

Analysis of the Effectiveness of the Application of Augmented Reality (AR) Based Learning Media in the field of informatics in Improving Digital Literacy

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ABSTRACT

Literasi digital saat ini sangat penting di era digital, termasuk kemampuan menggunakan teknologi informasi secara efektif menjadi salah satu kompetensi utama siswa yang mempersiapkan mereka menghadapi tantangan abad ke-21. Penelitian ini bertujuan untuk menganalisis efektivitas penerapan media pembelajaran berbasis Augmented Reality (AR) dalam meningkatkan literasi digital siswa kelas XI SMA Negeri 4 Malang, khususnya kelas XI GMS A. Literasi digital merupakan kompetensi penting di era digital, terutama dalam pembelajaran informatika. Media AR dipilih karena kemampuannya menyajikan konten pembelajaran interaktif dan imersif, yang terbukti dapat meningkatkan minat, motivasi, dan pemahaman siswa. Penelitian ini menggunakan pendekatan kuantitatif dengan desain pretest-posttest satu kelompok. Data dikumpulkan melalui tes literasi digital dan kuesioner, dan dianalisis menggunakan uji normalitas dan uji t sampel berpasangan. Hasil pretest menunjukkan skor rata-rata 59,37, sedangkan posttest meningkat menjadi 76,56. Uji t menunjukkan signifikansi 0,000. Temuan membuktikan bahwa media AR efektif dalam meningkatkan literasi digital siswa. Selain itu, observasi menunjukkan peningkatan keterlibatan dan antusiasme belajar. AR berpotensi menjadi inovasi pembelajaran informatika di sekolah menengah. Penelitian selanjutnya direkomendasikan menerapkan AR pada materi lain dan subjek yang lebih luas demi meningkatkan validitas hasil.

Digital literacy is currently very important in the digital era, including the ability to use information technology effectively to become one of the main competencies for students who prepare them to face the challenges of the 21st century. This study aims to analyze the effectiveness of the application of Augmented Reality (AR) based learning media in improving the digital literacy of XI grade students at SMA Negeri 4 Malang, especially XI GMS A class. Digital literacy is an important competency in the digital era, especially in informatics learning. AR media was chosen for its ability to present interactive and immersive learning content, which is proven to increase students' interest, motivation, and understanding. This study used a quantitative approach with a one group pretest-posttest design. Data were collected through digital literacy test and questionnaire, and analyzed using normality test and paired sample t-test. The pretest results showed an average score of 59.37, while the posttest increased to 76.56. The t-test showed a significance of 0.000. The findings prove that AR media is effective in improving learners' digital literacy. In addition, observations showed an increase in learning engagement and enthusiasm. AR has the potential to be an innovative way to teach informatics in secondary schools.



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INTRODUCTION

The application of Augmented Reality (AR) based learning media in the context of education, especially in the field of informatics, has become a topic that is increasingly attracting attention in an effort to improve digital literacy in students, especially at the secondary school level. Digital literacy which includes the ability to use information technology effectively, especially for the younger generation who will face the challenges of the 21st century (Fatoni, 2022; Hastini et al., 2020). Research shows that the application of technology in learning can increase learner engagement and facilitate concept understanding (Asani, 2023; Faridah et al., 2022).

AR as a learning media offers an interactive experience that is considered capable of having a good influence on learning interest and motivation in students (Shiyamsyah & Yuliani, 2022). The utilization of AR learners can see and intersect directly with digital content that is integrated with the real world so as to create a more interesting and effective learning environment (Asani, 2023; Faridah et al., 2022). Previous research states that the application of technology such as AR to learning can help learners in understanding complex material and improve their digital literacy skills (Faridah et al., 2022; Hastini et al., 2020). AR offers an interactive and immersive learning experience, which can improve learners' understanding and engagement in the learning process.

Previous research shows that the use of AR in education can increase learner motivation and confidence. For example, Putra argued that the integration of AR in learning can improve the quality of education by providing a more interesting and interactive learning experience (Andhika Pratama Putra et al., 2023). In addition, Dendodi emphasized that AR can help learners understand abstract concepts through clearer and more interesting visualizations, thus improving their understanding of the subject matter (Dendodi et al., 2024). This is in line with Setyowati and Probowati's findings which show that the development of applications that support digital literacy can provide the necessary training and assistance for learners to master information technology (Priyambudi et al., 2022).

The application of AR as a learning media at SMA Negeri 4 Malang not only has the potential to improve learners' digital literacy, but also provide them with the necessary skills to adapt to rapid technological developments. At SMA Negeri 4 Malang, the application of AR-based learning media is expected to have a positive impact on the digital literacy of grade XI students. By integrating AR in the informatics curriculum, learners not only learn about technology, but also develop critical and creative skills needed to adapt to rapid technological developments (Fatoni, 2022; Hastini et al., 2020). Analysis of the effectiveness of the application of AR learning media in SMA Negeri 4 Malang aims to evaluate its impact on the digital literacy of grade XI students, especially in grade XI GMS A. Digital literacy, which includes the ability to use information technology effectively, is becoming increasingly important in today's digital era, where access to information is vast and diverse.

Based on the explanation above, it is important to evaluate the effectiveness of the application of AR in improving students' digital literacy. Research conducted by Yulianti et al. shows that the application of AR in learning can provide a richer and deeper learning experience, which contributes to increasing students' understanding of the material being taught (Yulianti et al., 2022). Therefore, researchers conduct research related to analyzing the effectiveness of the application of AR-based learning media at SMA Negeri 4 Malang is very relevant, given the challenges faced by students in accessing and utilizing information in this digital era.

