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Development of Virtual Reality-Based Project-Based Learning Media and its Effectiveness for Historical Thinking Skills

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ABSTRACT: This development research aims to produce a Virtual Reality Media product based on Project Based Learning that is validated by experts and its effectiveness on Historical Thinking Skill. The development model used is the ASSURE Model. The development of this media has gone through stages of expert validation, user trials, small group trials, and main field trials involving 32 students to determine the level of effectiveness of the developed product. Data analysis was done using paired sample t-tests and effectiveness tests using eta squared formula. The expert validation results consisted of three experts: media design validation with a score of 4.5 (Above Average), subject matter validation with a score of 4.7 (Outstanding), and language validation with a score of 4.9 (Outstanding). In the user trial results, a score of 4.7 (Outstanding) was obtained. The expert validation results for media design showed that the media can be used with minimal revisions, while the validation results for subject matter, language, and user trials showed that the media can be used without revisions. The effectiveness test results of the media on historical thinking skills showed a value of 0.801 in the small group trial and a value of 0.61 in the large group trial, placing the effectiveness test results in the "large effect" category. Based on the effectiveness test results, the Virtual Reality media based on project-based learning has been proven to have a significant effect in improving students' historical thinking skills.

KEYWORDS: Media Virtual Realiy, Project Based Learning, Historical Thinking Skill, Instructional media, Learning History

I. INTRODUCTION

Education 4.0 provides freedom of learning and innovation to learners and educators. The opportunity for learning is vast, especially through technological applications such as Machine Learning, Deep Learning, and Data Science [1]. Technological advancements have driven a paradigm shift in learning towards digital-based education and have shifted the role of educators, no longer as the sole source of learning [2]. Technology in the field of education plays a significant role in transforming societal conditions for the better. Technological integration must be established because the teaching-learning process is continuous, meaning it must be constantly updated [3]. Learning processes integrated with technology will assist educators in enhancing classroom learning practices effectively, making the learning process more engaging and interactive [4]. One effort to integrate technology into the field of education is by creating innovative learning designs [5]. Through innovative learning designs, educators provide opportunities for learners to optimize their learning potential, thereby creating characterful learners with knowledge and good behavior. The rapid advancement of information technology has permeated all fields, including education, making the use of instructional media essential in the implementation of learning [6]. The application of instructional system design as part of developmental activities in educational technology aims to create learning environments that help learners achieve their desired competencies. The application of information technology development in the educational world in the 21st century can be implemented through the execution of learning activities, including History Learning, to improve the quality of historical learning, focusing not only on students' cognitive abilities but also on affective and psychomotor aspects [6].

The analysis of student performance reveals several significant issues: (1) the main problem lies in the learning sources used by students, which primarily consist of worksheets (LKS) and lack variety; (2) the use of instructional media is unengaging, monotonous, and fails to maximize the presence of information technology; (3) there are limitations in terms of information technology facilities, including wifi access and learning support tools. As a result, students experience difficulties in remembering materials and participating effectively in learning. Furthermore, the analysis of students' needs indicates that 75% of students can only remember and mention 1-3 megalithic era artifacts in Indonesia, while 25% answered that they did not know. The analysis of

learning style surveys shows that 53.33% prefer visual learning, 22.33% prefer auditory learning, and 25.33% prefer kinesthetic learning.

The analysis of the availability of resources in three schools shows that (1) 44.04% of content availability in the three schools is diverse, with most using worksheets and textbooks. Although educators have developed conventional teaching materials, historical maps, and e-comics, there are still implementation shortcomings; (2) 41.3% of technological resource availability in the three schools is minimal, with only classrooms and libraries available, lacking a history laboratory and technology-based instructional media; (3) 30.4% of instructional facility availability in the three schools includes classrooms and libraries, with an average of 26 students per class, but instructional aids for history learning are lacking; (4) 33.7% of human resource availability in the three schools is sufficient, with 3-5 educators per school, but most are not optimal in using computers, laptops, viewers, and smartphones for history learning. Based on the performance analysis and resource availability analysis mentioned above, an alternative is needed to address historical learning problems in line with the characteristics of Generation Z [7].

