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The effectiveness of using augmented reality to improve young learners' english vocabulary mastery

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Abstract

This research was conducted to examine the effectiveness of using Augmented Reality to improve young learners' English vocabulary mastery and to find out the students' perceptions after using Augmented Reality as a learning medium at one of elementary schools in Surabaya. This research used mix-method research design (quantitative and qualitative). The data collected using pre-test, post-test and questionnaire. The results of the students' pre-test and post-test were analysed quantitatively using the independent sample t-test through SPSS 27, and the results of the questionnaire data were analysed qualitatively. The result indicated that Augmented Reality effectively improved young learners' English vocabulary mastery with the mean scores in the experimental group increased notably from 37,6133 in the pre-test to 75,4000 in the post-test. According to the data of questionnaire, the students mostly agreed that their scores were improved because Augmented Reality offered interesting and enjoyable learning experience. This was an indication that using Augmented Reality not only significantly improve vocabulary scores but also positively impacts students' perceptions of the learning process.

Keywords: Effectiveness, Perception, Augmented Reality, English Vocabulary Mastery, Young Learners

INTRODUCTION

The importance of this topic lies in addressing the challenge of low English proficiency in countries like Indonesia, where English is taught as a foreign language primarily in formal classroom settings. This research contributes in examining the effectiveness of using Augmented Reality technology in improving young learners' English vocabulary mastery.

English holds significant importance for Indonesian students, particularly for young learners. Introducing English to young learners early is crucial to familiarize them with the language. Moreover, acquiring English language at an early age is easier. It is because young learner is in the golden period of learning. According to Oktaviani and Fauzan, 2017, in this period, a child has a superior

ability in acquiring the sets or units of language due to plasticity and virginity of their brain. Young learners typically refer to children in the early stages of their education, often in elementary or primary school.Bakhsh, 2016 stated that young learners are generally considered to be children ranging from five or six years old who are in the first year of elementary schooling and up to twelve years old.

Although young learners have a superior ability in acquiring the sets or units of language, most of them struggle with English vocabulary mastery due to limited exposure and inappropriate learning media and method. Limited vocabulary exposure refers to the condition where an individual has not been sufficiently exposed to a wide range of words and phrases in a language. Someone with limited vocabulary will face difficulty in delivering and understanding ideas of what people say (Saputri et al., 2022). As a result, it will hamper the successfulness of communication and make it harder for someone in learning anything well. In addition to limited vocabulary exposure, inappropriate learning media and method used during the learning process can also affect the English vocabulary mastery.

According to Puspitaloka et al., 2022, learning media holds a relatively significant position within the learning system as one of its components. By using learning media, teachers will be easier to deliver the materials to the students so that the learning materials can be clearly understood. In this modern era, people should adapt to the development of technology which is marked by rapid changes from the traditional things to the modern ones. Education is one of the fields that is influenced by technological development and teachers are expected to be able to integrate learning process with technology. According to Cahyadi et al., 2022, using advanced technology as learning media in English classroom will increase students' enthusiasm in learning the language and improve their language abilities. The integration of technology, particularly Augmented Reality (AR), in English language teaching is proposed as a solution to improve vocabulary mastery among young learners. Augmented Reality, with its engaging and interactive features, has the potential to make learning more appealing and effective, thereby it can improve students' motivation and proficiency in English vocabulary (Nugraha et al., 2019;Takkaç Tulgar et al., 2022; Khan et al., 2023). Another benefit of AR in the world of education is that the interactive nature of Augmented reality can encourage learning to be student-centred learning (Jamrus and Razali, 2019). This research aims to explore the effectiveness of AR in overcoming the current limitations of traditional vocabulary teaching methods.

There have been some previous studies related to Augmented Reality (AR). One of them was a study by Chen and Chan, 2019, entitled "Using Augmented Reality Flashcards to Learn Vocabulary in Early Childhood Education" that was conducted in Macau Kindergarten. This study examined the use of Augmented Reality (AR) flashcards as a tool for language acquisition in early childhood education by comparing them to traditional paper flashcards. The findings indicated that both AR and traditional flashcards could improve children's vocabulary acquisition with no significant difference in effectiveness. A similar study was conducted by Hafidah et al., (2022) entitled "Using Augmented Reality Flashcards to Improve English Vocabulary Mastery for Children Aged 4-5 Years" that aimed to improve English vocabulary proficiency in children aged 4-5 by implementing Augmented Reality flashcards. The results demonstrated a significant improvement in the children's English vocabulary proficiency, with their proficiency level rising from 35% in the first cycle to 85% by the end of the third cycle, falling into the "very well-developed" category. Last of all, a study was done by Khan et al., (2023), entitled "Assessing the efficacy of augmented reality in enhancing EFL vocabulary". Their study assessed the impact of AR in developing vocabulary learning. The data analysis, using the T-Test, revealed that AR effectively improved learners' vocabulary skills, and the students had a positive perception of the implementation of AR in their vocabulary learning experiences.

