

Effectiveness of an Augmented Reality Assisted Multiliteracy Learning Model in Improving Junior High School Students' Reading Comprehension

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Abstract

Reading comprehension is an essential language skill that supports students' academic achievement and literacy development. However, Indonesian students' reading literacy achievement remains relatively low, indicating the need for innovative learning models that integrate digital technology into classroom instruction. This study aimed to determine the effectiveness of an Augmented Reality (AR)-assisted multiliteracy learning model in improving seventh-grade students' reading comprehension. The study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group pretest-posttest design. The participants consisted of 60 students from SMP Negeri 229 Jakarta, divided equally into an experimental class and a control class. Data were collected through reading comprehension tests administered before and after treatment. Data analysis included descriptive statistics, Shapiro-Wilk normality tests, Levene's homogeneity tests, paired-samples t-tests, independent-samples t-tests, and N-Gain analysis. The results indicated that both groups experienced significant improvement. However, the experimental group achieved a higher mean increase (17.20) than the control group (11.97). The independent-samples t-test showed a significant difference between the posttest scores of both groups ($p = 0.000 < 0.05$). Furthermore, the N-Gain score of the experimental class (0.681) was categorized as high, while the control class (0.405) was categorized as moderate. These findings demonstrate that the AR-assisted multiliteracy learning model is more effective than conventional instruction in improving students' reading comprehension.

Keywords: *Augmented Reality, multiliteracy learning, reading comprehension, Indonesian language learning, quasi-experiment*

Introduction

Indonesian serves as the national language and a symbol of national identity while also supporting communication, knowledge development, and educational achievement. In the era of globalization and digital transformation, mastery of Indonesian language skills, particularly reading comprehension, has become increasingly important because students are required to understand, evaluate, and use information from various sources (Azhari et al., 2025). Reading comprehension is not merely the ability to decode written symbols; it also involves interpreting information, drawing inferences, evaluating ideas, and constructing meaning from texts (Snow & Uccelli, 2021).

However, the reading literacy achievement of Indonesian students is relatively still low. The Program for International Student Assessment (PISA) 2022 results showed that Indonesia's reading literacy score was 366, which was significantly lower than the

average of the OECD (487) (OECD, 2023). This finding indicates that a number of students are still having problems with the comprehension, analysis and evaluation of textual information. Similar concerns have been raised in studies of literacy learning in Indonesia, which show deficiencies in the higher-order reading skills of secondary school students (Indahri, 2021). In this situation, learning Indonesian language plays an important role in increasing literacy competence of students and developing their ability to understand and use information effectively (Rahmawati & Nugroho, 2022).

Preliminary observations conducted at SMP Negeri 229 Jakarta revealed similar conditions. Approximately 72% of seventh-grade students had difficulty identifying main ideas, 68% struggled to make inferences, and 65% were unable to connect textual information with real-life contexts. Furthermore, classroom instruction remained predominantly teacher-centered, whereas opportunities for collaborative discussion and critical interpretation of texts were limited. Approximately 75% of students perceived reading activities as monotonous, and 80% considered the learning materials insufficiently relevant to their daily experiences. These findings suggest that existing instructional practices have not adequately supported the development of students' reading comprehension.

The observations also showed limited integration of digital technology in reading instruction. Only approximately 10% of learning activities utilized digital media, resulting in low levels of student engagement during classroom learning. At the same time, the increasing use of digital technology in education requires careful consideration because the adoption of digital media does not automatically lead to improved reading comprehension. Delgado et al. (2020) demonstrated that the reading medium can influence comprehension outcomes, indicating the importance of designing digital learning environments that support meaningful reading processes rather than simply replacing printed materials with digital formats.

The advancement of educational technology also facilitates the creation of more engaging and significant learning experiences. Radianti et al. (2020) demonstrated that immersive technologies are being progressively investigated in educational environments due to their ability to offer interactive experiences and facilitate the visualization of learning material. While immersive technology by itself does not ensure enhanced educational results, its efficacy is contingent upon suitable instructional design, clear learning objectives, and the manner in which technology is incorporated into the educational experience. This suggests that technological advancements must be underpinned by a well-defined educational structure to guaranty their significant impact on student learning.

