The "*7 Wonders of the World-APP*" Augmented Reality-based Media to Improve Elementary School Students' Conceptual Understanding

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ABSTRAK

Siswa sekolah dasar tidak dapat memvisualisasikan objek virtual atau gambar pada beberapa materi IPS dalam lingkungan nyata. Penelitian ini bertujuan untuk mengembangkan media 7 Keajaiban Dunia-APP berbasis Augmented Reality untuk meningkatkan penguasaan konsep siswa sekolah dasar. Penelitian ini menggunakan metode four-D dan menggunakan desain pretest-postest control group. Metode pengumpulan data menggunakan kuesioner dan tes. Validitas meliputi validitas bahan ajar, validitas desain, dan validitas media pembelajaran dari dua ahli. Teknik analisis data menggunakan analisis deskriptif kualitatif, kuantitatif, dan statistik inferensial. Hasil penelitian menunjukkan bahwa proporsi hasil uji validitas materi pembelajaran, uji validitas desain media pembelajaran, uji validitas media pembelajaran mendapatkan kategori sangat valid. Hasil uji-t yaitu terdapat perbedaan yang signifikan terhadap penguasaan konsep siswa. Media 7 Wonders of the World-APP berbasis Augmented Reality sangat cocok dan efektif untuk diterapkan sebagai media pembelajaran IPS di sekolah dasar.

ABSTRACT

Elementary school students cannot visualize virtual objects or images on some social studies materials in a real environment. This study aims to develop 7 Wonders of the World-APP-based Augmented Reality media to improve elementary school student's mastery of concepts. This study used the four-D method and used a pretest-posttest control group design. Methods of data collection using questionnaires and tests. Validity includes the validity of teaching materials, design validity, and learning media validity from two experts. Data analysis techniques using descriptive qualitative analysis, quantitative, and inferential statistics. The results showed that the proportions of the validity test of learning materials, the validity test of the learning media design, and the validity test of the learning media got a very good category. The results of the t-test show significant differences in students' mastery of concepts. Media 7 Wonders of the World-APP, based on Augmented Reality, is very suitable and effective for learning media in elementary schools for social studies.

1. INTRODUCTION

Learning is a communication process and takes place in a system, so that learning media occupies a crucial component of the learning system (Hettinger et al., 2021; Islam et al., 2022; Setyawan & Fatirul, 2019). Without media, communication will not occur and the learning process will not be able to take place optimally. Learning media is an integral component of the learning system (Al-Maroof, R. A. S., & Al-Emran 2018; Saputro, R. E., & Saputra 2015). Learning media include visual media (graphs, diagrams, charts, posters, cartoons, comics), audial media (radio, tape recorder, language laboratory), projected still media (slides, overhead projector (OHP), and in focus), and projected motion media (film, television, video, computer). In the learning process, an educator must be able to create a fun learning environment and putting aside threats. To make fun learning environment, educators can use various and attractive

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teaching materials and media so that students feel interested and enjoy the learning process (Antara & Dewantara, 2022; Bronack, 2011; Rizaldi et al., 2020).

Technology-based media are needed to face Industrial Revolution 4.0 dan Society 5.0. Augmented reality is one of alternative learning media which can be used to respond to the challenge (Billinghurst et al., 2014; Bistaman et al., 2018). Augmented reality is a technology which uses two-dimensional and/or three-dimensional virtual objects into a real environment and then projects them in real time. Unlike virtual reality which completely replaces reality, augmented reality merely adds to or complements reality (Del Cerro Velázquez & Méndez, 2021; Sirakaya & Cakmak, 2018; Vagg et al., 2020). Virtual objects display information which users cannot perceive with their own senses. This makes augmented reality suitable as a tool to assist the perception and interaction of its use with the real world (Kiryakova et al., 2018; Novitasari, 2019; Wakid et al., 2020). Information displayed by virtual objects assists users to carry out activities in the real world. Well-designed media within a certain time limit can stimulate the emergence of internal dialogue. Then, there will be communication between students and the media or indirectly between students with the source of the message and the teacher (Guntur et al., 2020; Huh et al., 2020).

