

LEVERAGING AUGMENTED REALITY (AR) LEARNING MEDIA INTEGRATED WITH ASSEMBLR EDU TO ENHANCE EFL STUDENTS' VOCABULARY RETENTION

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ABSTRACT

Vocabulary retention remains a significant challenge in learning English as a Foreign Language (EFL), especially in settings with limited language exposure. Conventional teaching methods are often less interactive and less effective at supporting long-term vocabulary retention. This study aims to determine the effect of Augmented Reality (AR) learning media integrated with Assemblr Edu on the vocabulary retention of EFL students at SMPN 1 Terara. This study used a one group pre-experimental design with a pre-test and post-test involving 30 eighth-grade students selected through cluster random sampling. Data were collected using a vocabulary retention test consisting of 20 items and were analyzed using descriptive statistics, the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, a paired t-test, and Normalized Gain (N-Gain). The results showed that the students' average score increased from 66.67 on the pre-test to 80.83 on the post-test, with an average difference of 14.17 points. The paired-sample t-test yielded a t-value (29) of 14.167, $p = 0.000 (< 0.05)$, indicating a statistically significant difference between the pre-test and post-test scores, thereby rejecting the null hypothesis (H_0) and confirming the alternative hypothesis (H_1). The N-Gain analysis yielded an average score of 42.38% (medium category). These findings indicate that AR media integrated with Assemblr Edu is quite effective in improving EFL students' vocabulary retention through interactive, contextual, and immersive learning experiences.

Keywords: *Augmented Reality, Assemblr Edu, EFL, Vocabulary Retention, Pre-Experimental.*

ABSTRAK

Retensi kosakata masih menjadi tantangan signifikan dalam pembelajaran Bahasa Inggris sebagai Bahasa Asing (EFL), terutama di lingkungan dengan paparan Bahasa yang terbatas. Metode pengajaran konvensional sering kali kurang interaktif dan kurang mampu mendukung retensi kosakata jangka panjang. Penelitian ini bertujuan untuk mengetahui pengaruh media pembelajaran Augmented Reality (AR) yang terintegrasi dengan Assemblr Edu terhadap retensi kosakata siswa EFL di SMPN 1 Terara. Penelitian ini menggunakan desain pra-eksperimental one-group pre-test post-test yang melibatkan 30 siswa kelas VIII yang dipilih melalui cluster random sampling. Data dikumpulkan menggunakan tes retensi kosakata yang

terdiri atas 20 butir soal, kemudian dianalisis dengan statistik deskriptif, uji normalitas Kolmogorov-Smirnov dan Shapiro-Wilk, uji t berpasangan, serta Normalized Gain (N-Gain). Hasil penelitian menunjukkan bahwa nilai rata-rata siswa meningkat dari 66,67 pada pre-test menjadi 80,83 pada post-test, dengan selisih rata-rata sebesar 14,17 poin. Uji t sampel berpasangan menghasilkan nilai $t(29) = 14,167$, $p = 0,000 (< 0,05)$, yang menunjukkan adanya perbedaan yang signifikan secara statistik antara skor pra-tes dan pasca-tes, sehingga menolak hipotesis nol (H_0) dan mengkonfirmasi hipotesis alternatif (H_1). Analisis N-Gain menghasilkan skor rata-rata sebesar 42,38% (kategori menengah). Temuan ini menunjukkan bahwa media AR yang terintegrasi dengan Assemblr Edu cukup efektif dalam meningkatkan retensi kosakata siswa EFL melalui pengalaman belajar yang interaktif, kontekstual, dan imersif.

Kata kunci: *Realitas Tertambah, Assemblr Edu, Bahasa Inggris sebagai Bahasa Asing (EFL), Retensi Kosakata, Pra-Eksperimental.*

A. Introduction

In the context of education, particularly in the teaching of English as a Foreign Language (EFL), the challenge of vocabulary retention remains significant. Several EFL students struggle to memorize and use vocabulary correctly due to teaching methods that are still conventional and lack interactivity (Pamungkas et al., 2024). Digital transformation in education is driving the use of technology as an innovative learning medium. One such technology in the development of learning media is Augmented Reality (AR), which can interactively combine virtual objects with the real world (Mustaqim, 2016, p.175).