The incorporation of technology in education ought to be directed by pedagogical goals and the learning requirements of students, rather than solely by technological advancements. UNESCO (2023) highlighted that the integration of technology in education must be suitable, fair, substantiated by evidence, and sustainable. Technology ought to enhance significant learning and serve as a supplement, rather than a substitute, for the crucial function of educators and interpersonal engagement in the learning experience. Thus, the use of digital technology in reading pedagogy necessitates educational frameworks that link technical advancements with the enhancement of students' literacy skills.

One method deemed pertinent for tackling these issues is the Multiliteracy Learning Model. The multiliteracy viewpoint highlights the importance of several modalities of meaning creation, such as linguistic, visual, auditory, spatial, and digital formats, allowing learners to actively develop comprehension through a range of informational sources

(New London Group, 1996). In modern language instruction, multiliteracies pedagogy is becoming progressively significant as learners must decipher and generate meaning through various modalities of representation and digital environments (Lim & Tan, 2021). Prior research has indicated that training grounded in multiliteracy can enhance students' literacy performance, involvement, and reading comprehension abilities (Zhang et al., 2022).

The tenets of multiliteracy align with the Cognitive Theory of Multimedia Learning, which posits that learners enhance their comprehension when information is conveyed through synchronized verbal and visual formats (Mayer, 2021). Through the utilization of diverse modes of representation in texts, multiliteracy education can motivate students to actively create meaning, link knowledge, and analyze textual content from various viewpoints. Consequently, a multiliteracy framework offers a pertinent educational basis for tackling the difficulties of reading comprehension within a digital learning context.

This research incorporates Augmented Reality (AR) technology as a pedagogical tool to enhance the application of multiliteracy education. Augmented reality facilitates the incorporation of virtual entities into actual surroundings, therefore fostering engaging and relevant educational experiences. Studies have shown that augmented reality can improve student involvement, motivation, and educational results by offering significant visual assistance throughout the learning experience (Garzón & Acevedo, 2021). In reading pedagogy, augmented reality can assist learners in visualizing textual material, comprehending the interconnections between concepts, and relating information to real-world contexts.

The combination of multiliteracy pedagogy and AR technology is expected to provide a more interactive learning environment for reading instruction. Multiliteracy offers a pedagogical framework that encourages students to construct meaning through multiple modes of representation, whereas AR provides interactive visual and digital support that can contextualize textual information. This integration is particularly relevant to the characteristics of contemporary learners, who increasingly encounter information through a combination of textual, visual, and digital forms.

Prior research has examined multiliteracy pedagogy and augmented reality technology independently; however, there is a scarcity of studies that combine both methodologies in the context of Indonesian language education. The majority of current studies concentrate either on multiliteracy-oriented education or on augmented reality-supported teaching separately. Furthermore, research investigating the efficacy of a combined multiliteracy and augmented reality strategy in enhancing reading comprehension among junior high school students is still few. Consequently, there is a deficiency of studies concerning the efficacy of an AR-assisted Multiliteracy Learning Model in enhancing reading comprehension for junior high school pupils. This research sought to examine the efficacy of an AR-supported Multiliteracy Learning Model in enhancing the reading comprehension skills of seventh-grade pupils at SMP Negeri 229 Jakarta. The originality of this research resides in the amalgamation of multiliteracy pedagogy and augmented reality technology in Indonesian language education to foster a more engaging, contextualized, and significant reading experience. This research aims to conceptually enhance the advancement of technology-infused multiliteracy education and practically offer a novel instructional framework for augmenting students' reading comprehension.