Students who learn Social Sciences by reading and listening to teachers' lectures will not make a significant improvement in their conceptual understanding of the material. It will be different when the students can immediately see the visualization of the Social Sciences materials on the 7 wonders of the world according to the reality of the object displayed. With 3D images similar to the real wonders of the world, it will greatly facilitate children's conceptual understanding and a deep impression of how the objects look like. New innovations are needed to increase the success of the learning process. Technology is a means that enables the creation of the necessary learning environment in which the learning process can be realized in the most effective way (A. F. S. A. MZ et al., 2021; Peterson et al., 2020). By looking at students' cognitive development, the development of Augmented Reality-based media will be preferred by students in understanding abstract concepts in the learning process (Alkhattabi, 2017; Flores-Amado et al., 2020; Kusdiyanti et al., 2020). Augmented Reality is a technology whose effectiveness can be seen significantly in the field of education. It is very supportive to provide more meaningful learning by combining digital objects to create reality in the real world (Arici et al., 2019; Bistaman et al., 2018).

In Social Studies learning in elementary schools, students cannot visualize virtual objects or images in a real environment because they are still at the concrete operational stage or phase who can only understand real things. Virtual objects which cannot be seen in the real environment can be visualized by integrating graphics and computer technology and visualization technology. Elementary school students have difficulties in visualizing abstract social studies material concepts. Augmented Reality-based media can attract attention and be easily accepted elementary schools' students (Al-nawaiseh, 2020; Blevins, 2018; Peterson et al., 2020). Previous study state that augmented Reality media can increase learning motivation, experiences, and collaboration between students (Chen & Tsai, 2012; A. S. A. MZ et al., 2022; Yilmaz & Goktas, 2017). Thus, that it can increase students' interest and develop their sense of curiosity (Yilmaz & Goktas, 2017). Other result study found results of the validation and feasibility of Augmented Reality-based media are very good and suitable for use as learning media (Sahin & Yilmaz, 2020; Syawaludin et al., 2019). Based on the above mentioned explanation, it shows that the development of Augmented Reality-based media is needed by teachers and students in the learning process. This study aims to develop 7 Wonders of the World-APP-based Augmented Reality media to improve elementary school students' mastery of concepts. The development of the 7 Wonders of the World-APP Augmented Reality-based media is use to solve problems faced by elementary schools' students in learning. The media aimed to make learning more memorable and form a good understanding.

2. METHOD

The development of the 7 Wonders of the World-APP media used the 4-D Model (Choirun, N., & Anggana, 2014; Rizki & Linuhung, 2017). The population in this study were fifth grade elementary school students and the sample in this study involved 28 students in one class. The 4-D development model has four main stages: define, design, development, and disseminate (Herayanti, L., Habibi, H., & Fuaddunazmi, 2017). The first was defining stage (Define). The defining stage aimed to determine and define the requirements needed in media development. This stage consisted of four activity steps including initial and final analysis, student analysis, curriculum analysis, and material analysis (Kiryakova et al., 2018). The second was planning stage (Design). The design stage was carried out to design the 7 Wonders of the World-Augmented Reality-based APP. At this stage, the researchers prepared a design for making markers, a design for building an application consisting of interface design, and AR menu design. The result of this design was a product design which was followed by validity testing by experts.

The third was development stage (Development). The development stage aimed to produce valid and effective Augmented Reality-based 7 Wonders of the World-APP, so that the media can be used to

assist student learning on the materials (Antara & Dewantara, 2022). At this stage, there were three tests described as follows: (1) expert validity test which included learning material expert test, learning design expert test, learning media expert test, (2) Augmented Reality-based 7 Wonders of the World-APP media trial which included limited trials and field trials, (3) testing the effectiveness of the 7 Wonders of the World-APP in improving elementary school students' conceptual understanding. The last stage was disseminating stage (Desseminate). In the context of developing the 7 Wonders of the World-APP, the researchers limited it to the socialization stage of learning media through distribution in limited quantities to teachers. Distribution was intended to obtain responses and feedback on the learning media developed. If the target response of learning media users was good, then a large number of distributions would be made so that the learning media could be used widely.

