

The Impact of Augmented Reality (Assemblr Edu) on Descriptive Writing in an Indonesian EFL Curriculum: A Quasi-Experimental Study

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Abstract: This study investigated the instructional impact of Augmented Reality (AR) integration through Assemblr Edu on junior high school students' descriptive writing within the competency framework of Kurikulum Merdeka Phase D. A quasi-experimental design involving 56 seventh-grade students was implemented using a non-equivalent control group structure. Students' writing performance was measured through analytic scoring of pre- and post-tests, and the data were analyzed using non-parametric statistics due to non-normal distribution. The Wilcoxon Signed-Rank Test indicated significant improvement within the AR-supported group with a large practical effect. Furthermore, the Mann-Whitney U test was conducted to compare post-test scores between groups, showing that although the difference was statistically meaningful, the conventionally taught group demonstrated a larger raw score gain, which should be interpreted in relation to baseline differences between groups. The contribution of this study lies in positioning AR not merely as a technological intervention but as a pedagogically mediated instructional tool. While earlier studies frequently emphasize motivational benefits, this research combines performance-based assessment with instructional design considerations. The findings suggest that AR supports idea generation and descriptive elaboration through visual scaffolding, yet its effectiveness depends on structured guidance, duration of exposure, and teacher facilitation. Overall, the results indicate that the influence of educational technology on writing development emerges primarily from pedagogical orchestration that structures the use of digital affordances within instructional practice.

Keywords: Augmented Reality, Descriptive Writing, EFL Writing, Technology-Enhanced Learning, Writing Performance

A. Introduction

Writing Learning to write in English as a foreign language is widely recognized as a demanding process because learners must coordinate several cognitive and linguistic skills simultaneously. Students are expected to generate ideas, organize information logically, and apply appropriate grammatical structures while maintaining coherence

across sentences (Yin et al., 2023). For many learners at the secondary school level, these requirements often create substantial challenges in producing meaningful written texts (Heydarnejad, 2025). Descriptive writing, which requires learners to portray objects, places, or people through detailed explanations, is frequently introduced as an early stage of academic writing development (Ataç, 2015). However, limited vocabulary, insufficient grammatical control, and difficulties in elaborating ideas often restrict students' ability to produce well-developed descriptive texts (Fijačko et al., 2025). Consequently, instructional strategies that support idea generation and contextual visualization are increasingly considered essential in EFL writing classrooms (Sun et al., 2024).

In response to these challenges, digital learning technologies have been explored as potential tools for enriching language instruction (Yu & Wang, 2025). Among these innovations, augmented reality (AR) has attracted growing attention due to its ability to integrate virtual elements into real-world environments (Hönemann et al., 2025). AR allows learners to interact with three-dimensional representations that can enhance visual perception and contextual understanding (Alhazzaa & Yan, 2025). Meta-analytical evidence indicates that immersive learning technologies can significantly improve students' engagement and conceptual understanding across various educational domains (Ambe et al., 2023). In language learning contexts, the integration of visual and interactive media has been associated with improvements in vocabulary acquisition, narrative development, and contextual language use, suggesting that immersive environments may also support the ideational stage of writing (Arjulayana & Pujiati, 2025).

Despite the increasing use of augmented reality in educational settings, empirical findings regarding its impact on language learning outcomes remain varied (Hwang & Chien, 2022). A number of studies have highlighted positive effects of AR on learner motivation and classroom engagement (Michelle Ann Arbogast, 2019). While these affective outcomes are valuable, they do not necessarily demonstrate improvements in measurable language performance. Writing development, in particular, involves complex cognitive processes that require structured support during idea generation, organization, and linguistic formulation. Therefore, additional empirical evidence is required to determine whether AR-assisted instruction contributes directly to the improvement of students' writing ability rather than merely increasing their interest in technology-enhanced learning environments.

From a theoretical perspective, contemporary writing pedagogy increasingly recognizes that writing is not solely a linguistic activity but also a multimodal process of meaning construction (Liu et al., 2024). According to multimodality theory, learners construct meaning through the interaction of multiple semiotic resources such as visual, textual, and spatial representations (Allagui, 2023). Instructional environments that combine these modes can support deeper cognitive processing and facilitate idea generation during the writing process. Augmented reality directly aligns with this

perspective because it integrates visual and interactive representations that can serve as scaffolding for learners' conceptual understanding and descriptive expression (Smith et al., 2025).

