International Journal of Instruction *January 2023 ● Vol.16, No.1*
e-ISSN: 1308-1470 ● www.e-iji.net *p-ISSN: 1694-609X*
pp. 173-190

Article submission code: 20211229163743
Received: 29/12/2021 Revision: 06/07/2022
Accepted: 29/07/2022 OnlineFirst: 10/10/2022

Virtual Reality on Contextual Learning during Covid-19 to Improve Students' Learning Outcomes and Participation

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This study aims to produce and assess the feasibility of historical virtual reality video products developed to create contextual learning and implement developmental instructional media in online learning to improve student outcomes and participation during the pandemic. This research is a research and development (R&D) with a non-equivalent control group quasi-experimental technique to obtain data. The respondents of this study were 88 students of grade X senior high school in Yogyakarta, Indonesia. The results of product development were validated by historical material experts, teachers, and learning media experts to assess the quality and feasibility of the media. Analysis of quantitative data showed a significant effect on improving learning outcomes in the experimental class compared to the control group (sig < .05). Virtual reality instructional media users in the experimental class showed a good increase in participation. Based on the results of this study, VR has proven to be feasible and effective as a contextual learning instructional media because it can present conditions such as real situations and provide experiences for students to be able to improve learning outcomes and learn participation without having to come to a place.

Keywords: virtual reality, contextual learning, student's learning outcomes, student participation, learning

Citation: Setyowati, R. R., Rochmat, S., Aman., & Nugroho, A. N. P. (2023). Virtual reality on contextual learning during Covid-19 to improve students' learning outcomes and participation. *International Journal of Instruction*, *16*(1), 173-190.

INTRODUCTION

Learning history can be studied textually from books and literature and can also be analyzed according to the context of the place where the historical event occurred. Carrying out learning at the scene is beneficial in creating an interactive learning environment to contextualize learning content according to real situations and conditions (Chen et al., 2019; Michel & Smith, 2017; Kawuryan et al., 2021). According to study respondents, text-based instructions would be more successful if accompanied by tangible figurative representations (Elgort et al., 2018). Direct learning at the scene gives students great potential to learn with physical objects (Hwang et al., 2019). One of the things that contextual learning provides is that it allows for students with a detailed understanding of the material (Andrew Obermeier, 2021). Contextual learning can help teachers connect the material with students and encourage them to critically use their knowledge (Suryawati et al., 2010; Setiawan et al., 2020). This involvement allows students to synchronize the knowledge gained with real-life contexts. The result is that the learning received can be more meaningful, varied, and comprehensive (Sailer et al., 2021; Skukauskaitė & Girdzijauskienė, 2021). Furthermore, contextual learning fosters semantic, thematic, and pragmatic links between the target item and other frequently occurring words in context.

Implementing the distance learning system as an emergency online learning due to the Covid-19 pandemic is enough to limit the space for teachers to present contextual learning. Students have indicated anxiety about online learning and difficulty finishing assignments (Patricia Aguilera-Hermida, 2020; Setiawan et al., 2021). Meanwhile, one of the positive sides of the pandemic period during distance hwanglearning is the emergence of learning innovations by utilizing advances in science and technology. Computer-based learning allows students to select, plan, manage, and create their learning activities with great freedom (Arista & Kuswanto, 2018; Aman, 2019). Applying interactive media technology to high school students hopes to learn more independently (González et al., 2015). Several learning frameworks and models were developed with technical support (Låg & Sæle, 2019; Seufert et al., 2020). The use of digital media in learning activities enhances cognitive processes and student participation when storing, activating, and correlating learning materials with technology (Chi & Wylie, 2014).

Student learning outcomes and student participation can be used to observe and determine the depth of the material received by students. Several studies explain that during the Covid-19 pandemic, student learning outcomes in various parts of the world tend to decrease drastically, especially in numeracy and to read abilities (Allensworth, Elaine., Schwartz, 2020; Aucejo et al., 2020; Kuhfeld et al., 2020). The decline in student learning outcomes is also motivated by the loss of time students study (Aucejo et al., 2020; Clark et al., 2021; Hampton et al., 2021). Another factor is the difficulty of monitoring student academic progress due to technical problems often experienced by students (Gross, Betheny, Opalka Alice, 2020).