Previous research on the use of Augmented Reality (AR) in language learning has identified several obstacles and gaps. In Chen and Chan's 2019 study, while children enjoyed AR activities, teachers noted challenges in implementing AR flashcards in a kindergarten setting, such as technical difficulties and the need for additional training. Hafidah et al.'s 2022 study demonstrated significant improvements in vocabulary proficiency, but the classroom-action research approach and small sample size (20 children) may limit the generalizability of the findings. Additionally, the study did not compare AR with other teaching methods, leaving its relative effectiveness unclear. Khan et al.'s 2023 study, though showing positive results, was limited to a specific demographic (95 male EFL learners at one university), which may not represent broader populations. Furthermore, the quasi-experimental design and mixed-method approach, while robust, may still be subject to biases and confounding variables that were not fully accounted for. These gaps highlight the need for more comprehensive and diverse studies to better understand AR's impact on language learning.

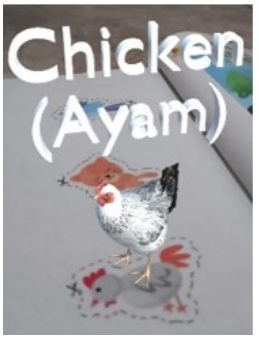
From the previous studies, it can be summarized that the first study which was conducted by Chen and Chan, 2019 and the second which was conducted by Hafidah et al., 2022 involved kindergarten students and the last study which was conducted by Khan et al., (2023) involved students in university as the research subject, while this present research will involve first grade students of elementary school. Secondly, the second study was conducted using Classroom Action Research method, while this research will be conducted using mixed-method approach. Thirdly, the last study had similarity with this present research in which both of them use mix-method approach however the last study differs from this present research in which the last study used a quasi-experimental design while this present research will use true experimental design.

The purpose of this research is to determine the effectiveness of Augmented Reality (AR) in improving young learners' English vocabulary mastery and to understand students' perceptions of using AR. This research is significant both theoretically and practically. Theoretically, this research is expected to give insights of Augmented Reality as the learning media for teaching English vocabulary mastery. Practically, it aims to improve students' vocabulary mastery through engaging 3D visuals, offer teachers a fun and effective teaching media in English vocabulary learning to make the learning process more enjoyable and effective, and serve as a reference for other researchers who are interested in exploring the effectiveness of using Augmented Reality in other English skills.

MATERIALS AND METHOD

2.1 Materials

Augmented Reality (AR) is a digital learning media that was created based on the Merdeka Curriculum-based English subject. It was used to deliver the material on the topic of Kinds of animals (pets) for first-grade students. This research involved Marker-based AR as a learning medium. Marker-based AR uses printed images which are available in the school text-book. Those pictures will be scanned by using handphone. The markers in this study were six animal pictures such as rabbit, chicken, cat, fish, bird, and duck.



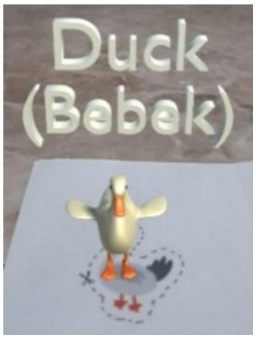


Figure 1. The Display of Augmented Reality

This research used a mixed-method research design (quantitative and qualitative). According to Creswell and Creswell, 2017, mixed-method is an approach which involves the collection of both qualitative and quantitative data in response to research questions or hypotheses. An experimental design was used in this type of quantitative research. According to Kuantitatif, 2016, the experimental research method is a research approach employed to investigate the impact of particular treatment on another factor in controlled conditions. In this research, the experimental design involved two groups and carry out using pre-test and post-test for the first group (the control group) and for the second group (experimental group) using pre-test, treatment, and post-test. The control group consisted of individuals who did not receive any treatment, while the experimental group was the one that received treatment through the use of Augmented Reality. The researcher used qualitative approach to explain the students' perceptions of using Augmented Reality. According to Creswell & David Creswell (2018), qualitative research is an approach used to explore and understand the meanings that individuals or groups assign to a social or human issue. The questionnaire data was analyzed based on a 5-points Likert scale and presented as a pie chart, accompanied by an explanation of the diagram.