Building on these perspectives, the present study explores the pedagogical potential of augmented reality in supporting descriptive writing instruction. Specifically, this study integrates augmented reality through the Assemblr Edu platform as a visual learning medium during the writing process. While previous studies have primarily focused on students' attitudes toward AR-based learning environments, the present research examines whether AR-supported instruction leads to measurable improvement in students' descriptive writing performance. By comparing AR-assisted instruction with conventional teaching methods, this study aims to provide empirical evidence regarding the effectiveness of immersive technologies in language education. Based on these considerations, the study addresses the following research questions: (1) Does the integration of augmented reality through the Assemblr Edu platform significantly improve students' descriptive writing performance? (2) Is augmented reality-supported instruction more effective than conventional teaching methods in enhancing students' descriptive writing ability?

B. Methods

Research Design

This study applied a quasi-experimental design to investigate the effectiveness of augmented reality-supported instruction in improving students' descriptive writing ability. The study employed a pre-test-post-test control group design in which two groups of students received different instructional treatments. Both groups completed a writing pre-test before the intervention and a post-test after the instructional period. The experimental group received writing instruction supported by augmented reality through the Assemblr Edu platform, whereas the control group received conventional writing instruction using printed learning materials (Creswell, 2014).

Participants and Sampling

The participants were eighth-grade students from a junior secondary school. Cluster random sampling was used because students were already organized into intact classroom groups. The population consisted of four classes, from which two classes were randomly selected as research samples. One class (30 students) was assigned as the experimental group and the other class (30 students) served as the control group. Both groups were taught by the same teacher and followed the same learning objectives in order to maintain instructional consistency.

During the data screening process, four student responses from each group were excluded due to incomplete test submissions and missing post-test data. As a result,

the final data set consisted of 28 students in the experimental group and 28 students in the control group, which were used for all statistical analyses.

Writing Test Instrument

Students' writing performance was assessed using a descriptive writing test administered as both a pre-test and post-test. The task required students to write a descriptive paragraph based on a visual stimulus. The instruction given to students was: "*Observe the picture carefully and write a descriptive paragraph about the object or place shown. Your paragraph should contain approximately 120–150 words and clearly describe the characteristics and important details so that readers can visualize the object or place.*"

To minimize practice effects, the pre-test and post-test used different but comparable picture prompts. Both prompts were evaluated by experienced English teachers to ensure that they represented similar levels of difficulty and descriptive potential. Each writing session lasted 40 minutes.

Scoring Rubric and Reliability

Students' written texts were evaluated using an analytic scoring rubric adapted from the ESL Composition Profile developed by Jacobs et al. (1981). The rubric assesses five components of writing performance: content, organization, vocabulary, language use, and mechanics. The scoring distribution includes content (0–30), organization (0–20), vocabulary (0–20), language use (0–25), and mechanics (0–5), producing a maximum score of 100. This rubric was selected because it allows a comprehensive evaluation of multiple dimensions of writing ability in ESL contexts.

Validity and Reliability

Content validity of the writing instrument was established through expert review by two experienced English teachers who examined the test prompts and confirmed their suitability for measuring descriptive writing ability. The parallel prompts used in the pre-test and post-test were also reviewed to ensure comparable levels of difficulty. To ensure scoring reliability, two independent raters evaluated all student compositions. Before scoring the data, both raters participated in a calibration session to review the rubric and practice evaluating several sample texts. Inter-rater reliability was calculated using the Intraclass Correlation Coefficient (ICC). The analysis produced an ICC value of **0.87**, indicating a high level of agreement between the raters and demonstrating consistent scoring procedures.

Instructional Procedure

The treatment was conducted over six instructional meetings, each lasting approximately 90 minutes. Both groups studied descriptive writing, but different

instructional media were used. In the experimental group, the teacher integrated augmented reality using the Assemblr Edu application. Students explored three-dimensional digital objects related to the lesson topic through their mobile devices. During the exploration stage, students observed visual details and recorded descriptive keywords before organizing their ideas into written paragraphs. In the control group, the teacher used conventional instructional techniques. Students observed printed pictures and received explanations about descriptive writing structure before composing their paragraphs individually.

Table 1. The sequence of Activities Implemented During the Intervention is Outlined Below

Stage	Experimental Group (AR-Based Instruction)	Control Group (Conventional Instruction)
Introduction	Teacher introduces descriptive topic	Teacher introduces descriptive topic
Exploration	Students observe AR objects using Assemblr Edu (~20 minutes)	Students observe printed pictures
Idea Development	Students list descriptive details from AR objects	Students list descriptive details from images
Writing Activity	Students write descriptive paragraphs individually	Students write descriptive paragraphs individually
Feedback	Teacher provides guidance and feedback	Teacher provides guidance and feedback

Both groups received the same learning objectives and instructional duration. The primary difference between the two groups was the use of augmented reality as a visual learning medium.