The research design was the pretest-posttest control group design. Prior to the learning process, a pretest was carried out to measure the initial ability of the students in both the control group and the experimental group. At the time of learning, the control group and the experimental group were given different treatment. The experimental group was given treatment by applying Augmented Reality-based 7 Wonders of the World-APP while the control group was given treatment by applying image media using conventional models. After the learning was carried out by giving different treatments to the control class and the experimental class, then a post-test was carried out to find out the differences and increase students' conceptual understanding. The research subjects in this study were the fifth-grade elementary school students. The limited trial involved 10 students and the field trial involved 28 students in one class. The data collected in this study was data on the validity of the 7 Wonders of the World-APP and the effectiveness of the media as seen through students' responses. The control class and an experimental class consisted of 28 students respectively. Variables, data, instruments, and analysis used in this study are presented in Table 1.

Table 1. Variable, Data, instrument, and analysis

Variable	Data	Instrument	Analysis
Media	Material validation results	Validity Sheet	Description of validity criteria
	Media validation results	Validity Sheet	Description of validity criteria
	Design l validation results	Validity Sheet	Description of validity criteria
	Validity Level	Scoring Rubric	Description of validity
	Percentage of student response trials is limited	Student response questionnaire	Description of student response
	Percentage of student responses field trials	Student response questionnaire	Description of student response
The Effectiveness	The difference in the use of the 7 Wonders of the World-Augmented Reality-based APP is significant	Conceptual understanding test	*Pretest-Posttest Control Group Design*
	The increase of Students' conceptual understanding	Conceptual understanding test	Gain score description

3. RESULT AND DISCUSSION

Result
The Development of the 7 Wonders of the World-APP Augmented Reality-based Media

The development of AR-based social studies learning media products for fifth grade elementary school students resulted in the android application "7 Wonders of the World-APP" accompanied by teaching materials and marker card posters. The 7 Wonders of the World-APP Augmented Reality-based media is an android application which must first be installed on an Android smartphone and used in conjunction with the teaching materials or marker card posters that have been provided. A media display of the 7 Wonders of the World-APP Augmented Reality-based media is show in Figure 1.

Figure 1. The 7 Wonders of the World-APP Application

Before conducting trials using the media, media validation must be carried out by experts beforehand. Media validation were carried out to know its validity based on learning material experts, learning media design experts, and learning media experts. Material expert validation was carried out by two experts who were competent with social studies subject matter, especially for elementary school students. Table 2 shows the results of the validation of learning material experts.

Table 2. Material Expert Validation Results

Aspects	Criteria	Scores	
		Expert 1	Expert 2
Learning Materials	Materials	4	4
	Contents	3	4
	The use of language	4	3
Percentage		**92%**	

Based on Table 2, the results of the validation of material experts through the validity test of learning material experts note that the percentage of social studies learning material expert validation is 92% with a very valid category. Learning materials which contained relevant material and content in accordance with core competencies and basic competencies in the applicable curriculum. The use of language was appropriate to the stages of students' cognitive development. The materials were considered good and easily understood by students. The validation of the learning design was carried out by two competent experts in the field of information and technology based on interactive learning media, especially Android. Table 3 shows the results of the validation of learning media design experts.

Table 3. Results of Learning Media Design Expert Validation

Aspect	Criteria	Scores	
		Expert 1	Expert 2
Learning Media Design	Media content quality	4	4
	Ease of application	4	3
	Marker suitability with the appearance of the application	3	4
	Media view	4	4
Percentage		**94%**	

Based on Table 3, the results of the validation of the learning media design expert obtained the percentage of the validity test came up with a very valid category as seen from four categories including: quality of media content, ease of application, marker suitability with the appearance of the application, and media view. The validation of learning media experts was carried out by two experts who are competent in the field of interactive learning media and learning strategies. The results of the learning media validation tests based on Augmented Reality can be seen in Table 4.