Azuma (1997) adds that Augmented Reality (AR) is a

technology that combines virtual objects with the real world in real-time. One example of an application that use Augmented Reality (AR) technology is Assemblr Edu. Assemblr Edu is an application developed to create interactive and engaging three-dimensional (3D) and Augmented Reality (AR) content by combining various existing objects (Assemblr, 2023). The researcher adds that this application can be used by students, teachers, educational developers, or instructors.

Assemblr Edu is one approach to created interactive learning materials that are effective in stimulating students' interest in learning and improving learning outcomes (Chairudin et al., 2023, p. 1313). Based on the research

conducted by Dewi et al. (2022), the use of the Assemblr Edu application in mathematics instructions at the vocational high school level was effective in improving learning outcomes, with 73.2% of students showing positive results. Furthermore, there was also an increase in enthusiasm during instruction due to the use of the Assemblr Edu application (Dewi et al., 2022, p.107). The above discussion is supported by the findings of Ibáñez & Delgado-Kloos, (2018), who noted that AR has been shown to enhance engagement and understanding of abstract concept through concrete visualization Ibáñez & Delgado-Kloos, (2018). Meanwhile digital assessment platforms such as Assemblr Edu have seen rapid growth learning tools. The use of this platform provides an opportunity to present vocabulary in contextual three-dimensional visual forms. Khoshnevisan (2022) demonstrates that AR can help students understand the contextual use of vocabulary.

The researcher observes that the use of appropriate learning media plays a crucial role in enhancing the effectiveness of students' learning processes. Although technology continues to advance, its

implementation in EFL education still faces various challenges. Many students struggle to understand English language material due to limited vocabulary, low motivation to learn, and the use of teaching methods that lack variety (Nation, 2022). In addition, teachers still tend to use conventional media that are less effective at explaining abstract concepts. The application of AR in education can enhance learning motivation, conceptual understanding, and student engagement in the learning process (Uriawan et al., 2025

Previous research has shown that the use of AR can improve students' conceptual understanding and motivation to learn. Delgado-Kloos (2018) found that AR enhances information retention and visual comprehension in language learning. Another study by Radianti et al. (2020) indicated that AR was effective in increasing student engagement in technology-based learning. Furthermore, in mathematics education, the use of the Assemblr Edu app at the vocational high school level was effective in improving learning outcomes, with 73.2% of students demonstrating positive results (Dewi et al., 2022, p.107).

The application of AR to improve students' visualization, engagement, conceptual understanding, and overall learning outcomes has been the main focus of earlier research (Delgado-Kloos, 2018, Radianti et al., 2020). Meanwhile, studies on the use Assemblr Edu generally emphasize increased motivation and interest in learning, without through testing its effectiveness on vocabulary retention as a cognitive learning outcome (Chairudin et al., 2023). Besides that, some studies use qualitative methods or small scale-experiments, thus failing to provide strong quantitative evidence regarding the effectiveness of this technological combination (Radianti et al., 2022, p.7)). Therefore, further research is needed to examine the effect of using AR integrated with Assemblr Edu on EFL students' vocabulary retention.

This research gap highlights the need for research that integrates Augmented Reality (AR) with interactive platforms such as Assemblr Edu in EFL learning context. Such integration has the potential to provide a more engaging learning experience while supporting students' vocabulary retention. Therefore, this

study aims to provide empirical evidence regarding the effectiveness of AR integrated with Assemblr Edu in improving EFL students' vocabulary retention through a quantitative approach. The findings are expected to contribute to development of technology enhance English language learning and offer practical insight for educators in selecting effective learning media.

B. Methodology

The research method will be used in this study is a quantitative research method with an experimental approach. The choice of a pre-experimental design is based on the research objective of measuring changes in students' vocabulary retention before and after the intervention. This aligns with the opinion of Ary et al. (2019), who stated that the one-group pre-test and post-test design allows researchers to observe changes occurring in a single group after the intervention by comparing pre-test and post-test scores. The experimental group will be exposed to a learning intervention using Augmented Reality (AR) educational media integrated with Assemblr Edu. The research design to

be implemented can be described as follows:

Table 1
One group Pre-test – Post-test Design

	Pre-test	Treatment	Post-test
Xa	T1	X	T2

This study will be conducted at SMPN 1 Terara during the 2026/2027 academic year. The selection of this location is based on academic and practical considerations relevant to the research objectives. In addition, the school is selected due to its accessibility for the researcher and the ease of obtaining permission and access to the research participants. This time frame is considered sufficient for administering the pre-test, implementing the treatment using Augmented Reality (AR) learning media integrated with Assemblr Edu, and conducting post-test.

