



Integration of Assemblr Edu-Based Augmented Reality in Supporting Students' 4Cs Competencies in English Language Teaching SMP Negeri 1 Gido

Maria Putri Cantika Hia¹, Yaredi Waruwu², Yasminar Amaerita Telaumbanua³, Kristof Martin Efori Telaumbanua⁴

^{1,2,3,4} Universitas Nias, Indonesia

Corresponding Author : ✉ mariaputricantikahia@gmail.com

ABSTRACT

The integration of digital technology in education has encouraged the use of innovative learning media to enhance students' twenty-first-century competencies. This study aimed to analyze the integration of Assemblr Edu-based Augmented Reality (AR) in English language teaching, its contribution to students' 4Cs competencies, and the challenges encountered during its implementation in Grade VIII-A at SMP Negeri 1 Gido. This study employed a descriptive qualitative design involving one English teacher and 32 students. Data were collected through classroom observations, field notes, interviews, and documentation and analyzed using thematic analysis. The findings revealed that Assemblr Edu-based AR was integrated through preparation, learning interaction, and evaluation stages. Students observed AR scenes, discussed environmental problems, responded to questions, completed collaborative tasks, and presented their ideas. The use of AR supported the development of critical thinking, creativity, collaboration, and communication by enabling students to analyze contextual environmental issues, generate and express ideas, work collaboratively to solve tasks, and communicate their responses through discussions and presentations. However, several challenges were identified, including unstable internet connectivity, difficulties in scanning AR markers, limited familiarity with AR applications, and students' limited confidence in using English. In conclusion, Assemblr Edu-based AR can support interactive, contextual, and student-centered English learning while facilitating the development of students' 4Cs competencies. Its effective implementation, however, requires appropriate pedagogical planning, technical preparation, and teacher guidance. The findings imply that AR can be integrated strategically into English instruction to create meaningful learning experiences and strengthen students' twenty-first-century skills.

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INTRODUCTION

The rapid development of Information and Communication Technology (ICT) in the twenty-first century has transformed educational practices by

changing how information is accessed, knowledge is constructed, and learning is delivered. Digital technology provides opportunities for teachers to create more flexible, interactive, and student-centered learning environments. In this context, education is increasingly expected to prepare students not only to acquire academic knowledge but also to develop competencies needed to respond to complex global challenges (Anisyah & Al., 2024). One of the central demands of twenty-first-century education is the development of the 4Cs competencies, namely critical thinking, creativity, collaboration, and communication. These competencies enable students to analyze information, generate ideas, work effectively with others, solve problems, and communicate ideas in different contexts (Oktadela & al., 2023).

English Language Teaching (ELT) is particularly relevant to the development of these competencies because English functions as an international language for communication and access to global information. Therefore, English learning should not be limited to grammatical knowledge and vocabulary memorization but should also provide opportunities for students to think critically, create ideas, collaborate with peers, and communicate meaningfully (Purnama & al., 2024). However, conventional classroom practices may restrict these opportunities when learning remains predominantly teacher-centered and relies heavily on memorization. Such practices can result in limited student participation, interaction, and opportunities to develop higher-order thinking and communication skills (Emilia et al., 2025).

This condition indicates the need for learning approaches that integrate language development with interactive and contextual learning experiences. One technology that has attracted increasing attention in education is Augmented Reality (AR). AR enables digital objects or information to be integrated into the real-world environment, allowing learners to interact with learning materials through visual and interactive representations. In education, AR can make abstract concepts more concrete, stimulate students' curiosity, and provide opportunities for active engagement. Assemblr Edu is one AR-based learning platform that provides three-dimensional objects, interactive scenes, and contextual learning experiences. These features allow teachers to present learning materials in forms that can be explored and observed by students rather than relying solely on conventional two-dimensional materials (Hadi, 2025).

The theoretical relevance of AR to English learning can be seen particularly in vocabulary and contextual language learning. Abstract words, objects, and situations may be difficult for students to understand when presented only through verbal explanations or written materials. Three-dimensional AR representations can provide visual and contextual support, enabling students to

associate language with concrete objects and situations. In addition, interactive AR activities can encourage students to observe, interpret, discuss, and respond to learning materials. Such activities are consistent with the principles of student-centered learning because students are positioned as active participants rather than passive recipients of information.