This research was conducted on the second semester of elementary school 2023/2024 academic year at Kebonsari 1 elementary school in Surabaya starting from 1 February 2024 until 5 March 2024. The samples of this research were collected by using purposive sampling technique. From four classes, two classes were taken as the samples of this research. This method was selected due to the homogeneity of the population by which the students have the similar English capability. The research sample consisted of first-grade students with 24 students from 1A class as the experimental group and 24 students from 1B class as the control group.

2.2 Data collection procedures

This research conducted tests by distributing pre-test and post-test with identical questions which consisted of 24 questions to students in classroom to assess the effectiveness of Augmented Reality. This research also collected the data by using questionnaire to obtain data on the students' perception of Augmented Reality. In this research, test is divided into pre-test and post-test. A pre-test was a test distributed to the students before they receive treatment. This test aims to assess the young learners' basic proficiency before they receive the treatment. Meanwhile, post-test was administered to both group (experimental and control group) after the experimental group receives treatment. After implementing the treatment and conducting the post-test, the experimental group was given a questionnaire. It was a closed questionnaire consisting of five questions or statements using a Likert scale that was distributed via questionnaire sheet. The questionnaire used a five-points Likert scale to capture the statements of the students in which they could choose among five response levels; (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, (5) strongly agree.

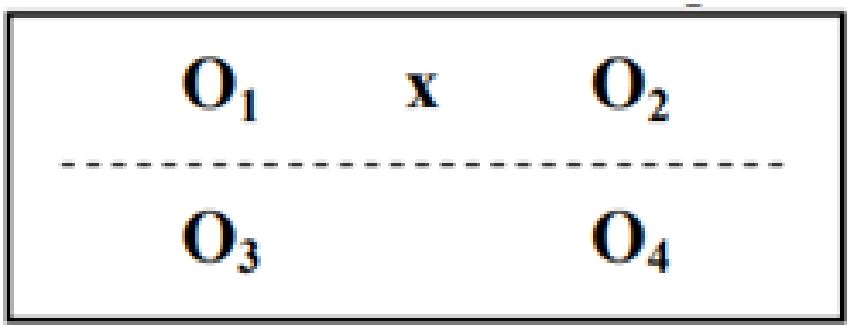


Figure 2. Experimental Design (Sugiyono, 2019)

O1 & O3 = Pre-test results from the initial conditions of the students before the treatment O2 = Post-test result of the students who was taught by using Augmented Reality O4 = Post-test result of the students who was taught by using book or followed a regular teaching technique without any special treatment

2.3 Data analysis procedures

The data analysis technique was conducted after collecting data from all respondents or other sources, including pre-tests, post-tests, and questionnaires. The data analysis techniques in this research involved the use of both inferential and descriptive statistics.

a. Inferential statistics was used to analyze data from both the pre-test and post-test. The researcher utilized the t-test technique to identify the difference in the mean of two independent samples (independent sample t-test). According to Hinton, 2014, An independent sample t-test is a statistical method used to compare the means of two independent groups to determine if there is a statistically significant difference between them. To make the measurement easier, the researcher used SPSS 27 statistical application program. This t-test aimed at comparing the means of two groups and determining if a significant difference exists between them. The criteria for acceptance are H0 if the significance value is > 0.05 which means there is no significant effect of using Augmented Reality in improving young learners' English vocabulary mastery and Ha if the significance value is < 0.05 which means there is a significant effect of using Augmented Reality in improving young learners' English vocabulary mastery. Previously, it is essential to conduct the prerequisite analysis tests, which include normality test, and homogeneity test.

b. Descriptive statistics were applied to analyze the questionnaire data which aimed to draw conclusions from the information collected regarding students' perceptions of using Augmented Reality.

