacher assistance only after attempting to solve problems independently. Interview findings showed that students consciously reflected on their mistakes before selecting another answer. One student explained that after receiving incorrect feedback, they reread the question to identify the source of

the error rather than relying on trial and error. These behaviors indicate active monitoring, reflection, and strategic adjustment during gamified learning.

Teacher interview findings further confirmed the development of students' self-regulation throughout the implementation of Froggy Jump. According to the teacher, most students initially attempted to solve problems independently, discussed their reasoning with classmates, and requested teacher assistance only after exhausting their own strategies. The teacher provided guidance through questioning instead of directly giving the correct answer, allowing students to maintain responsibility for their learning. The researcher interprets these interactions as evidence that self-regulation was strengthened through immediate feedback, collaborative discussion, and instructional scaffolding, enabling students to become more autonomous, reflective, and confident in monitoring and improving their grammatical understanding.

Table 2. Initial Coding: Self-Regulation

Data Sources	Representative Quotation	Initial Code	Category
S1–S5	"We re-read the question."	Re-reading question	the Monitoring comprehension
S2	"I read the question again before choosing the answer."	Reviewing answers	Self-monitoring
T1	"Most students tried to correct their answers by themselves first."	Independent correction	Self-monitoring
T1	"If they were still unsure, they asked me for clarification."	Seeking support	teacher Help-seeking

Table 2 explains that students demonstrated self-regulation through continuous monitoring and evaluation of their own learning while completing the Froggy Jump activities. The data show that students frequently re-read questions before selecting answers, indicating efforts to monitor comprehension and review their thinking rather than responding impulsively. Teacher observations further confirm that most students first attempted to correct their own mistakes independently before seeking assistance. When they remained uncertain, they asked the teacher for clarification, reflecting appropriate help-seeking behavior after personal effort.



Figure 2. Correct responses



Figure 3. Incorrect responses

Figures 2 and 3 illustrate how Froggy Jump promotes conceptual understanding and self-regulation through immediate feedback. When students select the correct passive voice sentence, the frog jumps forward and points are awarded, reinforcing accurate identification of the *to be* + Verb 3 pattern and encouraging strategic grammatical analysis. Conversely, selecting an incorrect answer causes the frog to move to the chosen option while one life is deducted, prompting students to reflect on their mistakes, reanalyze sentence structures, and revise their answers. Triangulated evidence from interviews, classroom observations, and document analysis indicates that students developed self-monitoring by rereading questions, comparing grammatical patterns, discussing uncertainties with peers, and seeking teacher assistance only after independent attempts. Although these behaviors demonstrate emerging self-regulation, many students still relied on teacher confirmation when encountering unfamiliar passive voice structures, suggesting that autonomous regulation was developing but not yet fully established.

Investment in Learning (Mental Effort and Persistence)

Investment in learning refers to students' willingness to devote cognitive effort and maintain persistence while completing learning tasks despite difficulties. In this study, it was reflected in students' careful reading of grammar questions, sustained attention during the Froggy Jump activity, repeated evaluation of answer choices, and continued engagement with unfamiliar Passive Voice structures. Student interviews revealed that participants deliberately analyzed each question before responding, often rereading the sentences when uncertain to ensure grammatical accuracy. Rather than prioritizing speed, students focused on understanding sentence structures and making informed decisions. These behaviors indicate meaningful cognitive investment and thoughtful engagement throughout the gamified learning process.

Teacher interview findings further demonstrated that students maintained persistence even when Passive Voice was introduced as a new grammatical topic. According to the teacher, learners remained enthusiastic, continued discussing alternative answers, reconsidered grammatical structures, and completed every task despite encountering difficulties. Instead of abandoning challenging questions, they sustained their effort until the activity was finished. The researcher interprets these findings as evidence that the motivational features of Froggy Jump, particularly immediate feedback and visible learning progress, encouraged students to invest cognitive resources and persevere throughout the lesson, fostering greater engagement and resilience during the learning process.

Table 3. Initial Coding: Investment in Learning

Data Sources	Representative Quotation	Initial Code	Category
S3	"I read the question first."	Reading carefully	Mental effort

S1-S5	"We looked for the answer that made the most sense."	Careful thinking	Mental Effort
S2	"We kept trying until we finished."	Completing the activity	Persistence
T1	"Students read the questions carefully before answering."	Careful reading	Mental effort
T1	"They kept trying even though Passive Voice was a new topic."	Continuing despite difficulty	Persistence

Table 3 explains that students demonstrated strong investment in learning through sustained mental effort and persistence while completing the Froggy Jump activity. The coding results show that students carefully read each question, analyzed alternative answers, and selected responses they considered most grammatically appropriate, reflecting deliberate cognitive engagement rather than impulsive guessing. In addition, both student and teacher data indicate that learners persisted in completing all tasks despite finding Passive Voice to be a new and challenging topic. Teacher observations confirmed that students remained focused, continued attempting difficult questions, and did not give up. Overall, the findings indicate that investment in learning was characterized by meaningful mental effort and sustained persistence throughout the activity.