AR-based learning is also theoretically relevant to the development of the 4Cs. Critical thinking can be encouraged when students analyze information, identify problems, and formulate responses based on AR-supported learning situations. Creativity can emerge when students explore digital objects and generate or present their own ideas. Collaboration can be developed through group activities in which students exchange ideas and complete learning tasks together. Communication can be practiced when students discuss, explain, and present their responses to teachers and peers. Previous research has reported that AR can contribute to student engagement, learning achievement, vocabulary development, motivation, critical thinking, and digital literacy (Anisyah & Al., 2024; Emilia et al., 2025; Oktadela & al., 2023; Joe & Aziz, 2025).

Research specifically concerning Assemblr Edu has also reported positive educational outcomes. Al-Zahra and Handayani (2025) found that Assemblr Edu integrated into problem-based learning supported students' creativity and engagement through interactive learning experiences. Sudarno et al. (2025) reported that Assemblr Edu enhanced students' conceptual understanding and motivation, particularly when abstract concepts were presented through interactive visual representations. Similarly, Rahmawati and Utami (2026) found improvements in learning outcomes through the use of Assemblr Edu to provide concrete and interactive representations of learning materials. Other studies have also associated Assemblr Edu with the development of critical thinking and analytical abilities (Lestari et al., 2023; Marsila et al., 2026). These findings demonstrate the potential of Assemblr Edu as a learning medium; however, much of the existing research emphasizes learning outcomes, motivation, or individual cognitive skills rather than examining how Assemblr Edu is implemented in English classrooms to support the four dimensions of the 4Cs simultaneously.

This issue is particularly evident at SMP Negeri 1 Gido. Based on preliminary observations conducted on November 18, 2025, English language teaching in Grade VIII-A was predominantly conducted through conventional instructional practices. Classroom activities provided limited opportunities for students to interact with digital learning media, participate actively, and express their ideas in English. Students also demonstrated limited confidence in communicating their ideas and difficulties in understanding some abstract

language concepts. These conditions suggest that students need learning experiences that provide greater visual support, contextualization, interaction, and opportunities for active participation. At the same time, the implementation of technology may present practical challenges, particularly in relation to internet connectivity, students' familiarity with digital applications, and teachers' ability to integrate technology with pedagogical objectives.

Accordingly, this study aims to analyze the integration of Assemblr Edu-based Augmented Reality in English language teaching at SMP Negeri 1 Gido, with particular attention to how the technology supports students' critical thinking, creativity, collaboration, and communication. The study also examines the challenges encountered during its classroom implementation. By focusing on the actual learning process rather than only on learning outcomes, this study is expected to contribute empirical evidence regarding the pedagogical use of AR in English language teaching and provide practical insights for teachers seeking to integrate digital technology with the development of students' 4Cs competencies.

RESEARCH METHOD

Research Design

This study employed a descriptive qualitative approach to obtain an in-depth understanding of technology integration in teaching and its contribution to students' competency development. According to Creswell and Creswell (2023), qualitative research is used to explore and understand the meanings individuals or groups ascribe to social or human problems. Similarly, Sugiyono (2021) explains that qualitative research examines phenomena in their natural settings, with the researcher serving as the key instrument. Therefore, this approach was considered appropriate because the study focused on teachers' and students' experiences, perceptions, classroom interactions, and practices related to the use of technology in teaching.

Research Setting, Object, and Participants

The research was conducted at SMP Negeri 1 Gido in Gido during [research period]. The object of the study was the integration of technology in teaching, particularly the use of digital tools in classroom activities and its contribution to students' competency development. The participants consisted of 1 teachers and 32 students who were directly involved in technology-supported learning activities. Participants were selected through purposive sampling because they were considered relevant sources of information for the research objectives. According to Creswell and Creswell (2023), purposeful selection allows

researchers to select participants who can provide rich and relevant information about the phenomenon being investigated.

Data Sources and Data Collection

The study used both primary and secondary data. Primary data were obtained through semi-structured interviews and classroom observations, while secondary data were collected from relevant documents such as lesson plans, teaching materials, students' assignments, and other learning documents. Interviews were conducted to explore participants' experiences and perceptions regarding technology use, while observations were used to examine how technology was implemented during actual classroom activities. Documentation was used to complement and verify the information obtained from interviews and observations. According to Miles, Huberman, and Saldaña (2020), the use of multiple sources of qualitative data supports a more comprehensive understanding of the phenomenon.