Over the last several years, a significant trend in education has been the growing understanding by researchers and educators of the importance of moving beyond the

teaching of concepts and facts to include actual behaviors and students' daily lives in learning and teaching (Gebre & Polman, 2020; Kuhn, 2010; Silseth, 2018). Not a few changes have occurred due to the implementation of distance learning during the pandemic. The government simplifies and enforces an emergency curriculum to reduce the psychological burden of students due to studying at home during a pandemic (PG Dikdas, 2020). The sudden application of distance learning and pandemic situations and conditions dramatically affects students' stress levels (Betty, Pfefferbaum, 2020; Kuhfeld, Megan, Tarawasawa, Beth., 2020). Packaging learning to be easy to understand and attract students' attention with technology media is one of the challenges of the teaching and learning process during the pandemic. For textual materials such as history, shifting learning activities to technology requires various adjustments.

Virtual Reality (VR) offers users an experience as if they were in a natural environment through a simulation room created by advanced technology. Virtual reality is believed to create immersive and interactive displays for users (Fromm et al., 2021; Radianti et al., 2020). Virtual reality improves student attention during learning (Amprasi et al., 2022). Spatial immersion created by VR also stimulates users to be in the real world because it looks authentic, and they can feel the atmosphere in the place (Freina & Ott, 2015). These conditions make VR media promising to be used in various fields, including education, especially in online learning systems for students at the higher education level (Roberson & Baker, 2021; Wohlgenannt et al., 2020). Virtual reality is also claimed to provide students with an experience of seeing real objects, placing students as observers, entering a particular space and time, and involving students in a virtual environment (Basu & Johnsen, 2014; Kwon, 2019). As a technology that relies on the illusion of absolute immersion, VR demands the user to move through their environment as if they were physically there in an immersive universe. Thus students may take any action according to the game rules (Amprasi et al., 2022). In addition, in learning models and designs, VR can assist teachers in providing a more comprehensive learning experience and giving a more modern feel to learning (Gong, 2021). Previous research claims that VR media during a pandemic has been shown to reduce students' stress levels and provide a pleasant learning experience (Bermejo-Berros & Gil Martínez, 2021; Yang et al., 2021).

The primary purpose of this research is to implement VR media in history learning to improve student learning outcomes and student participation during the implementation of the distance learning system. So far, VR media has been widely developed and used in the health sector, while in education, VR media is still very minimal. Using VR as a supporting tool to carry out distance learning is an innovative step in education that researchers apply to historical subjects. This study wanted to see the effect of VR media on student learning outcomes and student participation in learning history. The researcher assumes that the implementation of VR media in education can provide contextual learning according to simulations of the sophistication of tools and give new color to history subjects that have been considered boring subjects.

METHOD

Type of Research

Research and Development (R&D) is the term used to describe this study. R&D research was selected to create VR learning products on history subject material. The product was used to compare the differences in students learning outcomes and participation during and after using virtual reality in class. Before testing operations, VR video as a product is validated and reviewed by an expert to confirm the quality and adjustability of this media for a student.

Model of Development

This study employs two development models: Borg and Gall (2003) and Dick and Carey's (2013) model. Adaptation is carried out to get a development model consistent with VR research and development features in history learning.

Procedure of Development

The research development approach contains steps suited to the model's development. These stages involve analysis, design, development, validation, and product assessment tasks. Observation and interviews with teachers and students were used to perform a needs analysis. This requirements analysis exercise aims to collect valuable data for developing learning materials and products based on the problems encountered in history learning. In the design and development stage comes the needs analysis activity. The findings of the design and development process are then developed and validated. Experts in media technology and learning media validated the system. In addition to expert validation, evaluations were conducted by material experts, teachers, and learning media. The validation findings are then used to collect quality information and provide suggestions for product enhancement.