Figure 4. Activity completion and final score

Figure 4 illustrates the final score displayed after students completed all Froggy Jump questions. The score provided immediate feedback by showing the number of correct answers, enabling students to evaluate their understanding of the Passive Voice concept and reflect on their grammatical mastery. This feature also helped students identify areas requiring further improvement while encouraging self-assessment and continuous learning. Furthermore, the final score functioned as a motivational element, inspiring students to monitor their progress, improve future performance, and remain actively engaged throughout the gamified learning process.

Task-Seeking and Strategic Problem Solving

Task-seeking and strategic problem solving refer to students' ability to apply appropriate cognitive strategies when overcoming learning difficulties. In this study, these behaviors were reflected in comparing answer alternatives, revisiting previous questions, identifying grammatical clues, and developing individual strategies instead of relying on trial and error. Student interviews showed that learners intentionally answered easier questions first and then compared them with more difficult items to recognize recurring Passive Voice patterns before making final decisions. This approach demonstrates strategic planning, analytical reasoning, and reflective decision-making, indicating that students actively regulated their thinking while completing the Froggy Jump activity and strengthened their cognitive engagement with grammatical concepts.

Teacher interview findings further revealed that students gradually expanded their problem-solving strategies beyond the immediate game tasks. When learners experienced difficulty, the teacher encouraged them to identify the subject, object, and verb before transforming sentences into Passive Voice rather than providing direct answers. As students gained confidence, several created their own examples and requested additional Passive Voice exercises after completing the activity. The researcher interprets these findings as evidence that Froggy Jump stimulated independent inquiry and strategic thinking, encouraging students to extend their learning beyond classroom requirements while developing greater autonomy, curiosity, and higher-order cognitive engagement in grammar learning.

Table 4. Initial Coding: Task-Seeking / Strategic Problem Solving

Data Sources	Representative Quotation	Initial Code	Category
S2	"I checked each answer choice carefully."	Comparing answer choices	Strategy use
S3	"I answered the other questions first, then compared them."	Comparing questions	Problem-solving strategy
S3	"I re-read the question because I misunderstood it."	Reviewing understanding	Strategic revision
S1-S5	"We wanted to learn more because it was fun."	Curiosity	Learning initiative
T1	"Students identified the subject, object, and verb before answering."	Analyzing sentence structure	Strategic analysis
T1	"Some students asked for additional examples after the activity."	Exploring further learning	Learning initiative

Table 4 explains that students demonstrated task-seeking and strategic problem-solving by applying deliberate learning strategies rather than relying on guesswork during the Froggy Jump activity. The findings show that students

carefully compared answer choices, revisited previous questions, and reread misunderstood items to improve their responses, reflecting strategic revision and analytical thinking. Teacher observations further indicate that students systematically analyzed sentence components, including the subject, object, and verb, before answering. Additionally, several students expressed curiosity by requesting further examples after the activity, demonstrating learning initiative and a willingness to extend their understanding beyond the assigned tasks.



Figure 5. Question review interface

Figure 5 illustrates how students identified the correct passive voice sentence by analyzing grammatical elements, including to be, Verb 3, and subject-verb agreement. Instead of guessing, they carefully compared alternative sentence structures and evaluated grammatical accuracy before making their selections. This process encouraged students to apply analytical reasoning, strategic problem-solving, and conceptual understanding, demonstrating the characteristics of deep learning while strengthening their ability to recognize and apply Passive Voice structures accurately.

Discussion

The findings demonstrate that Educaplay's Froggy Jump effectively promoted students' cognitive engagement by facilitating deep learning strategies, self-regulation, investment in learning, and strategic problem solving during Passive Voice instruction (Ahmad et al., 2026; Zolfaghari et al., 2025). Students did not merely memorize grammatical rules but actively analyzed sentence structures by identifying the to be + Verb 3 pattern, connecting new knowledge with previous learning experiences, and applying conceptual reasoning before selecting answers (Setyawan, 2026). These findings are consistent with Li and Lajoie's (2022) framework, which argues that deep cognitive engagement occurs when learners actively construct meaning through elaboration, knowledge integration, and reflective thinking rather than surface memorization (X. Li et al., 2022; Mehdi, 2026). Similarly, Ishaq et al. (2021) reported that gamified Mobile-Assisted Language Learning (MALL) environments promote analytical reasoning and experiential learning through interactive activities (Laksanasut, 2025). However, unlike previous studies that primarily emphasized improvements in learning achievement and motivation, the present study reveals the cognitive mechanisms underlying students'

engagement, showing how gamified learning supports meaningful grammar processing through collaborative analysis and immediate feedback.