RESULT AND DISCUSSION

3.1 Results

After conducting post-tests for both the experimental and control groups, the researcher aims to compare the data from each group to identify and measure the difference in students' English vocabulary scores. The following table presents pre-test and post-test scores in both control and experimental groups

Table 1. Control and Experimental Groups Scores

Respondent	Control Group		Respondent	Experimental Group	
	Pre-Test	Post-Test		Pre-Test	Post-Test
AFR	0,00	49,92	AP	0,00	62,40
AAS	33,28	41,60	APV	29,12	74,88
ASD	49,92	87,36	AAI	41,60	62,40
ADK	24,96	54,08	AAN	58,24	91,52
AVPA	37,44	41,60	AANS	45,76	74,88
AAP	24,96	49,92	APA	45,76	87,36
BCP	41,60	45,76	AF	62,40	83,20
CARP	24,96	24,96	ARA	29,12	87,36
DAH	0,00	49,92	API	45,76	45,76
FMRU	4,16	24,96	BAAS	49,92	99,84
GYPH	66,56	74,88	DFP	54,08	91,52
GEL	79,04	95,68	DPO	37,44	83,20
HRR	16,64	49,92	DPA	49,92	70,72
MRS	0,00	45,76	FTA	62,40	79,04
MTR	29,12	49,92	GDA	20,80	54,08
MAF	0,00	0,00	KAAE	83,20	99,84
MFA	29,12	41,60	MGA	12,48	41,60
MFA	45,767	54,08	MDPP	20,80	70,72
NNKIF	70,72	79,04	NASF	0,00	70,72
NNGCP	70,72	74,88	PDT	8,32	62,40
SQP	29,12	29,12	RRH	49,92	95,68
VD	4,16	12,48	RAP	16,64	74,88
AVTA	0,00	0,00	SAL	54,08	74,88
EVTA	0,00	8,32	YM	24,96	70,72

Table 1. above indicated the comparison scores of pre-test and post-test obtained by control group who was taught by using book or followed a regular teaching technique without any special treatment and experimental groups who was taught by using Augmented Reality. From the table above, it can be seen that most respondents indicated an improvement from pre-test to post-test. A few respondents indicated minimal or no improvement. For instance, respondent CARP remained at 24.96 in both tests and respondent AVTA and MAF had 0.00 in both tests. In experimental group, most respondents showed significant improvement from pre-test to post-test. For instance, respondent DFP improved significantly from 54.08 to 91.52 and respondent NASF indicated a remarkable improvement from 0.00 to 70.72 and respondent NASF indicated a remarkable improvement from 0.00 to 70.72. The experimental group generally indicated more significant improvements in post-test scores compared to the control group.

Table 2. Descriptive Statistics of Control and Experimental Groups

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test Control	24	0,00	79,04	28,4267	25,39828
Post-test Control	24	0,00	95,68	45,2400	25,65313
Pre-test Experiment	24	0,00	83,20	37,6133	21,44051
Post-test Experiment	24	41,60	99,84	75,4000	15,62861
Valid N (listwise)	24				

Table 2. indicated the mean scores of pre-test and post-test both in control and experimental groups. From the table above, it can be seen that pre-test scores in control group range from 0,00 to 79,04 and Post-test scores range from 0.00 to 95.68. Furthermore, in experimental group, Pre-test scores range from 0.00 to 83.20 and Post-test scores range from 41.60 to 99.84. The mean scores of pre-test and post-test in control group was increased from 28,4267 to 45,2400, which indicates

there is a mean score improvement of 16,81333, while the mean score of pre-test and post-test in experimental group was increased from 37,6133 to 75,4000, which indicates there is a significantly higher mean score improvement of 37,78667. This indicated an improvement in students' scores when they were taught using Augmented Reality.

Before conducting the comparative test of the learning outcomes (Independent Sample t-test), it is essential to conduct the prerequisite analysis tests which include normality test and homogeneity test.

Normality test

A normality test is a statistical procedure used to determine whether a data set is well-modelled by a normal distribution, meaning it assesses whether the data follows a bell-shaped curve typical of a normal distribution. According to Kwak and Park, 2019, basic decision making in normality testing are as follow:

1) H0, If the significant value > 0.05, it indicates the data is normally distributed.
2) Ha, If the significant value < 0.05, it indicates the data is not normally distributed.

The normality test results for the learning outcomes of both experimental and control groups were presented in Table 3.