The reliability of the product evaluation was confirmed by the participation of qualified educators and various forms of educational media. Testing methods used for assessment include individual (or one-to-one) testing, limited testing, and field testing. During the individual exam, the responders identified six different students. This was done in response to the remarks and recommendations provided by students on the preliminary product. The participants in the experiment were all in the tenth grade, and it was only a small test. The results of the limited test were then examined to make additional changes. The product might be tested in the field.

Field trials are product trials conducted in the classroom to boost students' learning independence and grasp of ideas. The subjects of the field trial were adolescents from grade X Budi Utama senior high school Yogyakarta, which had 69 students, and senior high school 2 Bantul, which had 19 students. The experiments were carried out utilizing the Two Group pretest-posttest Design, which means that experimental and control classes were engaged.

Data Collection Instruments

This research is development research, then implemented to see the effectiveness of the developed instructional media. The data analysis used is a non-equivalent quasi-experimental quantitative utilizing a control group (Maciejewski, 2018; Shadish, W., Cook, T., Campbell, 2005). Data from both groups were analyzed to determine changes from different treatments between the two classes (Berger et al., 2012; Sugiyono, 2018). The population of this study was taken from senior high schools in Yogyakarta, Indonesia, namely Budi Utama senior high school Yogyakarta and senior high school 2 Bantul in grade X. The number of samples used was 88 students consisting of 69 representatives for the experimental class and 19 for the control class. Further samples can be calculated with Sugiyono's (2018) formula in Table 1.

Table 1
The research sample student respondent

Number	Class group	School	Determination population	Sample Size
1.	Experiment class	Budi Utama Senior High School Yogyakarta	$\frac{27}{125} x110 = 23{,}76$	23
			$\frac{27}{125} x110 = 23{,}76$	23
			$\frac{19}{125} x110 = 16{,}72$	23
2.	Control class	Senior High School 2 Bantul, Yogyakarta	$\frac{22}{125} x110 = 16{,}72$	19
				88

Data analysis was carried out to see the increase in student learning outcomes by comparing students' test results before and after using VR media in the experimental class and before and after learning with conventional media. The following is the N-Gain formula used to determine the increase in student learning outcomes in the experimental and control classes.

$$N - Gain = \frac{(Posttest\ score\ -\ Pretest\ score)}{(Ideal\ Score\ -\ Pretest\ score)}$$

Description:
N-gain = Normalized gain
Post Test = The final grade of learning
Pre Test = Initial value of learning
Ideal score = Maximum (highest) score

The criteria for improving student learning outcomes can be seen from the N-gain value obtained from the results of data analysis and then compared with the distribution table scores below. The criteria for the N-gain that can be used for decision-making according to Hake's (1998) criteria can be seen in Table 2.

Table 2
Distribution of N-gain scores

N-gain Scores	Criteria
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Data were analyzed using IBM SPSS version 25.00. Data analysis started from descriptive, normality, homogeneity, and paired samples tests. The normality test with Kolmogorov-Smirnov and Shapiro-Wilk used a reference for calculating the value (sig) > 0.05. At the level of homogeneity, the data is declared homogeneous if the significant value (sig) > 0.05. The next calculation determines the difference between the pretest student learning outcomes of the experimental class and the control class seen from the Sig value. (2-tailed) < 0.05.

Another factor that this study wants to know is student participation during the learning process. Researchers made direct observations on students regarding student participation in the experimental and control classes. In addition, when carrying out learning, the researchers recorded the names of students who asked during learning about the material being taught. The criteria for improving student learning outcomes can be seen from the N-gain value obtained from the results of data analysis and then compared with the distribution table scores below. The criteria for the N-gain that can be used for decision-making can be seen in Table 2.