The population of this study is all of the eighth-grade consist of students at SMPN 1 Terara during the 2026/2027 academic year. This population will be selected because it possesses characteristics relevant to the research context, namely students currently studying English as a foreign language (EFL) who have a need to enhance their vocabulary retention

through the use of technology-based media.

The researcher collects data through tests consisting of a pre-test and a post-test. During the first session, the experimental group takes a pre-test to measure their initial ability to understand the English learning material without any intervention. This test aims to assess the students' initial understanding before implementing learning using Augmented Reality (AR) integrated with Assemblr Edu.

C. Results and Discussion

1. Descriptive Statistic

This study involved 30 eighth-grade students from SMPN 1 Terara who were grouped into a single experimental group. Data were collected using test instrument consisting of 20 items, including 10 multiple choice questions, 5 picture-matching questions, and 5 word-class analysis questions. The test was administered as a pre-test before the intervention and a post-test after intervention using Augmented Reality (AR) learning media integrated with Assemblr Edu. Data analysis was performed using SPSS Statistic 20 for Windows software.

Table 2 The result of the pre-test and post-test

	Test	Lowest Score	Highest Score
Experimental Group	Pre-test	50	85
	Post-test	65	95

Based on the Table, it can be seen that in the pre-test phase, the lowest score obtained by students in the experimental group was 50 and the highest score reached 85. Meanwhile, in the post-test phase, the lowest score increased to 65 and the highest score reached 95. This significant shift in the lower and upper limits generally indicates an improvement in vocabulary retention ability after the treatment using AR media integrated with Assemblr Edu. Furthermore, a more detailed descriptive statistical analysis, including the average (mean), standard deviation, minimum and maximum values, is presented in table 3 below.

Table 3 Descriptive Statistics

Statistic	Pretest	Posttest
Mean	66.6667	80.8333
Median	70	80
Mode	70	85
Standard Deviation	9.4989	7.9960
Minimum	50	65
Maximum	85	95

Based on the data, the lowest score on the pre-test was 50 and the highest was 85 with a mean score of 66.67 and a standard deviation of 9.498, while the lowest score on post-test was 65 and the highest was 95 with a mean score of 80.83 and standard deviation of 7.996. The average difference between pre-test and post-test was 14.17 points, indicating a significant increase in students' vocabulary retention after using AR media integrated with Assemblr Edu. The median pre-test score of 70 and post-test score of 80 also reinforced this picture.

Before hypothesis testing was conducted, a normality test was first conducted to ensure that the pre-test and post-test score data were normally distributed, so that the use of parametric statistical tests could be methodologically justified. As explained in Chapter III, the normality test was conducted using the Kolmogorov-Smirnov test using SPSS Statistics 20 software. However, considering the number of samples in this study was $N = 30$, the Shapiro-Wilk test because it was also considered more sensitive and accurate for small to medium-sized samples ($n \leq 50$). The decision-

making criteria used were if the significance value ($p \geq 0.05$), then the data was declared normally distributed, conversely, if $p < 0.05$, the data was declared not normally distributed. The results of the normality test are presented in Table 4.

Table 4 Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre test	0.171	30	0.026	0.935	30	0.066
Post test	0.166	30	0.035	0.942	30	0.106

a. Lilliefors Significance Correction
b. Source: primary data (pre-test post-test) was processed in June 2026 by SPSS

According to the SPSS data result, the Shapiro-Wilk test shows that the pre-test score obtained a significance value of 0.066, which is higher than 0.05. This result indicates that the pre-test data were normally distributed. Similarly, the post-test score obtained a significance value of 0.106, which is also higher than 0.05. Therefore, the post-test data were also normally distributed. Although, the Kolmogorov-Smirnov test showed a significance value of 0.026 for the pre-test and 0.035 for the post-test, these results were not used as the basic for interpretation because the sample

size was 30. According to the criterion for samples of 50 or fewer, the Shapiro-Wilk provides a more appropriate assessment of data normality.