Table 3. Tests of Normality

			Kolomogorov-Smirnova	
	Kelas	Statistic	df	Sig.
Hasil	PreControl	.164	24	.096
	PostControl	.157	24	.131
	PreExperiment	.148	24	.187
	PostExperiment	.132	24	.200*

*. This is a lower bound of true significance

a. Lillefors Significance Correction

The results of the normality test for the pre-test and post-test scores in both control and experimental groups were indicated in the table above. These results focus on the significance values from the Kolmogorov-Smirnov test. The calculation of the normality test indicated the Sig. value of the control group pre-test was 0,096 and the Sig. value of the experimental group pre-test was 0,187. Then the calculation of the normality test indicated the Sig. value of the control group post-test was 0,131 and the Sig. value of the experimental group post-test was 0,200. Since the significance values exceeded 0,05, the null hypothesis (H0) is accepted, indicating that the data follows a normal distribution. Therefore, it can be concluded that the data is normally distributed.

Homogeneity test

Homogeneity test or homogeneity of variance is a test used to determine if the variances of two or more groups are equal or same. One commonly used method for homogeneity test is Levene's test. This research used SPSS 27 statistical application program with the significance level () = 0.05. The fundamental decision-making criteria for the homogeneity test are as follows: 1) H0, If the significant value > 0.05, it indicates that the data distribution is homogeneous.
2) Ha, If the significant value < 0.05, it indicates that the data distribution is not homogeneous.

The homogeneity test results for the learning outcomes of both experimental and control groups were presented in Table 4.

Table 4. Tests of Homogeneity Variances

		Levene Statistic	df1	df2	Sig.
Hasil	Based on Mean	1.701	3	92	.172
	Based on Median	1.570		92	.202
	Based on Median and with adjusted df	1.570	3	81.285	.203
	Based on trimmed mean	1.677	3	92	.177

The results of the homogeneity test for the pre-test and post-test scores in both control and experimental groups were indicated in the table above. These results focused on the significance values from the Lavene's test. Since the significance values were higher than 0,05, the null hypothesis (H0) is accepted, indicating that the data distribution is homogeneous.

Table 5. Group Statistics

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Hasil	PostControl	24	45.2400	25.65313	5.23642
	PostExperiment	24	75.4000	15.62861	3.19018

The table above indicated that the mean post-test score in experimental group was 75,4000, while mean post-test score in control group was 45,2400. Descriptively, the test results indicated a score difference of 30.16 between the control and experimental groups. The standard deviation value for the experimental group's post-test scores was 15,62861, compared to 25,65313 for the control group. Additionally, the standard error mean value for the experimental group's post-test was 3,19018, whereas it was 5,23642 for the control group.

Table 6. Independent Sample T-Test

Levene's Test for Equality of Variance				t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailde)	Mean Dif-fer-ence	Std. Error Difference	Lower	Upper
Hasil	Equal vari-ances as-sumed	3.077	0.0086	-4.919	46	<,001	-30.16000	6.13167	-42.50241	-17.81759
	Equal vari-ance not as-sumed			-4.919	38.006	<,001	-30.16000	6.13167	-42.57285	-17.74715

Based on the table above, the degrees of freedom (df) was 46 and the p-value (sig. two-tailed) was < 0,001 when the significance level is 0,05. The criteria of acceptance are:
1) H0 is accepted, if the significance value (p-value) is > 0,05
2) Ha is accepted, if the significance value (p-value) is < 0,05
For the interpretation of decision based on the criteria of acceptance above, it can be seen that the p-value (sig. two-tailed) which was < 0,001 is smaller than 0,05. It can be concluded that the hypothesis says that there is a significant effect of using Augmented Reality in improving young learners' English vocabulary mastery. In addition, the results confirmed that Augmented Reality is an effective media for improving young learners' English vocabulary mastery.

Students' Perception of Using Augmented Reality

The questionnaire for the experimental group consisted of five statements that 24 students needed to respond to using a five-points Likert scale. The statements were as follows:

(1) The use of Augmented Reality is helpful in improving English vocabulary mastery.
(2) The use of Augmented Reality allows me to memorize the vocabulary and its meaning easily.
(3) The use of Augmented Reality in learning English vocabulary makes the English vocabulary learning process more fun.
(4) The use of Augmented Reality increases the learning efficiency and effectiveness.
(5) The use of Augmented Reality in learning English vocabulary allows me to have a new learning experience.