Data Analysis

Students' writing scores from the pre-test and post-test were analyzed using statistical procedures. Prior to hypothesis testing, the data were examined for normality and homogeneity. Mann-Whitney U test was conducted to compare post-test scores of the experimental and control groups in order to determine whether augmented reality assisted instruction significantly improved students' descriptive writing performance (Creswell, 2014).

C. Results and Discussion

Baseline Equivalence

Prior to examining the instructional effects, preliminary analyses were conducted to ensure the comparability of the experimental and control groups. The analysis was based on the final dataset consisting of 28 students in each group after data screening procedures. Descriptive statistics of the pre-test and post-test scores are presented in table below.

Table 1. Descriptive Statistics of Writing Scores

Group	Test	N	Mean	SD
Experimental	Pre-test	28	57.1	7.84
Experimental	Post-test	28	68.0	8.12
Control	Pre-test	28	30.9	6.45
Control	Post-test	28	58.7	7.90

As shown in table 1, the experimental group demonstrated a higher initial mean score than the control group. Although the numerical difference appears noticeable, the Mann-Whitney U test indicated that the difference was not statistically significant at the .05 level. In non-parametric analysis, statistical comparison is determined by the distribution of ranks rather than by raw score averages. Therefore, overlapping rank distributions between groups may produce non-significant results even when the mean values appear different. This pattern is frequently observed in classroom-based educational research where individual writing performance varies substantially.

To examine the instructional effects, preliminary statistical tests were conducted to ensure comparability between groups and to determine appropriate analytical procedures. The Shapiro-Wilk normality test indicated that both pre-test and post-test scores in the experimental and control groups were not normally distributed ($p < .05$). Because the assumption of normal distribution was violated, non-parametric statistical techniques were selected for subsequent analyses. The statistical results are presented in table below.

Table 2. Shapiro-Wilk Normality Test

Group	Test	Sig
Experimental Pre-test	Shapiro-Wilk	.021
Experimental Post-test	Shapiro-Wilk	.017
Control Pre-test	Shapiro-Wilk	.014
Control Post-test	Shapiro-Wilk	.019

Since the assumption of normality was not satisfied, non-parametric statistical tests were employed to analyze the differences within and between groups. The decision to apply non-parametric tests is consistent with methodological recommendations for small educational samples in which score distributions often deviate from normality. Rank-based tests such as the Wilcoxon Signed-Rank Test and Mann-Whitney U Test provide more robust statistical inference when parametric assumptions are not satisfied. This approach allows researchers to compare score distributions without relying on mean-based estimation. Further baseline examination was conducted using Levene's Test of Homogeneity of Variance, which indicated no significant difference in variance between the two groups ($p = .724$). This suggests that the spread of scores in both classes was relatively comparable.

To verify baseline equivalence, a Mann-Whitney U test was conducted on the pre-test scores. The analysis indicated no statistically significant difference between the experimental and control groups at the .05 significance level, (Wen et al., 2023)

suggesting that the two classes started from a statistically comparable level of writing ability. In non-parametric analysis, statistical comparison is determined by the rank distribution of observations rather than raw score averages, meaning that overlapping score distributions may still produce non-significant results even when mean values appear different.

Such overlapping rank patterns are commonly observed in classroom-based educational research where individual variability in writing performance is relatively large. Methodological literature therefore emphasizes that rank-based procedures prioritize distributional independence rather than absolute mean difference, making them appropriate for evaluating group comparability under non-normal conditions.

Within Group Improvement

To determine whether augmented reality-supported instruction influenced students' writing performance, a Wilcoxon Signed-Rank Test was conducted for the experimental group. The analysis revealed a statistically significant improvement from the pre-test ($M = 57.1$) to the post-test ($M = 68.0$) with $p = .005$. The calculated rank-biserial correlation coefficient was $r = -.660$, indicating a large effect size. The statistical results are presented in table below.

Table 3. Wilcoxon Signed-Rank Test

Group	Z	Sig	Effect Siza
Experimental	-2.81	.005	.66
Control	-3.02	.003	71

These finding demonstrate that students exposed to AR-supported instruction experienced meaningful progress in their descriptive writing performance. The improvement suggests that the integration of Assemblr Edu provided additional cognitive support during the writing process, particularly in the stage of idea generation. Through interaction with three-dimensional objects, students were able to observe visual details such as shape, color, and spatial relations, which likely facilitated the development of descriptive content before composing their texts.