Another important finding concerns the development of students' self-regulation during the Froggy Jump activity. Students consistently monitored their own understanding by rereading questions, comparing grammatical patterns, discussing uncertainties with peers, and seeking teacher assistance only after making independent attempts (X. Li et al., 2022; B. Yu, 2023). These findings support Li and Lajoie's (2022) proposition that self-regulated learners continuously monitor, evaluate, and modify their cognitive strategies while completing learning tasks (Detken Landázuri et al., 2025; Handikaningtyas et al., 2025). Likewise, Yundayani et al. (2021) argued that technology-enhanced language learning promotes learner autonomy through reflective interaction and social scaffolding. Nevertheless, this study also identifies an important distinction from previous research. Although students demonstrated emerging self-regulatory behaviors, many still relied on teacher confirmation when encountering unfamiliar Passive Voice structures (H. Wu & Wang, 2026; X.-Y. Wu, 2024). This finding suggests that gamified MALL environments alone may not fully develop autonomous regulation unless accompanied by instructional scaffolding that gradually transfers cognitive responsibility from teachers to learners.

The findings further indicate that Froggy Jump sustained students' investment in learning by encouraging continuous mental effort and persistence throughout the learning activity. Students remained attentive, carefully evaluated grammatical alternatives, revisited confusing questions, and completed every task despite encountering unfamiliar grammatical structures (Ge et al., 2025; Xu & Richardson, 2024). Moreover, students independently developed problem-solving strategies by comparing answer choices, revisiting previous questions, analyzing sentence components, and extending learning beyond classroom requirements through requests for additional exercises. These findings reinforce previous studies by Akkara et al. (2022) and Viberg et al. (2023), which concluded that gamified learning environments maintain learners' motivation by balancing challenge and competence while encouraging active participation (Dahalan et al., 2023; Kumar et al., 2023). However, this study extends existing literature by demonstrating that persistence and strategic problem solving are not merely behavioral outcomes but represent indicators of sustained cognitive engagement. Thus, gamification should be understood as a catalyst for deeper cognitive processing rather than simply an instrument for increasing students' motivation or enjoyment.

The present study contributes both theoretically and practically to the literature on Mobile-Assisted Language Learning (MALL). Theoretically, it extends Li and Lajoie's (2022) multidimensional framework by providing empirical evidence that deep learning strategies, self-regulation, mental effort and persistence, and strategic problem solving interact dynamically within a gamified English grammar classroom (Arianto et al., 2025; Lan & Zhou, 2025). The findings also demonstrate that cognitive engagement develops through

continuous interactions among learners, teachers, instructional tasks, and digital learning environments rather than through technology alone. Practically, the study provides evidence that Educaplay's Froggy Jump can serve as an effective instructional medium for promoting meaningful grammar learning when integrated with appropriate teacher scaffolding, collaborative discussion, and reflective feedback. These findings offer practical guidance for English teachers seeking to design cognitively engaging MALL-based instruction while contributing new qualitative evidence regarding the mechanisms through which gamified mobile learning facilitates deeper cognitive engagement in secondary English education.

CONCLUSION

This study concludes that the implementation of Educaplay's Froggy Jump within Mobile-Assisted Language Learning (MALL) effectively fostered students' cognitive engagement by promoting deep learning strategies, self-regulation, mental effort and persistence, and strategic problem solving during Passive Voice instruction. The most important lesson from this study is that meaningful cognitive engagement emerges not merely from the use of digital technology, but from the interaction between gamified learning activities, teacher scaffolding, collaborative learning, and students' active construction of knowledge. The study contributes to the field of English language education by providing qualitative evidence that extends Li and Lajoie's multidimensional cognitive engagement framework into a gamified MALL context, thereby enriching current understanding of how cognitive engagement develops during grammar learning. Nevertheless, this study is limited to a single case involving five students in one senior high school and one grammatical topic. Future studies should involve larger and more diverse participants, different English language skills, and mixed-methods or longitudinal designs to examine the long-term development of cognitive engagement across various MALL environments.

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