Table 4. Learning Media Expert Validation Results

Aspects	Criteria	Scores	
		Expert 1	Expert 2
Learning Media	Media Quality	4	4
	Media technical quality	3	4
	Media Appearance	4	4
Percentage		**96%**	

Based on Table 4, the results of the validation of learning media experts obtained a percentage of 92% with a very valid category seen from three categories: media quality, media technical quality, and appearance. After testing the validity of learning materials, media designs, and learning media, it can be said that the 7 Wonders of the World APP Augmented Reality-based media is very valid to be use as social studies learning media in elementary schools. The effectiveness of the 7 Wonders of the World-APP Augmented Reality-based media in elementary schools can be seen from the results of students' responses from the questionnaires which were conducted in limited trials and field trials. The results of the limited trial use of the 7 Wonders of the World-APP media based on Augmented Reality show that the percentage of student response questionnaire results is 91% with a very good category seen from the eight criteria. After conducting limited trials, field trials were carried out with a larger number of students, namely 28 students. The results of field trials show that the percentage of student response questionnaire analysis results is 94% and considered in the very good category. It can be concluded that the learning process will be more effective and make it easy for students to learn abstract materials.

At this stage, the researchers tested the effectiveness of the media to improve elementary school students' conceptual understanding. The testing was carried out through a pretest-posttest control group design experiment. The hypothesis being tested was students' understanding using the 7 Wonders of the World-APP Augmented Reality-based media was better than students who used picture media. Before the hypothesis was tested, the data was tested for homogeneity and normality first, and the results showed that the data was homogeneous and normally distributed. The results of data analysis can be seen in Table 5.

Table 5. The Results of Data Analysis Using The T-Test

	Pretest		Sig.	Posttest		Sig.
	Experiment Class	Control Class		Experiment Class	Control Class	
Highest score	77	84		92	89	
Lowest score	56	55		80	67	
Mean	68.68	67.50		84.93	77.29	
Standard Deviation	6.074	7.290		3.589	4.875	
t-test score	**3.657**		**0.034**	**6.680**		**0.029**

Based on Table 5, it shows that in the pretest there was no significant difference between the average score of the control class and the experimental class. In the pretest, the average scores of the experimental class and the control class were 68.68 and 97.50, respectively. However, in the posttest, there was a significant difference between the average scores of the experimental class and the control class. The average scores of the experimental class and the control class were respectively 84.93 and 77.29 with a sig. 2 tailed is 0.029 <0.05, so the conclusion was that H0 was rejected and H1 was accepted. Thus, it can be interpreted that there is a significant difference in conceptual understanding between experimental class students who use the 7 Wonders of the World-APP Augmented Reality-based media and control class students who use picture media. To see how effective the 7 Wonders of the World-APP media, the researchers measured it by using the N-gain value. The N-gain value was calculated based on the difference in the average pretest and posttest scores. Table 6 shows the results of the N-Gain test.

Based on Table 6, the results of the N-Gain test show that the gain in the average score of students' concept mastery is 76.20% which is included in the effective category. Based on these results, it can be said that learning using the 7 Wonders of the World-APP Augmented Reality-based media applied to the experimental class was able to improve elementary school students' mastery of concepts.