Table 7. Questionnaire Responses from students

Question/ Statement	Number of Responses				
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
(1)	22	2	0	0	0
(2)	16	8	0	0	0
(3)	19	4	0	1	0
(4)	14	8	1	0	1
(5)	12	7	2	2	1

For the first questionnaire item, 22 students (92% of the total respondents) strongly agreed, 2 students (8%) agreed, and 0 students (0%) neither agreed nor disagreed, disagreed, or strongly disagreed. The second questionnaire item indicated that 16 students (67% of the total respondents) strongly agreed, 8 students (33%) agreed, and 0 students (0%) neither agreed nor disagreed, disagreed, or strongly disagreed. The third questionnaire item indicated that 19 students (79% of the total respondents) strongly agreed, 4 students (17%) agreed, 0 students (0%) neither agreed nor disagreed, 1 student (4%) disagreed, and 0 students (0%) strongly disagreed. The fourth questionnaire item indicated that 14 students (58% of the total respondents) strongly agreed, 8 students (34%) agreed, 1 student (4%) neither agreed nor disagreed, 0 students (0%) disagreed, and 1 student (4%) strongly disagreed. The fifth questionnaire item indicated that 12 students (50% of the total respondents) strongly agreed, 7 students (29%) agreed, 2 students (8%) neither agreed nor disagreed, 2 students (9%) disagreed, and 1 student (4%) strongly disagreed.

3.2 Discussion

From the data of results above, the comparison of pre-test and post-test results between the experimental and control groups indicated a significant difference in young learners' English vocabulary mastery when experimental group was taught by using Augmented Reality while control group was taught by using book or following a regular teaching technique without any special treatment.

Table 6. contained the results of the independent sample t-test, the p-value (sig. two-tailed) is < 0,001 which is less than 0,05. Based on the hypothesis requirement, if the significance value is less than 0,05, the alternative hypothesis (Ha) is accepted and the null hypothesis (H0) is rejected. This indicated that there is a significant difference between the experimental and control groups especially difference in scores obtained by young learners' after using Augmented Reality. The difference is proven in the pre-test and post-test scores. The results demonstrated that using Augmented Reality can improve young learners' English vocabulary mastery. The mean score for the experimental group increased from 37,6133 in the pre-test to 75,4000 in the post-test. Similarly, the mean score for the control group increased from 28,4267 in the pre-test to 45,2400 in the post-test. This indicated that young learners who used Augmented Reality as a learning medium obtained a higher mean

score compared to those who did not use Augmented Reality. In conclusion, Augmented Reality is effective as a learning media for improving young learners' English vocabulary mastery.

The improvement in the experimental group's post-test scores resulted from the advantages of using Augmented Reality. First, AR technology has made significant contributions to language education by serving as a powerful visual tool that captures learners' attention and enhances their focus during the learning process (Kim and Kim, 2018). It happens because Augmented Reality helps create vivid and memorable associations with new vocabulary. For instance, when learning new words, students can see 3D models or animations that represent the words in real-time as a result it makes the vocabulary more tangible and easier to remember.

Second, Augmented Reality technology significantly enhances language education by creating engaging and enjoyable learning environments (Safar et al., 2016). This engaging and enjoyable environment is likely a key factor behind the improvement in the experimental group's post-test scores. When young learners find the learning process enjoyable and stimulating, they are more motivated in their studies. The use of Augmented Reality makes vocabulary learning more dynamic and appealing, which helps maintain young learners' interest and encourages active participation. As a result, they are more likely to absorb and retain vocabulary effectively. The enjoyable learning atmosphere created by Augmented Reality technology not only keeps young learners focused but also enhances their overall comprehension and memory retention which leads to better performance in post-tests.

The results of data analysis were also in line with the previous studies. The first previous study entitled "Using Augmented Reality Flashcards to Improve English Vocabulary Mastery for Children Aged 4-5 Years" by Hafidah et al., 2022. This study implemented Augmented Reality flashcards as a learning medium for vocabulary learning. The data analysis indicated that using Augmented Reality flashcards for teaching English to 4-5-year-old children at Marsudisiwi Kindergarten has indicated that a significant improvement in their English vocabulary mastery. This improvement is proven from the study's outcomes, particularly in the significant number of children who demonstrated highly developed language skills by the end of the research period. The second previous study entitled "Assessing the efficacy of augmented reality in enhancing EFL vocabulary" by Khan et al., (2023). Their study assessed the impact of AR in developing vocabulary learning. This study used AR virtual field trips for vocabulary learning. The data analysis, using the T-Test, revealed that AR effectively improved learners' vocabulary skills, and the students had a positive perception of the implementation of AR in their vocabulary learning experiences.