Method

This research utilized a quantitative methodology through a quasi-experimental framework featuring a nonequivalent control group with pretest and posttest assessments. The study was carried out at SMP Negeri 229 Jakarta in the second semester of the 2025/2026 academic year. The study involved 60 seventh-grade children chosen via cluster random sampling, categorized into two groups: an experimental group ($n = 30$) and a control group ($n = 30$). The experimental cohort was instructed through the AR-enhanced Multiliteracy Learning Model, while the control cohort underwent traditional reading pedagogy. The autonomous variable was the AR-assisted Multiliteracy Learning Model, whereas the reliant variable was the students' reading comprehension. Data were gathered by a reading comprehension assessment conducted prior to the intervention (pretest) and after to the intervention (posttest). The assessment was designed utilizing reading comprehension metrics, such as recognizing core themes, grasping both overt and covert information, drawing conclusions, and appraising written material. Prior to execution, the instrument underwent validation by specialists to confirm its content validity and appropriateness for the research aims. The gathered data were examined utilizing IBM SPSS Statistics 26. Descriptive statistics were employed to ascertain the average scores and score distributions of pupils. The Shapiro-Wilk test was utilized to evaluate the normality of the data, whereas Levene's test was applied to determine the homogeneity of variance. Hypothesis testing was performed utilizing paired-samples t-tests to assess enhancements within each group and independent-samples t-tests to discern disparities between the experimental and control groups. Additionally, N-Gain analysis was conducted to evaluate the efficacy of the educational model in enhancing students' reading comprehension. The significance threshold was established at 0.05.

Results

Students' Reading Comprehension Achievement

To determine the effectiveness of the AR-assisted Multiliteracy Learning Model, descriptive and inferential statistical analyses were conducted on students' pretest and posttest scores. The descriptive statistics are presented in Table 1.

Table 1. Descriptive Statistics of Pretest and Posttest Scores

Group	N	Minimum	Maximum	Mean	SD
Pretest Control	30	19.00	47.00	33.80	6.96
Posttest Control	30	28.00	59.00	45.77	7.35
Pretest Experimental	30	23.00	49.00	35.57	6.51
Posttest Experimental	30	40.00	60.00	52.77	5.79

Table 1 indicates that both cohorts exhibited an enhancement in reading comprehension scores following the educational intervention. Prior to the intervention, the average scores of the experimental group (35.57) and the control group (33.80) were notably alike, suggesting equivalent baseline capabilities. Subsequent to the intervention, the average score of the experimental group rose to 52.77, whereas the control group attained an average score of 45.77. The elevated posttest mean score of the experimental group indicates that students educated using the AR-assisted Multiliteracy Learning Model exhibited superior reading comprehension compared to their peers who underwent traditional instruction.

Normality Test

Before conducting hypothesis testing, the data were examined for normality using the Shapiro-Wilk test. The results are presented in Table 2.

Table 2. Shapiro-Wilk Normality Test

Group	Statistic	df	Sig.
Experimental Pretest	0.964	30	0.402
Experimental Posttest	0.957	30	0.264
Control Pretest	0.972	30	0.613
Control Posttest	0.968	30	0.487

According to Table 2, all significant values above 0.05. Consequently, the pretest and posttest data for both cohorts had a normal distribution and satisfied the prerequisites for parametric statistical evaluation.

Homogeneity Test

The homogeneity of variance was examined using Levene's test. The results are presented in Table 3.

Table 3. Levene's Test of Homogeneity

Variable	Levene Statistic	df1	df2	Sig.
Pretest	0.184	1	58	0.669
Posttest	1.256	1	58	0.267

According to Table 3, the significant values for the pretest and posttest scores surpassed 0.05. The findings suggest that the variances of both the experimental and control groups were consistent. As a result, the data met the prerequisites necessary for conducting an independent-samples t-test analysis.

Improvement of Reading Comprehension Achievement

To determine whether there were significant improvements in students' reading comprehension achievement before and after the intervention, paired-samples t-tests were conducted. The results are presented in Table 4.

Table 4. Paired-Samples t-Test Results

Group	Mean Difference	T	df	Sig.
Control	11.967	6.074	29	0.000
Experimental	17.200	11.090	29	0.000

The findings reveal that both cohorts demonstrated statistically significant enhancements in reading comprehension performance, as evidenced by significance values of 0.000 ($p < 0.05$). Nonetheless, the extent of enhancement varied between the two cohorts. The experimental cohort achieved an average increase of 17.20 points, far surpassing the control group's increase of 11.97 points. The results indicate that the application of the Augmented Reality-assisted Multiliteracy Learning Model led to enhanced reading comprehension among pupils.