FINDINGS AND DISCUSSION

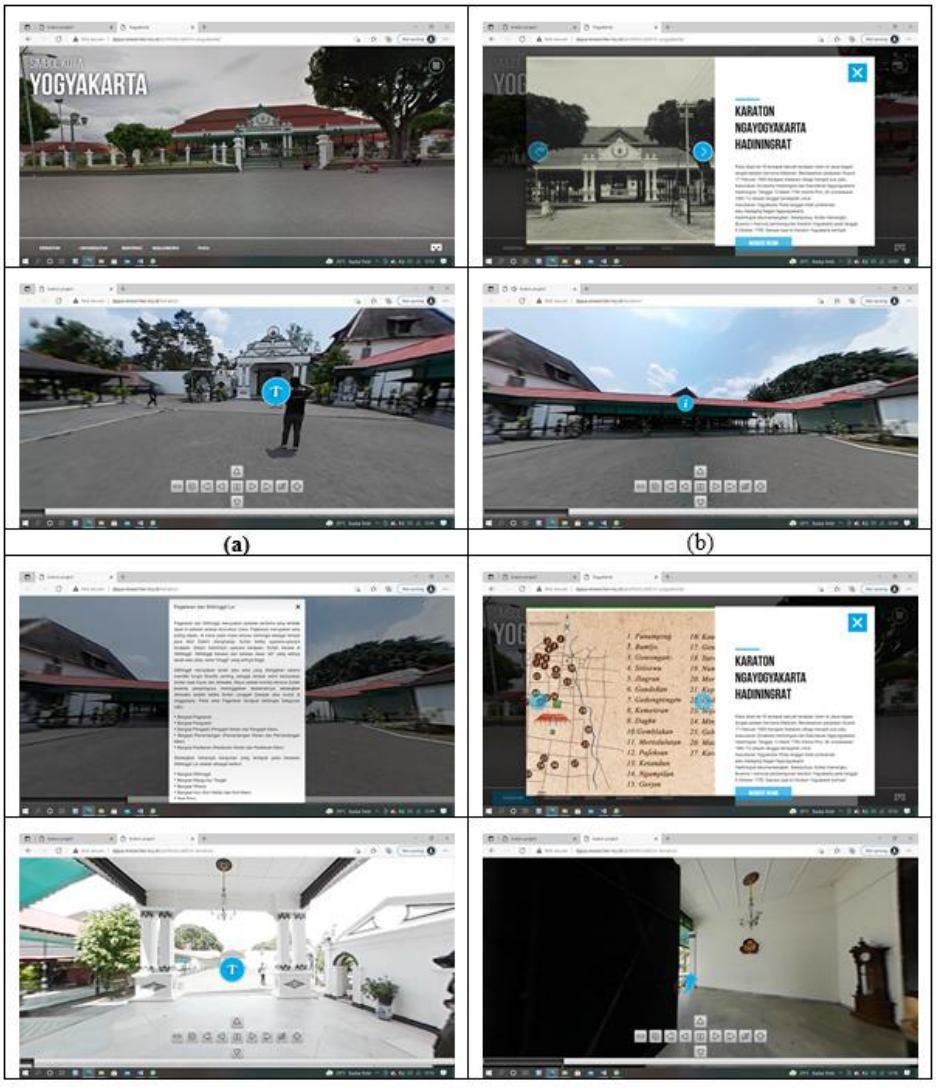

Figure 1
Result of virtual reality development product media

Appropriateness and Quality of the Virtual Reality on Contextual Learning Instructional Media

Virtual reality as instructional learning media was a measure to know the appropriateness and quality of the product with validation and evaluation by the expert. The level of quality was measured through evaluation by material experts, teachers, and learning media that try this VR media. Expert conduct validation using a questionnaire with a Likert scale (1-4). The validation result by a history material expert can be seen in Table 3 below.