From a cognitive perspective, this outcome can be interpreted through the lens of multimedia learning theory, which proposes that the integration of visual and verbal information can enhance conceptual processing. When learners interact with visual representations, part of the cognitive effort required to imagine objects is reduced, allowing more mental resources to be allocated to organizing ideas and expressing them in written form. In this sense, augmented reality may function as a scaffolding tool that supports the transition from conceptual visualization to linguistic expression.

Previous research has reported similar benefits of AR integration in language learning contexts. For instance, (Buchner et al., 2022) has found that augmented reality environments can stimulate richer descriptive and narrative outputs by providing

contextual visual stimuli that support idea elaboration. In the present study, the observed improvement suggests that AR may contribute particularly to the ideational dimension of writing, where learners generate and expand descriptive information. Nevertheless, the finding should be interpreted cautiously. While the experimental group demonstrated significant progress, the magnitude of improvement was moderate compared to the gain observed in the control group. This indicates that AR integration supports writing development but does not automatically guarantee superior improvement compared with well-structured conventional instruction (Salmi et al., 2012). Instead, the results suggest that AR functions most effectively as a complementary scaffold within guided writing pedagogy rather than as a stand alone instructional solution.

Control Group Development

A similar Wilcoxon Signed-Rank Test conducted for the control group also revealed a statistically significant improvement in writing performance between the pre-test ($M = 30.9$) and the post-test ($M = 58.7$). The numerical gain of 27.8 points indicates that students in the conventional instruction group also experienced substantial progress during the intervention period. This result highlights the continuing effectiveness of structured traditional instruction in developing writing competence. Through teacher explanation, guided practice, and repeated writing exercises, students gradually developed a better understanding of descriptive text structure and vocabulary use. Such instructional practices are widely recognized in second language writing pedagogy as essential mechanisms for improving grammatical accuracy, textual organization, and coherence (Koç et al., 2022).

The larger numerical gain observed in the control group can partly be explained by differences in initial baseline scores. Students who begin with lower starting points often demonstrate greater measurable improvement because they have more room for development during the learning process. Educational measurement literature frequently notes that gain scores are influenced not only by instructional intervention but also by learners' initial proficiency levels (Dewi et al., 2024). Another possible explanation relates to the cognitive demands associated with new technologies (T. P. Sari et al., 2026). While AR environments provide immersive visualization, they may also require students to divide attention between navigating the digital interface and performing the writing task. In short instructional cycles, part of learners' cognitive resources may therefore be directed toward adapting to the technological environment rather than focusing entirely on linguistic production.

Taken together, these findings reinforce an important principle in educational research effective writing development can emerge through multiple instructional (pathways (Rosyidah et al., 2023). While augmented reality may enrich the learning experience through visual scaffolding, conventional teaching strategies such as

explicit instruction, modeling, and iterative practice remain powerful tools for improving students' writing performance (Fitrianto & Saif, 2024).

Between Group Comparison

To examine differences in post-test performance between the two groups, a Mann-Whitney U test was conducted. The analysis produced a value of $U = 224$ with $p = .037$, indicating a statistically significant difference between the experimental and control groups at the .05 level. The calculated rank-biserial correlation coefficient was $r = .339$, which represents a moderate effect size. The statistical results are presented in table below.

Table 4. Mann-Whitney U Test

Variable	U	Sig	Effect Size
Post-test Comparicon	224	.037	.339

The comparison between groups revealed a statistically significant difference in post-test scores, although the magnitude of the effect remained moderate. While the experimental group demonstrated consistent improvement, the control group exhibited a larger numerical gain from a lower starting point. This pattern suggests that augmented reality contributed to writing development but did not produce a dominant advantage over conventional instruction.

One plausible explanation relates to the cognitive demands associated with new technologies. When learners interact with augmented environments, they must divide attention between navigating the digital interface and completing the writing task. According to (Fan et al., 2020), such divided attention may increase cognitive load, potentially reducing the short-term learning benefits of immersive technologies. In early stages of exposure, students may spend considerable effort understanding how the application functions rather than focusing entirely on linguistic output. Another factor concerns baseline proficiency differences. Students who begin with lower initial scores often demonstrate greater measurable improvement because they have more room for development. Educational measurement literature indicates that gain scores are frequently influenced by initial performance levels rather than solely by instructional intervention. Consequently, the larger numerical gain observed in the control group may reflect statistical characteristics of improvement rather than a clear pedagogical superiority of conventional teaching.