Comparison of Posttest Achievement

To determine whether significant differences existed between the posttest scores of the experimental and control groups, an independent-samples t-test was conducted. The results are presented in Table 5.

Table 5. Independent-Samples t-Test Results

Variable	t	df	Sig.	Mean Difference
Posttest Experimental vs Control	3.980	58	0.000	7.000

The findings demonstrate a statistically significant disparity in the posttest scores between the experimental and control groups ($p < 0.05$). The average disparity of 7.00 points indicates that participants in the experimental group attained superior reading comprehension scores compared to those in the control group. Consequently, the Augmented Reality-enhanced Multiliteracy Learning Model yielded superior educational results compared to traditional teaching methods.

Effectiveness of the Augmented Reality-Assisted Multiliteracy Learning Model

The effectiveness of the learning model was further examined through N-Gain analysis. The results are presented in Table 6.

Table 6. N-Gain Analysis Results

Group	Pretest Mean	Posttest Mean	N-Gain	Percentage (%)	Category
Control	33.80	45.77	0.405	40.5	Moderate
Experimental	35.57	52.77	0.681	68.1	High

The N-Gain evaluation reveals that the experimental cohort had a greater degree of enhancement compared to the control cohort. The experimental group secured an N-Gain score of 0.681, classified as high, whereas the control group attained an N-Gain score of 0.405, deemed moderate. The disparity of 27.6 percentage points between the two cohorts further reflects the efficacy of the intervention applied in the experimental group.

The results offer compelling proof that the Augmented Reality-assisted Multiliteracy Learning Model significantly enhances students' reading comprehension performance. This efficacy is substantiated by three principal metrics. Initially, the experimental cohort demonstrated a statistically significant enhancement from pretest to posttest. Secondly, the posttest performance of the experimental group was markedly superior to that of the control group. Thirdly, the N-Gain score of the experimental cohort attained a high classification, while the control cohort persisted in the intermediate classification. These findings validate that the amalgamation of multiliteracy pedagogy and Augmented Reality technology fosters a more captivating and significant educational atmosphere, hence improving students' reading comprehension abilities more efficiently than traditional instructional methods.

Discussion

The results of this research indicate that the Augmented Reality-enhanced Multiliteracy Learning Model markedly enhanced students' reading comprehension abilities. This conclusion is substantiated by the statistical findings, which indicated a notable enhancement in the experimental group's performance from pretest to posttest ($p = 0.000$), a significant disparity between the posttest scores of the experimental and control groups ($p = 0.000$), and a superior N-Gain score in the experimental group (0.681)

relative to the control group (0.405). The findings suggest that students engaged in learning activities that combined multiliteracy pedagogy with Augmented Reality technology demonstrated superior advancements in reading comprehension compared to their peers who underwent traditional instruction.

The model's efficacy can be elucidated using the tenets of multiliteracy education. The New London Group (1996) posits that literacy in modern society transcends conventional reading and writing, encompassing the capacity to decipher and create meaning through many forms of communication. In this research, learners interacted with texts in visual, digital, and interactive formats, allowing them to examine information from multiple viewpoints. These educational experiences motivated students to actively create understanding, evaluate information, and relate textual material to their existing knowledge. Consequently, learners cultivated a more profound comprehension of the literature they engaged with. This discovery aligns with the assertions of Cope and Kalantzis (2020), who contended that multiliteracy pedagogy fosters significant learning by motivating learners to interact with diverse modes of representation and communication.

The notable enhancement seen in the experimental group indicates that the multiliteracy method effectively transitioned the educational paradigm from teacher-directed instruction to learner-focused education. Throughout the execution of the model, students engaged in observing, debating, understanding, and assessing information conveyed via texts and digital media. This situation differs from traditional educational methods, in which learners frequently serve as inactive recipients of knowledge. Active participation in the learning process has been acknowledged as a vital element affecting reading comprehension, as it enables students to build knowledge through interaction and contemplation. Consequently, the superior performance of the experimental group might be ascribed to the chances afforded for active engagement and collective interpretation during the educational experience.