2. Statistic Required Testing Hypothesis

a. T-test

The t-test is used to determine whether the researcher accepts or rejects the null hypothesis or the alternative hypothesis. The t-test in this study is an independent samples t-test and a significance test. If the p-value or sig (2-tailed) greater than the significance level of sig = 0.05 the null hypothesis is accepted. If the p-value is less than sig = 0.05, then the alternative hypothesis is accepted. The t-test is conducted using SPSS version 20. The hypotheses tested was H_0 : There is no significant effect using Augmented Reality integrated with Assemblr Edu on students' vocabulary retention. H_1 : There is significant effect using Augmented Reality integrated with Assemblr Edu on students' vocabulary retention. The results of the paired t-test are presented in Table 6 and 7 below.

Table 5 Paired Samples Statistics

Variable	Mean	N	Std. Deviation	Std. Error Mean
Posttest	80.83	30	7.996	1.460
Pretest	66.67	30	9.499	1.734

Table 6 Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper			
Posttest - Pretest	14.167	6.576	1.201	11.711	16.622	11.799	29	.000

Tables 5 and 6 present the results of the paired samples t-test conducted to test the research hypothesis, namely whether there is a statistically significant difference between students' vocabulary retention scores before and after the implementation of AR learning media integrated with Assemblr Edu. Based on the Table 7, the results of the paired t-test showed that the mean paired difference between the pre-test and post-test was 14.17, with a standard deviation of 6.576 and the standard error of 1.201. The confidence interval (CI) shows a range of values between 11.711 and 16.622 which is entirely on the negative side and excludes the zero valued.

This further confirms that the difference between the pre-test and post-test is significant and consistent. The calculated t-value obtained was 11.799 with degrees of freedom (df=

29) and a significance value (2-tailed) of 0.000. This significance value is much smaller than the $\alpha = 0.05$ level ($p = 0.000 < 0.05$), so H_0 is rejected and H_1 is accepted. Thus, it can be concluded that there is a statistically significant difference between students' vocabulary retention score before and after using Augmented Reality (AR) learning media integrated with Assemblr Edu. The rejection of H_0 aligns with the theoretical framework proposed by Mayer (2005) through the Cognitive Theory of Multimedia Learning becomes more effective when information is presented simultaneously through verbal and visual channels, as was done by the Assemblr Edu-based learning media in this study. The results indicate that the intervention provided has a significant effect on improving English vocabulary retention of eighth-grade EFL students at SMPN 1 Terara.

b. Average Pre-test and Post-Test Scores

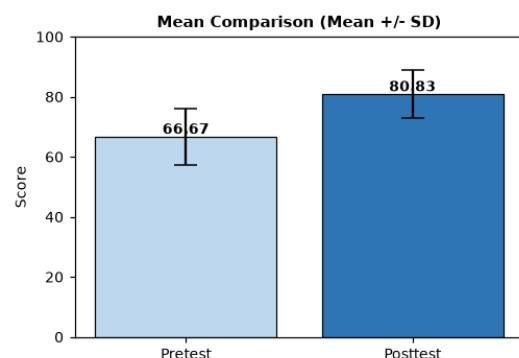


Figure 1. Mean comparison of pretest and posttest (Mean $\pm$ SD).

Figure 1 shows a comparison of the mean scores between the pre-test and post-test of the experimental group, which consisted of 30 eighth-grade EFL students. The chart illustrates an increase in students' vocabulary retention after the implementation of Augmented Reality integrated with Assemblr EDU. The x-axis represents the two testing phases, namely the pre-test and post-test, while the y-axis represents the mean scores. As shown in the figure, the mean score increased from 66.67 in the pre-test to 80.83 in the post-test, indicating an improvement in students' vocabulary retention after the treatment.