In addition to being an effective learning media for helping young learners easily master English vocabulary, Augmented Reality also fosters positive perceptions among students regarding its use in their vocabulary learning experiences. This assertion is supported by the responses to five items on a questionnaire developed by the researcher for the students that can be seen in Table 7. For the first questionnaire item, the students' answers proved that the use of Augmented Reality helps young learners in improving their vocabulary mastery.

The second questionnaire item indicated that Augmented Reality helps young learners easily memorize vocabulary and its meanings. The first and second questionnaire items are in line with Khan et al., (2023) stated that Augmented Reality effectively improved learners' vocabulary skills, and the students had a positive perception of its integration into their vocabulary learning experiences.

The students' responses on the third questionnaire item indicated that using the use of Augmented Reality in learning English vocabulary makes the English vocabulary learning process more fun. As Hafidah et al., (2022) stated that Augmented Reality can help students' learning, making the teaching and learning process more engaging and fun. This is because students can use their smartphones to scan printed images which are available in the book or markers, which then display 3D objects.

The data of fourth questionnaire item indicated that a large majority of students consistently reported positive experiences indicating that the use of Augmented Reality significantly increases learning efficiency and effectiveness.

The fifth questionnaire item indicated that the use of Augmented Reality in learning English vocabulary provides young learners with a novel and engaging learning experience. As Nugraha et al., (2019) stated that Augmented Reality (AR) technologies provide exciting new opportunities for supporting the new learning experiences by superimposing digital information onto the real world. The majority of students responded positively, indicating that this technology not only enhances vocabulary mastery but also introduces an innovative approach to their education.

Based on the presented results, the questionnaire items are interconnected to explain that Augmented Reality significantly improves young learners' English vocabulary mastery. The students' responses demonstrated that using Augmented Reality as a learning medium makes vocabulary learning more engaging and enjoyable. This approach encourages active class participation and helps students identify and memorize vocabulary more effectively. Therefore, it can improve young learners' English vocabulary mastery.

The students' perceptions align with the results of the previous study. The previous study entitled "ARbis Pictus: A Study of Vocabulary Learning with Augmented Reality" by Ibrahim et al., (2018). This previous study used mixed-method survey (questionnaire with short interview) to obtained the students perception on how efficient and engaging they perceived in using Augmented Reality. The previous study's results indicated that Augmented Reality helped students' vocabulary learning by being more realistic, applicable to real life, immersive, and by displaying objects in real time and space which offered an incredibly futuristic experience.

CONCLUCION

This research was conducted to examine the effectiveness of using Augmented Reality to improve young learners' English vocabulary mastery. The results confirmed the acceptance of the alternative hypothesis (Ha) which indicated that the experimental group exhibited significant improvement in English vocabulary mastery after being taught by using Augmented Reality. Consequently, the null hypothesis (H0) was rejected. Therefore, it can be concluded that using Augmented Reality effectively improves young learners' English vocabulary mastery. Furthermore, the students' perceptions were highly positive and indicated that using Augmented Reality as a learning medium makes vocabulary learning more engaging and enjoyable. Based on the conclusion above, Augmented Reality is an effective learning media to improve young learners' English vocabulary mastery, therefore the researcher would like to give recommendations to other researchers who are interested in using Augmented Reality for teaching and learning English or as an alternative reference for conducting future research.

AUTHOR CONTRIBUTION STATEMENT

The role of the authors in this research is described as follows: N.P.R devised the main conceptual idea, created the learning media (Augmented Reality), carried out the experiment, processed the data, performed the analysis of the results, and wrote the manuscript. T.S helped supervise and provided critical feedback or consultation in writing the manuscript. E.P.B and D.D contributed to the final version of the manuscript. T.S, E.P.B, and D.D discussed the results and commented on the manuscript.

DECLARATION

The authors of this study certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such

as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

DATA AVAILABILITY

The dataset generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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