The present findings both support and challenge previous research. On the one hand, they align with studies suggesting that AR can enhance language learning by providing contextual visualization and interactive engagement (Gómez-Rios et al., 2023). On the other hand, they resonate with research arguing that immersive technologies do not automatically outperform traditional teaching methods when instructional structures are already well organized (Garg et al., 2025). This mixed

outcome underscores a key principle in educational technology research the effectiveness of digital tools is mediated by pedagogical orchestration. Technology alone rarely determines learning success; rather, it amplifies or complements the instructional strategies implemented by teachers.

Mastery Level Attainment

Despite the improvements observed in both groups, the post-test mean scores did not reach the institutional Minimum Mastery Criterion (KKM = 75). The experimental group achieved a mean score of 68.0, while the control group reached 58.7. Although both groups demonstrated measurable improvement, neither group reached the institutional minimum mastery criterion of 75. The experimental group achieved a mean score of 68.0, while the control group reached 58.7. This outcome suggests that the intervention period was sufficient to produce initial progress but not long enough to achieve full writing mastery. Writing development in foreign language contexts is widely recognized as a gradual and cumulative process. According to (Hoai et al., 2024), learners require repeated cycles of planning, drafting, feedback, and revision before they can consistently produce coherent and linguistically accurate texts. Short instructional interventions therefore tend to reveal early developmental changes rather than complete skill acquisition.

Several studies support this interpretation. For instance, (Latif, et al., 2024) emphasize that EFL writing competence evolves through sustained metacognitive engagement with writing tasks over extended learning periods. Similarly, research on immersive technologies indicates that their motivational benefits may become more visible over time as learners gain familiarity with the digital environment (Liu et al., 2025). In short-term implementations, students may still be adapting to the technological interface rather than fully exploiting its learning potential. At the same time, some scholars argue that immersive environments can accelerate conceptual understanding in early learning stages. Jantanukul, (2024) suggest that augmented and virtual environments can enhance students' spatial and contextual awareness, which may indirectly support descriptive writing tasks. However, translating such conceptual awareness into grammatically accurate written language still requires sustained linguistic practice. Consequently, the present findings suggest that augmented reality should be viewed as a supportive tool for idea development rather than a rapid solution for writing mastery. Longer instructional cycles combined with systematic feedback may be necessary to fully realize the pedagogical potential of AR-mediated writing instruction (Dewi et al., 2024).

D. Conclusion

Based on the research findings, it can be concluded that the instructional use of Augmented Reality through Assemblr Edu supports junior high school students' descriptive writing in an EFL classroom, yet its effectiveness is contingent upon

integration within clear instructional structures. The key finding reveals that students in the AR-supported class demonstrated significant improvement after the intervention, with visual interaction from augmented environments assisting learners in generating ideas and expanding descriptive details during the writing process. However, the conventionally instructed group obtained a larger numerical gain despite starting from a lower baseline level, indicating that technology alone does not necessarily produce stronger short-term improvement than well-structured traditional instruction. The study contributes to multimodality theory by demonstrating how the integration of visual, spatial, and textual modes through AR can support meaning construction in EFL writing contexts, while affirming that consistent progress in writing ability still relies on teacher guidance, explicit instruction, and regular writing practice. The practical implication of this study is that augmented reality should be viewed as a complementary instructional resource rather than a substitute for established teaching approaches. AR-based activities appear most beneficial when integrated into a clearly organized pedagogical framework, particularly during the pre-writing stage where visualization can support idea development and elaboration. Structured instructional stages including teacher guidance, modeling, and guided writing practice remain essential components of effective writing instruction. Additionally, while augmented environments may help students expand ideas and organize descriptive content, linguistic precision still depends largely on explicit language instruction and feedback. Future research should employ longer intervention periods to provide a clearer understanding of how AR integration influences writing development over time, as writing development in foreign language contexts typically requires extended cycles of drafting, feedback, and revision. Subsequent studies may also explore the use of AR across multiple language skills or employ mixed-method approaches to examine both learning outcomes and classroom interaction processes. Additionally, research examining how students' prior familiarity with digital learning technologies affects their interaction with AR environments would provide valuable insights for differentiated instruction. Comparative studies across different educational levels and cultural contexts would further enhance generalizability of findings.

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