The research process consisted of preparation, data collection, data analysis, and verification. During data collection, the researcher conducted interviews, observed classroom activities, recorded field notes, and collected relevant documents. The researcher acted as the main instrument in collecting and interpreting the data, consistent with the characteristics of qualitative research described by Sugiyono (2021).

Data Analysis

The collected data were analyzed interactively following Miles, Huberman, and Saldaña (2020), through three main processes: data condensation, data display, and conclusion drawing and verification. First, interview transcripts, observation notes, and documents were organized and condensed by selecting and coding information relevant to technology integration and students' competency development. Second, the condensed data were displayed through thematic categories and descriptive narratives to identify patterns and relationships. Finally, conclusions were drawn and continuously verified by comparing information from interviews, observations, and documents.

RESULT AND DISCUSSION

Research Results

Presentation of Findings based on Theme

The findings were developed through classroom observations, field notes, teacher interviews, and interviews with 32 students and analyzed through thematic coding in NVivo 12. The selective coding process generated three major themes: Integration of Assemblr Edu in English Language Teaching, Students' 4Cs Competencies Supported by Assemblr Edu, and Challenges in the

Implementation of Assemblr Edu. The results are presented according to these original themes.

Integration of Assemblr Edu in English Language Teaching

The findings showed that Assemblr Edu-based AR was integrated into English language teaching through preparation, interaction, and evaluation during two classroom meetings in Grade VIII-A of SMP Negeri 1 Gido. Before the lesson, the teacher prepared printed AR markers, worksheets, smartphones, internet access, learning objectives, and group arrangements. The teacher introduced the topic “No Littering,” explained the learning objectives related to environmental pollution and English expressions, distributed the AR markers, and demonstrated how to scan them. The teacher also checked whether the AR content could be accessed properly before the activity.

During interaction, students scanned the markers and viewed three-dimensional scenes of a clean river and a polluted river. They discussed the scenes in groups, completed worksheets, and answered questions such as “What do you see?” and “Why did the river become dirty?” The teacher guided observation, provided vocabulary, and encouraged students to use simple English. Field notes showed that students took turns scanning the markers, pointed to the three-dimensional objects, and used the visualization as the basis for discussion. In the second meeting, several students accessed the AR content with less assistance, indicating increased familiarity with the application.

Evaluation was conducted through group presentations, follow-up questions, worksheet completion, and teacher feedback. The teacher corrected vocabulary, pronunciation, and sentence construction when necessary and reviewed the environmental message and English expressions at the end of the activity. Thus, AR was used not only as a visual medium but as part of observation, discussion, language practice, presentation, and evaluation.

Students’ 4Cs Competencies Supported by Assemblr Edu-based AR

a. Critical Thinking

Assemblr Edu-based AR supported critical thinking through observation, comparison, analysis of environmental problems, and answering questions. Students compared clean and polluted river scenes and discussed causes and effects of pollution. They identified human behavior, littering, and failure to preserve nature as causes and discussed effects on communities, safety, and daily activities. Students also explained that they answered questions based on their observations of the AR scenes. The teacher used analytical questions to encourage students to identify causes, effects, and possible solutions. These findings indicate that the AR visualization

provided concrete evidence for observation, comparison, and evidence-based responses.

b. Creativity

The findings showed that AR supported creativity through idea generation, sentence construction, and development of descriptions. Students reported that the visualization helped them create their own ideas and English sentences. Some students selected better words, added ideas from books or other sources, used their own understanding, and proposed solutions for keeping rivers clean. Students produced sentences describing dirty rivers, garbage, and ways to prevent littering. However, some students used the present tense although the teaching module targeted the simple past tense. Therefore, students could generate ideas and communicate meaning, but grammatical accuracy, particularly in the simple past, still required teacher guidance.

c. Collaboration

Collaboration appeared through group discussion, task sharing, peer assistance, and cooperative participation. Students took turns scanning the AR markers, observed the scenes together, discussed environmental problems, completed worksheets, and shared responsibilities. Students reported helping one another, exchanging opinions, explaining difficult parts, and solving technical problems together. The teacher confirmed that group members divided roles such as scanning, observing, writing, and discussing. Nevertheless, one student reported that some group members focused on their own activities, showing that collaboration was not equally effective for all students.

d. Communication

Communication was supported through discussion, presentation, question-answer activities, and English practice. Students used the AR scenes to describe environmental situations and explain their answers. The teacher encouraged simple English and provided vocabulary and sentence models. However, many students did not use English consistently and relied more on Indonesian during discussions. Some students reported difficulty starting to speak English, limited vocabulary and grammar knowledge, and lack of confidence during presentations. Thus, AR provided a meaningful context for communication, but students' English proficiency and confidence influenced the extent of their participation in English.