Table 3
History material validation results

No.	Aspect	Score	Max Score	Category
1.	Learning Media	24	24	Very Appropriate
2.	History Subject Material	40	44	Very Appropriate
3.	Language	26	28	Very Appropriate
	Total	90	96	Very Appropriate

The validation results obtained from historical material experts on the developed virtual reality media are considered valid as alternative learning media for students. A note of improvement given by the historical material expert is that the media reloading process on SCORM takes quite a while to display the video. Based on the assessment results, all aspects of VR media are categorized as very suitable, with a total score of 90, meaning 93.75% of the maximum score.

Teachers as users of virtual reality media developed by researchers are also involved in media validation. Media validation carried out by the teacher includes; Audio-Visual Matter, History Subject material, Layout and Navigation, Video and Simulation, and Language. The validation results can be described in Table 4.

Table 4
Teacher validation results

No.	Aspect	Score	Max Score	Category
1.	Audio-Visual Matter	22	24	Very Good
2.	History Subject Material	16	16	Very Good
3.	Layout and Navigation	18	20	Very Good
4.	Video and Simulation	22	24	Very Good
5.	Language	16	16	Very Good
	Total	94	100	Very Good

The fact that teacher validation results reveal that the five components of the generated VR media are legitimate demonstrates that the validation was successful. The history teacher, as a validator, offers remarks to the student to boost the audio loudness of the virtual reality instructional media. The result of validation claims that virtual reality media con historical content can provide an ambiance consistent with real life. Consequently, the validation findings acquired from the teachers got a score of 94, which is equivalent to 94% of the entire maximum value.

The usage of virtual reality media to deliver contextual learning on historical information has been validated by industry professionals in media. Professionals in the field of media will carry out evaluations, and they will include a wide variety of subjects, such as audio-visual material, layout and navigation, layout information, video and simulation, and language. The number 88, which was arrived at by surveying media experts, is equivalent to 95.65 percent of the most excellent attainable value. According to the rating collected from expert media judgment, the newly produced virtual reality media falls into the highly viable category. This information is presented in Table 5.

Table 5
Instructional media validation result

No.	Aspect	Score	Max Score	Category
1.	Audio-Visual Matter	18	20	Very Appropriate
2.	Layout and Navigation	20	20	Very Appropriate
3.	Layout Information	12	12	Very Appropriate
4.	Video and Simulation	23	24	Very Appropriate
5.	Language	15	16	Very Appropriate
	Total	88	92	Very Appropriate

The virtual reality learning media that has been designed and found to be legitimate by specialists is then put into use so that students may investigate the changes that take place both before and after utilizing this form of educational technology. During the tests carried out on these pupils, they were randomly assigned to two experimental and control classes.

Result Data Student Learning Outcomes

IBM SPSS Version 25.00 was used to analyze the study's findings to assess whether or not there were shifts in the learning outcomes for students. When students worked on problems connected to the Mataram Kingdom History content, they saw a rise in their final marks, which indicates that their learning outcomes had improved. The statistical analysis findings indicated that the average value of student learning outcomes showed a substantial rise in the experimental class compared to the pretest and post-test results administered to the students. During this time, the average pretest and post-test results for student learning did not change much in the class that served as the control and utilized traditional media. The whole data set is presented in the table that follows.

Table 6
Descriptive Statistics

	Descriptive Statistics				
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest experiment class	69	60	83	72,60	5,934
Post-test experiment class	69	81	93	86,54	2,861
Pretest control class	19	61	83	74,70	5,516
Post-test control class	19	65	87	77,45	5,969
Valid n (listwise)	19				

Table 7
Test of normality

Tests of Normality							
Class		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Students learning outcomes	Pre Test Experiment Class	0,071	69	.200*	0,983	69	0,520
	Post test experiment class	0,122	69	0,020	0,980	69	0,386
	Pre test control class	0,223	19	0,013	0,938	19	0,246
	Post-test control class	0,186	19	0,082	0,939	19	0,251

Table 8
Test of homogeneity of variance

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Student Learning Outcomes	Based on Mean	13,550	1	80	0,420
	Based on Median	9,243	1	80	0,319
	Based on Median and with adjusted df	9,243	1	54,189	0,364
	Based on trimmed mean	12,841	1	80	0,581