The use of instructional media that aligns with the needs of Generation Z will enable them to learn and receive education better. One technology-based instructional media that can be considered is Virtual Reality (VR) technology. Virtual Reality (VR) technology is a method of presenting learning materials in three-dimensional media, commonly known as 3D, created with the assistance of computer components to make it appear more realistic, supported by other devices [8]. Implementing VR technology-based instructional media in education aims to enhance information absorption [9]. The use of virtual reality allows manipulation of synthetic world objects through controllers, enabling learners to practice and interact with objects in the virtual world in a more engaging and beneficial manner [10]. Referring to the above presentation, the existence of virtual reality as a support for historical learning media is worth considering. The instructional media to be developed in this research focuses on the scope of historical subjects, namely the Origins of Ancestors and Spice Route in Indonesia, using the Project Based Learning model employing the ASSURE model.

METHOD

Research Design

This research utilizes the research and development method with the ASSURE model, developed by Sharon Smaldino, Robert Henich, James Russell, and Michael Molenda, with the following steps: (1) Analyze learner characteristics; (2) State performance objectives; (3) Select methods, media, and materials; (4) Utilize materials; (5) Require learner participation; (6) Evaluate and revise Each step involves specific tasks aimed at ensuring effective instructional design and implementation.

Sample and Data Collection

The initial data was obtained from observations of 3 educators and X-grade students at SMAN 1 Jember, SMAN Arjasa, and SMAN 4 Jember during the Odd Semester of the Academic Year 2023-2024. Subsequently, field research data was obtained from research conducted on 1 educator and 32 X-grade IPS 2 students at SMAN 4 Jember.

Analisis Data

The data analysis was conducted using both qualitative and quantitative methods. Qualitative data was analyzed through observation results, comments, expert suggestions, and documentation. Quantitative data was analyzed using SPSS software to assess the validation results from experts, user trials, and effectiveness tests of the Virtual Reality Media based on project-based learning that has been developed. The formulas used to calculate expert validation and user trials are as follows:

$$R = \frac{\sum n}{T}$$

Explanation:

R : The average validation score
∑n : The total validation score
T : The total number of items/questions

Table 1. Product Eligibility Criteria

Rating	Qualification	Conclusion
4,6 ≤ SV > 5,0	*Outstanding*	Can be used without revision
3,6 ≤ SV > 4,5	*Above average*	Can be used with minor revisions
2,6 ≤ SV > 3,5	*Average*	Can be used with moderate revisions
1,6 ≤ SV > 2,5	*Below Average*	Can be used with major revisions
1,0 ≤ SV > 1,5	*Unsatisfactory*	Cannot be used

The formulas used to test the effectiveness of the developed product consist of normality test, paired sample t-test, and effectiveness test using eta-squared. The normality test is conducted to assess the normality of the obtained data. The paired sample t-test is used to determine if there is a difference between two paired samples. The Paired Sample T-test in this study is conducted using data that refers to the indicators of students' historical thinking skills [11]. The formula for the paired sample t-test is as follows:

$$thit = \frac{\bar{D}}{\frac{SD}{\sqrt{N}}}$$

Explanation:

t : The calculated t-value

$\bar{D}$: The average difference between measurements 1 and 2

SD : Standard deviation of the differences between measurements 1 and 2

N : Sample Size

Next, to test the level of effectiveness of Virtual Reality Media on Historical thinking skills, we use the eta-squared formula as follows:

$$Eta\ Squared = \frac{t^2}{t^2+(N-1)}$$

Explanation:

t : t-value

N : Sample Size [11]

Table 2. Criteria for Relative Effectiveness Test

Value	Qualification
0,01	Small Effect
0,06	Moderate Effect
0,14	Large Effect

RESULT AND DISCUSSION

Result

A. Expert Validation Results

The product developed in this study is a Virtual Reality Media based on project-based learning for history subjects, created using the Artsteps application. The developer has integrated the syntax of project-based learning models into the developed media. The integration process involves displaying each syntax in the form of images, allowing learners to follow instructions according to the displayed syntax. The Virtual Reality Media Based on Project-Based Learning for Historical Thinking Skill Using the ASSURE Model has been validated by three experts: a media design expert, a subject matter expert, and a language expert. These experts have validated and assessed the suitability of the developed product. Based on the experts' evaluations, the following results were obtained.