Table 6. T-Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score	56	0.25	1.00	0.7620	0.23522
NGain_Percent	56	25.00	100.00	76.2032	23.52174
Valid N (listwise)	**56**				

Discussion

The 7 Wonders of the World-APP is a learning media developed using Augmented Reality technology. AR technology is the development of marker-based technology, which means that to see virtual objects in the form of 3D image models in this application, there must be a marker image object scanned using a smartphone camera, the marker image is called a target marker (A. S. A. MZ et al., 2022; Peterson et al., 2020; Sural, 2018). The utilization of Augmented Reality technology due to the use of marker-based AR technology using objects that can be pointed to be displayed on the screen provides a different experience for students and teachers. In the era of the industrial revolution 5.0, the development of technology-based media in the field of education is used to assist the learning process which can increase students' interest and motivation to better understand learning material (Guntur et al., 2020; Sáez-López et al., 2020). Good learning material is material which contains relevant material and content in accordance with core competencies and basic competencies in accordance with the applicable curriculum and the use of language that is adapted to the stages of student cognitive development so that material can be easily understood (Cholilah, 2017; Tegeh, I. M., Simamora, A. H., & Dwipayana, 2019).

Augmented Reality (AR)-based media is able to present illustrations of three-dimensional learning material so that the visualization becomes more specific (Ewais & Troyer, 2019; Saputro & Saputra, 2015). Information in learning is clearer because it can combine the virtual world and the real world. From the results of the learning media design validation test, the 7 Wonders of the World-APP Augmented Reality-based media is very valid to be used. After testing the validity of learning materials, designs, and media, it can be said that the 7 Wonders of the World-APP Augmented Reality-based media is very valid to be used as social studies learning media in elementary schools (Ewais & Troyer, 2019; Gün & Atasoy, 2017; Hidayat et al., 2021). The results of field trials showed that the percentage of student response questionnaire analysis results was 94% in the very good category. It can be concluded that the learning process will be more effective and make it easier for students to learn abstract material by using the 7 Wonders of the World-APP Augmented Reality-based media as social studies learning media in elementary schools (Celik et al., 2020; Habig, 2020; Kusdiyanti et al., 2020).

The effectiveness of the 7 Wonders of the World-APP media based on Augmented Reality that was developed in increasing students' conceptual understanding is very possible, as evidenced by the results of the t-test which stated that there was a significant difference with the results of the t-test 0.029 <0.05. As well as the results of the N-Gain test stated that there was an increase in students' understanding after using the 7 Wonders of the World-APP Augmented Reality-based media with a percentage of 76.20% in the effective category. This is because the material presented in the 7 Wonders of the World-APP Augmented Reality-based media is packaged in an interesting way and explained using real-world examples. Social studies learning by using real examples is effective in developing understanding or what is called concept mastery (Dewi, M. D., & Izzati, 2020; Kowiyah et al., 2019; Paroqi et al., 2021). This makes students more active in learning and easier to understand the material presented (Buchori, A., & Rahmawati, 2017; Hoyles et al., 2013).

Especially the world's wonders material contained in the 7 Wonders of the World-APP Augmented Reality-based media. When Student learning becomes interesting and meaningful, students are motivated to learn it because they know the use of the material they learn, and can apply it in everyday life (Darmaji et al., 2019; Ediyanto et al., 2020; Nisa et al., 2020). This result is in line with several previous findings which state that augmented reality-based media has proven effective in helping students learn (MZ, A. S. A., Bianto, M. A., & Aprillya 2022; Hakim 2018). In addition, other previous study also stated that the media can improve students' critical thinking skills (Billinghurst et al., 2014). Then, in the context of science, augmented reality-based media is also proven to be able to help students learn easier. In addition, this media can also support student-centered learning. The implication of this research is to provide new information regarding the application of augmented reality-based media for elementary school students. This information will be very helpful especially for teachers at the elementary school level as a reference in carrying out the learning process. It is hoped that further research can deepen and broaden the scope of research related to the use of Augmented Reality-based programs for elementary school students. Because as we know learning at the basic level is very important and essential, teachers must be able to carry out effective learning.

4. CONCLUSION

Based on the research results, it was found that the 7 Wonders of the World-APP-based Augmented Reality media is very valid for students in elementary schools. Media 7 Wonders of the World-APP can improve student understanding. The responses indicated that the media was very good and could be used by teachers to improve students' understanding of concepts. Thus, teachers can use media based on Augmented Reality 7 Wonders of the World-APP to support the learning process so that learning becomes more meaningful.

5. ACKNOWLEDGE

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