In summary, Figure 1 illustrates the improvement in students' vocabulary retention after the implementation of Augmented Reality integrated with Assemblr Edu. The mean score increased from 66.67 in the pre-test to 80.83 in the post-test, indicating a substantial improvement in students' learning outcomes that the difference between the pre-test and post-test scores was statistically significant.

c. Normalize Gain (N-Gain)

Table 8
N-Gain Effectiveness Interpretation Criteria

N-Gain Value	Category
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Medium
$g < 0.30$	Low

To measure the effectiveness and magnitude of improvement in students' vocabulary retention more comprehensively, the researcher used the Normalized Gain (N-Gain) formula proposed by Meltzer (as cited in Ramadhani & Izzati, 2023). Gain is calculated based on the difference between the post-test and pre-test score divided by the difference between the maximum ideal score pre-test score. The N-Gain interpretation categories used are; High if the N-Gain value $g \geq 0.70$; Medium if $0.30 \leq \text{N-Gain} < 0.70$; and Low if $\text{N-Gain} < 0.30$. The distribution of the N-Gain calculation results for all 30 students in the experimental group is presented in Table 7 below.

Table 7 N-Gain Effectiveness Interpretation Criteria

N-Gain Value	Students	N-Gain (%)	Category
$g \geq 0.70$	2	6.7%	High
$0.30 \leq g < 0.70$	22	73.3%	Medium
$g < 0.30$	6	20.0%	Low
Mean	30	42.38%	Medium

Based on the data above, shows that the total 30 students in the experimental group, 2 students (6.7%) were in the high N-Gain category (N-Gain value > 0.70), which means that their vocabulary retention improvement was very effective. The majority of students, namely 22 students (73.3%), were in the medium N-Gain category ($0.30 \leq \text{N-Gain} \leq 0.70$), indicating that the intervention provided significant improvement for the largest proportion of the study participants. The low N-Gain category (20.0%) were 6 students, indicating that all students experienced improved vocabulary retention after the treatment. The average N-Gain valued for the experimental group as a whole was 0.4238 (42.38). Overall, the distribution of N-Gain categories supports the effectiveness of Augmented Reality integrated with Assemblr Edu as a learning medium for enhancing students' vocabulary retention. These findings are consistent with the average N-Gain score, which falls within the medium category, indicating a moderate level of effectiveness in improving students' vocabulary retention. This is consistent with Mayer's (2005) principle regarding the modality effect,

whereby information conveyed through a simultaneous combination of visual and verbal cues is more easily processed and retained in students' working memory.

D. Conclusion

Based on the data analysis and discussion presented in Chapter IV, this study concludes that the use of Augmented Reality (AR) learning media integrated with Assemblr Edu has a significant and positive effect on the vocabulary retention of eighth-grade EFL students at SMPN 1 Terara in the academic year 2026/2027. This conclusion is drawn from three converging lines of statistical evidence. First, descriptive statistical analysis revealed a substantial improvement in students' mean vocabulary retention scores, rising from 66.67 on the pre-test to 80.83 on the post-test a mean difference of 14.17 points. The minimum score increased from 50 to 65 and the maximum score from 85 to 95, with the post-test minimum exceeding the pre-test maximum, indicating that the treatment elevated the performance of all participants across the board. This improvement was further illustrated visually in the average score diagram

(Figure 15), which depicts a steep and consistent upward trajectory.

Second, the results of the paired samples t-test ($df = 29$) = 11.711 with a significance value of $p = .000$, which is considerably smaller than the significance threshold of $\alpha = .05$. These results led to the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_1), confirming that the observed difference in vocabulary retention scores before and after the intervention is statistically significant. The 95% confidence interval of the mean difference, spanning from 11.711 to 16.622, corroborates the consistency and reliability of this finding.

Third, the Normalized Gain (N-Gain) analysis produced a mean N-Gain score of 0.424, classified in the medium category. The distribution of N-Gain scores showed that 2 students (6.67%) achieved high improvement and 22 students (73.3%) achieved medium improvement, and 6 students were in the low category (20.0%). This indicates that all 30 participants demonstrated meaningful vocabulary retention gains as a result of the AR-based intervention, confirming the

effectiveness and equitable impact of the learning medium.

In summary, the integration of Augmented Reality (AR) with Assemblr Edu as a learning medium creates an immersive, three-dimensional, and contextually rich learning environment that substantially enhances EFL students' capacity to retain English vocabulary. These findings are aligned with Mayer's (2005) Cognitive Theory of Multimedia Learning, which asserts that presenting information simultaneously through visual and verbal channels optimizes information processing in working memory and supports durable long-term retention.

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