Table 3. Expert Validation Data Results

	$\bar{X}$	N	$\sum_n$	Min	Max	σ	Hasil
Expert Media Design Validation Data	4,5	12	54	4	5	0,52	4,5
Expert Subject Matter Validation Data	4,7	21	100	3	5	0,56	4,7
Expert Media Design Validation Data	4,9	10	49	4	5	0,32	4,9

Explanation:

$\bar{x}$: Average validation score

$\sum_n$: Total Validation Score

N : Total Validation Items

Based on the assessment by the media design expert, the developed media obtained a score of 4.5. Therefore, referring to the product suitability table, the qualification result is above average, meaning the instructional media can be used with minor

revisions. According to the assessment by the subject matter expert, the developed media obtained a score of 4.7. Therefore, referring to the product suitability table, the qualification result is outstanding, indicating that the instructional media can be used without revisions. Based on the assessment by the language expert, the developed media obtained a score of 4.9. Therefore, referring to the product suitability table, the qualification result is outstanding, indicating that the instructional media can be used without revisions.

B. USER TRIAL RESULTS

1. Educators

Based on the assessments provided by educators, the following results were obtained.

Table 4. Statistical Analysis of Educator User Trial Data

	$\overline{X}$	N	$\sum_n$	Min	Max	σ
Educator User Trial Data	4,7	10	47	4	5	0,42

$$\bar{x} = \frac{\sum n}{N}$$

$$\bar{x} = \frac{47}{10}$$

$$\bar{x} = 4,7$$

Explanation:

$\bar{x}$: Average validation score

$\sum_n$: Total Validation Score

N : Total Validation Items

Based on the assessment by educators during the user trial of the developed media, it obtained a score of 4.8. Therefore, referring to the product suitability table, the qualification result is outstanding, indicating that the instructional media can be used without revisions.

2. Small Group Students

Table 5. Analysis of Small Group Trial Data

Paired Samples T Test Pretest dan Postest								
	$\bar{x}$	N	α	α x	r	t	Df	p.
Pretest	3.26	10	0.14861	0.268	0.084	-6.029	9	0.000
Posttest	3.77	10	0.15226					

Based on the table above, it is known that the average pretest result is 3.26 (Standard Deviation = 0.14861) and the posttest result is 3.77 (Standard Deviation = 0.15226). The average posttest result is higher than the average pretest result. This indicates an increase in historical thinking skills among small group students after using virtual reality media. The significance value of the pretest and posttest results is 0.074. Therefore, it can be said that there is a significant correlation between the pretest and posttest scores of the small group at a confidence level of 5% with a level of 0.268. The table above shows that there is a relationship between the pretest and posttest in the small group trial. This can be seen from the Sig. (2-tailed) value of 0.000 with a probability value of 0.000 <0.5, indicating a significant difference between the pretest and posttest scores in the small group trial. Based on the analysis of the small group trial data, further analysis is conducted to measure the effectiveness of the media in history learning. The calculation of effectiveness can be described by the formula below.

$$Eta\ Squared = \frac{t^2}{t^2+(N-1)}$$

$$= \frac{-6.029^2}{-6.029^2+(10-1)}$$

$$= \frac{36.348}{36.348+(9)}$$

$$= \frac{36.348}{45.348}$$

$$= 0.801$$

The calculation of effectiveness using the eta squared formula shows a result of 0.801. Referring to the effectiveness test criteria, this indicates that the effectiveness value falls within the qualification of a Large Effect. This suggests that the developed media has a significant influence on improving students' historical thinking skills.