Challenges in Implementation

The implementation involved technical, operational, and communication-related challenges. Students experienced poor internet connections, slow

loading, difficulty scanning markers, and unclear AR displays. Some students were also unfamiliar with AR applications and needed assistance. Students addressed these problems by borrowing hotspots, asking classmates for help, adjusting camera positions, rescanning markers, and following teacher instructions. The teacher repeated demonstrations, organized students into groups, and provided direct assistance. Language-related difficulties also remained because some students relied on Indonesian and were less confident speaking English. Overall, the challenges did not prevent participation but affected the smoothness of AR-based learning.

Discussion

The findings demonstrate that Assemblr Edu-based AR was integrated as part of a complete instructional sequence rather than used as an isolated technological tool. Preparation ensured that students understood the learning procedure and could access the AR materials. Interaction connected the three-dimensional environmental scenes with observation, discussion, and English production, while evaluation connected the activity with presentation and feedback. This pattern answers the research focus concerning how Assemblr Edu was implemented in English learning: the technology was embedded in preparation, classroom interaction, and assessment activities.

The findings also indicate that AR supported the development of the 4Cs because the competencies emerged from the same learning activities. The visual scenes gave students concrete information to compare and analyze, supporting critical thinking. The same scenes stimulated ideas and sentence construction, supporting creativity. Group tasks encouraged students to divide responsibilities and assist one another, supporting collaboration. Presentations and discussions provided opportunities for communication. Therefore, the results suggest that the 4Cs were interconnected rather than developed independently.

The findings are relevant to the broader understanding of technology-supported and contextual English learning. In this study, the AR visualization created a meaningful context for students to discuss an environmental issue and use English to express observations. The result is also consistent with the view that interactive learning media can provide students with concrete experiences that support participation and language production. However, the present findings add an important qualification: technology alone did not guarantee accurate English use or equal participation. Students still required teacher scaffolding, vocabulary support, sentence models, and peer assistance. Specific comparisons with previous empirical studies should be connected to the studies already reviewed in the Introduction or Literature Review rather than introducing unsupported references.

The results signify that Assemblr Edu can function as a bridge between visual experience and language production. Students did not have to depend entirely on abstract verbal explanations to understand the environmental topic. They could observe the AR scenes and use them as shared evidence when answering questions and constructing sentences. This helped make the environmental problem more concrete and gave students ideas for communication. At the same time, the results show that the educational value of AR depends on instructional design. The difficulty with the simple past tense demonstrates that visual stimulation may generate content ideas without automatically producing the targeted grammatical form.

Another implication concerns the relationship between engagement and learning outcomes. Students' positive responses to realistic and interactive materials suggest that AR can make classroom activities more engaging, but engagement should not be treated as evidence of language improvement by itself. In this study, students participated actively in observation and group discussion, yet several still experienced difficulty using English accurately and confidently. This distinction is important because it shows that successful technology integration should be evaluated through both participation and achievement of language objectives. The findings therefore support a balanced use of AR in which visual and interactive experiences initiate learning, while teacher explanation, guided practice, feedback, and opportunities for repeated English use consolidate the learning process. In addition, the technical challenges indicate that access conditions should be considered when planning AR-based instruction. Reliable connectivity, suitable devices, and sufficient preparation time can influence whether students experience the technology as a learning resource or as an interruption. For future implementation, teachers and researchers should document these contextual factors alongside learning outcomes so that the effectiveness of AR can be interpreted more accurately across different classroom settings. This is especially important in schools where internet access and student devices are not consistently available.