An additional element enhancing the model's efficacy is the incorporation of Augmented Reality technology. Augmented reality technology allowed learners to see written information via three-dimensional models, animations, and engaging digital media. These attributes assisted learners in grasping abstract notions, seeing connections between ideas, and understanding the chronological order of events depicted in texts. For learners who had previously struggled with recognizing central concepts, drawing conclusions, and deciphering implicit details, AR offered contextual assistance that enhanced understanding. This discovery corroborates the research conducted by Garzón and Acevedo (2021), which determined that augmented reality learning markedly enhances students' comprehension, motivation, and academic performance in various educational settings.

The results are consistent with Mayer's (2021) Cognitive Theory of Multimedia Learning, which posits that learners comprehend information more efficiently when auditory and visual elements are delivered concurrently. By combining textual resources with augmented reality representations, learners could engage with information via several cognitive pathways, leading to more significant educational experiences. The visual assistance offered by AR diminished cognitive obstacles often faced during reading tasks and aided pupils in organizing information more efficiently. As a result, learners exhibited enhanced understanding of written material and attained superior results on the post-assessment.

Moreover, the elevated N-Gain score attained by the experimental group signifies that the model was both statistically significant and pedagogically relevant. The N-Gain value

of 0.681 is classified as high, indicating significant enhancement in students' reading comprehension skills. Conversely, the control group attained a moderate N-Gain score of 0.405, suggesting that traditional teaching methods were less efficacious in promoting learning advancement. These results furnish factual proof that the amalgamation of multiliteracy pedagogy and augmented reality technology yields superior advantages compared to conventional methods in reading education.

The findings of this research further augment the expanding corpus of literature related to technology-facilitated literacy education. Prior research has indicated the beneficial impact of multiliteracy pedagogy on literacy advancement and the efficacy of augmented reality technology in enhancing learning engagement. Nonetheless, research integrating these two methodologies in Indonesian language acquisition is still scarce. Consequently, this study builds upon earlier discoveries by illustrating that the amalgamation of multiliteracy and augmented reality can significantly enhance reading comprehension in middle school children. The integration of multimodal literacy techniques with interactive digital technology fosters a learning atmosphere that is increasingly engaging, contextual, and pertinent to the requirements of twenty-first-century students.

The results indicate that the Augmented Reality-assisted Multiliteracy Learning Model serves as a potent pedagogical advancement for Indonesian language education. In addition to enhancing reading comprehension proficiency, the model fosters active learning, analytical thinking, teamwork, and digital literacy competencies. These skills are crucial for learners navigating a swiftly changing digital landscape. Consequently, the use of this strategy could provide a beneficial option for educators aiming to elevate literacy teaching and augment students' academic performance in Indonesian language settings..

Conclusion

The research determines that the Augmented Reality-enhanced Multiliteracy Learning Model significantly enhances the reading comprehension skills of seventh-grade pupils at SMP Negeri 229 Jakarta. This finding is corroborated by the notable enhancement observed in the experimental group, which exhibited a mean rise of 17.20 points and a significance level of 0.000 ($p < 0.05$). Additionally, the independent-samples t-test revealed a notable disparity between the experimental and control groups, with a mean posttest difference of 7.00 points ($p = 0.000$). The N-Gain analysis revealed that the experimental group attained a score of 0.681 (68.1%), classified as high, in contrast to the control group's score of 0.405 (40.5%), which is classified as moderate.

The results enhance the advancement of multiliteracy-oriented and technology-infused Indonesian language education by illustrating that the integration of multimodal learning with Augmented Reality fosters a more engaging, contextual, and learner-centric educational atmosphere. The model can effectively function as a supplementary teaching method for Indonesian language educators to enhance students' reading comprehension while also promoting active learning and digital literacy.

Nonetheless, this research possesses multiple constraints. The study was performed in a single junior high school with a modest sample size of 60 pupils, perhaps limiting the applicability of the results to other educational settings. Subsequent investigations ought to encompass larger and more varied cohorts across various educational institutions and levels. Subsequent research could investigate the efficacy of the paradigm in fostering additional literacy-related skills, including critical thinking, digital literacy, writing, and multimodal literacy.

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