3. Large Group Trial

Table 6. Results of Large Group Trial Data Analysis

Paired Samples T Test Pretest dan Postest								
	$\bar{x}$	N	α	α x	r	t	Df	p.
Pretest	3.27	32	0.24755	0.303	0.0537	-7.110	31	0.000
Posttest	3.65	32	0.23401					

Based on the table above, it is known that the average pretest and posttest results are 3.27 (Standard Deviation = 0.24755) and 3.65 (Standard Deviation = 0.23401) respectively. The average posttest result is higher than the average pretest result. This indicates an increase in historical thinking skills among large group students after using virtual reality media. The significance value of the pretest and posttest results is 0.261. Therefore, it can be said that there is a significant correlation between the pretest and posttest scores of the large group at a confidence level of 5% with a level of 0.303. The table above shows that there is a relationship between the pretest and posttest in the large group trial. This can be seen from the Sig. (2-tailed) value of 0.000 with a probability value of 0.000 <0.5, indicating a significant difference between the pretest and posttest scores in the large group trial.

Based on the analysis of the large group trial data, further analysis is conducted to measure the effectiveness of the media in history learning. The calculation of effectiveness can be described by the formula below. The formula used to analyze the level of relative effectiveness in the use of Virtual Reality-Based Project-Based Learning Media for Historical Thinking Skill using the ASSURE Model applied to the large group is presented as follows.:

$$Eta\ Squared = \frac{t^2}{t^2+(N-1)}$$

$$= \frac{-7.11(2)}{-7.11(2)+(32-1)}$$

$$= \frac{50,55}{50,55+31}$$

$$= \frac{50,55}{81,55}$$

$$= 0,61$$

Based on the results of the relative effectiveness test using the eta squared formula on the large group, the obtained result is 0.61. This indicates that the result falls into the "Large Effect" category.

DISCUSSION

The product developed in this study is Virtual Reality (VR) Media based on Project Based Learning. This research examines the feasibility and effectiveness of VR-based project-based learning media on students' historical thinking skills. The developers have created VR media and conducted trials regarding its effectiveness in students' historical thinking skills. The results of small and large group trials show that the media is effective in enhancing students' historical thinking. Based on the small group trial value of 0.801, the media falls into the category of large effect, indicating its effectiveness. Similarly, in the large group trial, the media also falls into the category of large effect with a value of 0.61. Several studies support the use of VR technology in learning and its ability to enhance historical thinking. VR technology has the potential to revolutionize education by providing immersive experiences across various disciplines, including social sciences. It allows manipulation of objects in a virtual world similar to the real world. VR can play a significant role in promoting historical learning. The combination of direct instruction, primary source documents, and media engagement, whether immersive VR or flat-screen video watching, seems to inspire historical empathy. VR technology has been recognized as a significant advancement in education, facilitating learning through highly realistic 3D visualizations. VR in teaching and learning allows manipulation of objects in a virtual world similar to the real world. VR is developed to enhance critical thinking skills among students. Its use encourages innovative learning media to increase student participation and critical thinking perspectives, bringing students closer to VR technology. The application of VR in education has been studied extensively, showing promising results in various fields. Hence, VR is deemed highly suitable for educational purposes and is expected to significantly enhance historical thinking skills. In conclusion, VR media is considered highly suitable for use in education, especially for enhancing historical thinking skills among students, as supported by various research findings.

CONCLUSION

The development of Virtual Reality (VR) Media based on Project Based Learning in history subjects using the ASSURE Model yields the following conclusions: (1) The analysis of media design validation resulted in a score of 4.5 with the qualification of Above Average, meaning it can be used with minor revisions. The validation analysis of subject matter obtained a score of 4.7 with the qualification of Outstanding, indicating it can be used without revisions. The last validation analysis, conducted by language experts, resulted in a score of 4.9 with the qualification of Outstanding, meaning it can be used without revisions; (2) The analysis of the trial test values for a small group of 10 students in class X IPS 2 SMAN 4 Jember, which amounted to 0.801, indicates that the media falls into the category of large effect. Similarly, in the large group trial, the media also falls into the category of large effect with a value of 0.61. Based on these results, it can be concluded that the VR-based Project Based Learning media in history subjects using the ASSURE Model has been well-validated and is suitable for use. Additionally, it is effective in enhancing students' Historical Thinking Skills.

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