The implications are relevant to English teachers and classroom practice. AR activities should be aligned with learning objectives, language targets, questions, worksheets, and assessment. Teachers should explicitly connect what students observe in AR with the vocabulary and grammatical structures being practiced. Group arrangements can help students share devices and provide peer support, particularly when access to technology is limited. Teachers should also prepare alternative procedures for unstable internet connections and scanning problems. These measures can help maintain learning continuity without allowing technical issues to dominate the lesson.

The reasons behind the findings can be understood from the interaction between the AR medium, classroom organization, teacher support, and students' existing abilities. The realistic three-dimensional scenes provided a common object of attention, making observation and discussion easier. Group work created opportunities for students to exchange ideas and solve problems collaboratively. Teacher questioning moved students beyond simply viewing the AR content toward identifying causes and effects. Conversely, unstable internet and limited familiarity with AR created technical interruptions, while differences in vocabulary, grammar, and confidence affected communication. These conditions explain why the findings were positive but not uniform across all students.

The results also suggest several actions for future implementation. Teachers should continue using demonstrations and direct assistance, especially during students' first experience with AR. Activities should include clear language scaffolding so that students can convert observations into accurate English. Grammar practice should be explicitly connected to the AR context when a particular grammatical target is required. Group roles should be clearly distributed to encourage balanced participation. Future researchers can investigate Assemblr Edu with other English skills, topics, grade levels, and learning contexts and can examine changes in specific 4Cs competencies and English accuracy. Such research can further clarify how AR can be optimized as an instructional medium for meaningful and language-focused learning.

CONCLUSION

This study examined the implementation of Assemblr Edu-based Augmented Reality (AR) in English language teaching for Grade VIII-A students at SMP Negeri 1 Gido. The findings were obtained through classroom observations, field notes, teacher and student interviews, documentation, and thematic analysis. The study identified three main findings concerning the integration of Assemblr Edu in English language teaching, the development of students' 4Cs competencies, and the challenges encountered during its implementation.

The most distinctive finding of this study is that the use of Assemblr Edu-based AR was implemented through a systematic learning process consisting of preparation, interaction, and evaluation. During preparation, the teacher organized learning materials, AR markers, worksheets, devices, internet access, learning objectives, and group activities. During interaction, students observed 3D representations of clean and polluted rivers, discussed what they observed, answered questions, identified causes and effects of environmental pollution,

and developed English sentences. During evaluation, students presented their group work and received feedback on vocabulary, pronunciation, and sentence structure. This indicates that AR was not used merely as a technological display but was integrated into classroom activities to support students' learning processes.

Another important finding concerns students' 4Cs competencies. Assemblr Edu-based AR supported critical thinking by encouraging students to compare situations, identify causes and effects, and provide explanations based on their observations. It also supported creativity by stimulating students to generate ideas, create English sentences, describe situations, and propose solutions. Collaboration developed through group discussions, task sharing, peer assistance, and joint completion of worksheets. Communication was supported through classroom discussions, presentations, question-and-answer activities, and opportunities to use English. However, the development of these competencies was not equal among all students because some students still experienced difficulties with vocabulary, grammar, confidence, and participation.

The added value of this research lies in its pedagogical contribution to the use of AR in English language teaching. The findings show that Assemblr Edu-based AR can connect visual learning experiences with English language production and the development of 4Cs competencies. The contribution is therefore not limited to the use of AR technology itself, but to how the technology is integrated with teacher guidance, group activities, language practice, observation, discussion, and evaluation. This provides a contextual example of how AR can be incorporated into English learning activities involving environmental topics.

This study also has several limitations. It involved only one class, Grade VIII-A at SMP Negeri 1 Gido, and the implementation was conducted within a limited number of learning meetings. The study also relied mainly on qualitative data, while technical problems such as unstable internet connections, difficulties scanning AR markers, and unfamiliarity with the technology affected the learning process. In addition, students' language limitations and lack of confidence sometimes restricted their ability to communicate in English.

Therefore, further research could involve larger and more diverse groups of students, different grade levels, English skills, and learning topics. Future studies could also employ quantitative or mixed-method approaches to examine changes in students' 4Cs competencies and English language performance. Further investigation could focus specifically on language accuracy, teacher scaffolding, group organization, and technological support. Overall, this study

indicates that Assemblr Edu-based AR has potential to support meaningful English learning when it is accompanied by careful preparation, teacher guidance, collaboration, and explicit language instruction.

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