Based on the output of table 5 above, it is known that the significance value (sig.) for all data both on the Kolmogorov-Smirnov test and the Shapiro-Wilk test > 0.05, it can be concluded that the research data is normally distributed. Furthermore, after the data meets the standard requirements, a data homogeneity test is carried out to see the homogeneity of the overall data. The output results in table 6 above show that the value is significant (sig.). The Based Mean is 0.420 > 0.05, so it can be concluded that the experimental and control class's post-test data variants are the same or homogeneous.

Table 9
Paired samples t-test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper	t	df	Sig (2tailed)
Pair 1	Pretest experiment class - Post-test experiment class	-13.937	6.953	.876	-15.688	12.185	-15.908	62	.000
Pair 2	Pre-test control class - Post-test control class	-2.789	6.312	1.448	-5.832	.253	-1.926	18	.070

The 95% confidence interval provides additional information regarding the effectiveness of the media used in each group. The 95% confidence interval shows that the average group receiving treatment using VR media ranges from -15,688 to -12,185 with sig (2-tailed) 0.000 < 0.05, meaning that it can be explained that there are significant differences in student learning outcomes before using VR media and after using VR media. While the 95% confidence interval for the average control group -5.832 to 0.25 with a value of sig (2tailed) 0.070 > 0.00 can be interpreted that there is no significant increase in student learning outcomes for the control group. The scores for student learning outcomes (post-test – pretest) were analyzed to analyze variance in the experimental group compared to the control group as an independent variable Becker (1999). Student learning outcomes increased when students used VR media in the experimental class, post-test experiment class – post-test as indicated by M = -13,937 and Std. Mean error 0.876 compared to control pretest control class - posttest control class show that M = -2.789 and Std. Mean error 1.44, p < 0.0005. The 95% confidence interval analysis results showed a significant increase in student learning outcomes for the experimental class students and a minimal increase in student learning outcomes for the control class students.

Table 10
Result of N-Gain Score

N-gain Scores	Mean upper bond	Criteria
Experiment class	0,5	Medium
Control class	0,02	low

To strengthen the analytical data from SPSS above, the researcher added an N-gain analysis. Based on the results of the calculation of the N-gain score test, it shows that the average value of the N-gain score for the experimental class (VR method) is 0.5, which is included in the moderate or fairly effective category. Meanwhile, the average N-gain score for the control class (conventional learning method) is 0.2, including the low or not effective variety. The conclusion that can be drawn is that VR media is quite effective in improving student learning outcomes in the History of the Islamic Mataram Kingdom for grade X high school students in Yogyakarta. Meanwhile, VR media effectively enhances student learning outcomes in the History subject matter for the History of the Islamic Mataram Kingdom for grade X students in Yogyakarta.

Result Data Student Participation

After incorporating VR media into the teaching process, there was a discernible shift in the level of student involvement, as demonstrated by the findings of an experiment on the deployment of media. These shifts may be exhibited according to numerous characteristics based on filling out the questionnaire (Likert scale), which are explained in the following table.

Table 11
Gain scores on the participation aspect before using virtual reality instructional media

No.	Aspect	Score	Max Score	Category
1.	Answer Teacher Question	12	20	
2.	Respond Teacher Explanation	9	24	
3.	Self Confidence	10	16	
4.	Asking Question	10	20	
5.	Capable Telling Material	8	18	
	Total	49	98	Low

Table 12
Gain scores in the participation aspect after using virtual reality instructional media

No.	Aspect	Score	Max Score	Category
1.	Answer Teacher Question	17	20	
2.	Respond Teacher Explanation	17	24	
3.	Self Confidence	13	16	
4.	Asking Question	18	20	
5.	Capable Telling Material	14	18	
		79	98	High

Figure 2 provides a visual representation of the contrast between the application of virtual reality media in students' contextual learning.

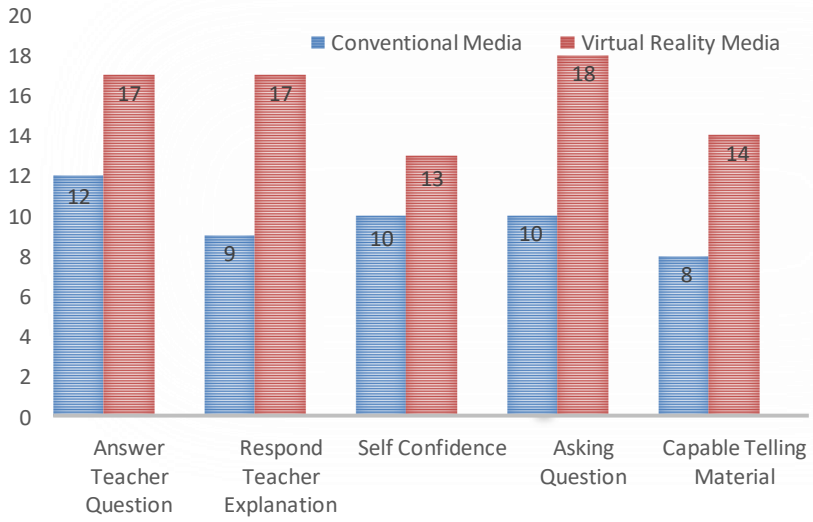

Figure 2
Graph showing the difference in student involvement scores before and after utilizing virtual reality in the classroom experiment

The level of student engagement goes from low to high when they use virtual reality media to study historical content and contextualize it. According to the five indicators presented in Figure 2, the level of student engagement in responding to questions posed by the instructor is low. The number of answers from students to their professors when the content was explained utilizing traditional learning media and virtual reality media increased by roughly 50 percent. The students showed considerable improvements in their levels of self-confidence. When comparing the lower group to the high category, one can detect a huge difference in students' level of interest in asking their teachers questions. Alterations may also be seen in the material's capacity to be retold, an essential book component. Based on these findings, it is possible to conclude that student involvement in classroom learning that uses virtual reality media as contextual learning media has grown overall in all five dimensions.

CONCLUSION

Virtual Reality media in history education has substantially influenced learning results and student engagement in the subject. A comparison of the experimental class's usage of VR media between the pretest and the post-test revealed a significant difference in student learning outcomes as evaluated by sig scores of 0.000< 0.05, according to the paired sample t-test data analysis (2-tailed). When students continue to use conventional

media in their learning history, there is no change in the student learning outcomes, as indicated by the score sig. (2-tailed) 0.07 > 0.5, which can be determined by comparing the pretest and post-test scores of the control class's student learning outcomes. The influence of VR media in learning may also be observed in the difference between the experimental and control classes' N-gain scores. In the practical class, VR media was shown to affect student learning outcomes with a score of 0.5 in the medium category, making it highly beneficial for usage in assisting learning. Compared to traditional media, the control class n-gain score attained is 0.2, which falls into low or ineffective. Apart from being immersive, this study demonstrates that virtual reality media may also positively affect student learning outcomes cognitively and via participation. The effectiveness of this historical learning exercise reflects the development of an interactive interaction between teachers and students. This research offers an alternative innovation to educators in developing immersive learning media that engages and arouses students in the study of history. Demonstrating the usefulness of virtual reality as a learning aid can also serve as a reference point for future research and development of VR media in other areas of educational research. However, more studies should be conducted to determine if virtual reality technologies can improve and help involve students actively in class. The same research also needs to be developed to provide learning options other than sourced from textbooks.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Yogyakarta State University for offering the most excellent alumni scholarships in the Ph.D. program and funding this study. To the instructors who constantly encourage me to study and grow. We would like to express our gratitude to the students of SMA Budi Utama Yogyakarta and SMA N 2 Bantul for agreeing to participate in this research.

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