METHOD

The research method that will be used in analyzing the effectiveness of the application of Augmented Reality (AR) based learning media in improving the digital literacy of grade XI students at SMA Negeri 4 Malang, especially in class XI GMS A, will adopt a quantitative approach with a quasi-experimental research design. This design was chosen because it allows researchers to compare learning outcomes before and after the application of AR media, as well as to evaluate the impact of the intervention on students' digital literacy.

This study will use a One Group Pretest-Posttest Design where learners will undergo a pretest to measure their digital literacy level before the application of AR media, then will be given learning using AR media, and end with a final test (posttest) to measure the changes that occur (Andhika Pratama Putra et al., 2023; Sylvia et al., 2020). This method has been proven effective in various previous studies that

show significant improvements in learning outcomes after the application of AR-based learning media (Mukhtar et al., 2023; Wulandari et al., 2020).

The population in this study is all grade XI students at SMA Negeri 4 Malang. The sample will be taken by purposive sampling, considering classes that have similar characteristics in terms of initial digital literacy skills. This study will involve one class consisting of approximately 32 learners (Listiawan et al., 2022).

Data will be collected through questionnaires designed to measure digital literacy, as well as tests that will be used to measure learning outcomes before and after the intervention. The questionnaire will cover aspects such as the ability to use information technology, understanding of digital security, and skills in searching for information online (Kardika et al., 2023). In addition, observation during the learning process will also be conducted to assess learners' interaction with AR media and their engagement in learning (Prasetio et al., 2019).

Data obtained from the pretest and posttest will be analyzed using descriptive and inferential statistics. Normality test using Kolmogorov Smirnov will be conducted to ensure that the data is normally distributed, and then paired sample t-test will be used to determine whether there is a significant difference between pretest and posttest results (Andhika Pratama Putra et al., 2023; Sylvia et al., 2020). The results of this analysis are expected to provide a clear picture of the effectiveness of AR-based learning media in improving students' digital literacy.

The AR-based learning media to be used in this research is designed to provide an interactive and engaging learning experience. The AR application will present content relevant to the informatics curriculum, such as programming simulations, introduction to computer hardware, and basic concepts in information technology (Mukhtar et al., 2023; Wulandari et al., 2020). Previous research shows that the use of AR can increase students' motivation and confidence in learning (Andhika Pratama Putra et al., 2023; Listiawan et al., 2022).

After the learning implementation, an evaluation will be conducted to assess the effectiveness of AR media in improving digital literacy. Reflections from learners and teachers will also be collected to get feedback on the learning experience using AR media (Agustina Kusuma Dewi et al., 2024; Eddy & Novelia Tri R. A., 2022). This is important for the improvement of future learning methods.

Through this systematic and planned approach, it is hoped that the research can make a significant contribution to the development of more effective learning methods in improving students' digital literacy in today's digital era.

RESULT AND DISCUSSION

This study obtained results with a population and sample using the GMS A class of 32 students by applying AR-based learning media. The reliability test uses the *Cronbach Alfa* formula which shows in the GMS A class 0.789 exceeds 0.600 so it is said to be reliable. The application of learning media in GMS A class was carried out by giving a *pre-test* before implementation and a *post-test* given at the end of learning. The application aims to determine the feasibility level of the learning media developed and applied to the GMS-A class. Purchasing *pre-test* and *post-test* using Google Form which was distributed by researchers to students. The results of the *pre-test* and *post-test* are listed in table 1.

Table 1. Pre-test and Post-test Results

Class	Value Description	Total	Min	Max	Mean	Median	Mode
GMS-A	<i>Pre-test</i>	1900	25	85	59.37	60	60
	<i>Post-test</i>	2450	35	95	76.56	80	80

The results of the *pre-test* and *post-test* that have been carried out in the GMS A class are listed in table 1. Based on the table above, the analysis obtained is the increase in students' scores on the scores obtained by students before and after implementation.

Normality test using one-sample Kolmogorov Smirnov which is displayed on Table 2

Table 2. Normality Test

One sample Kolmogorov Smirnov		
Statistic	Pre-test	Post-test
N	32	32
<i>Std. Deviation</i>	16.449	12.728
<i>Sig. (2-tailed)</i>	0.112	0.077

Based on the One-sample Kolomogorov Smirnov normality test, the pre-test value obtained a standard deviation value of 16.449 and while the post-test standard deviation value obtained a standard deviation value of 12.728. The significance value obtained in the pre-test is 0.112 while the post-test significance value obtained is 0.077. So that the pre-test and post-test data can be categorized as normally distributed because it exceeds 0.05.

This study uses the paired sample t-test hypothesis test because it uses a sample of 1 class, namely the GMS A class by applying AR learning media. The paired sample T test results are shown in Table 3.

Table 3. Hypothesis Test

Variable	Mean	Std. Deviation	t	sig
<i>Pre-test and post-test</i>	-17.18750	11.56591	-8.046	0.000

Based on the paired sample test obtained based on the value data owned. The acquisition of the t table value is negative, namely -8.046. The significance value of the pre-test and post-test obtained 0.000, meaning that the significance value (2-tailed) obtained is smaller than 0.05, it can be concluded that H0 is rejected and Ha is accepted.

So that it is concluded that there is a positive influence on the digital literacy of students in GMS A class before and after the implementation of AR learning media. Therefore, the analysis of the effect of the implementation of AR-based learning media on students of class XI GMS A is able to have a positive influence, because there are differences in digital literacy that can be seen from the interest and enthusiasm of students in using AR-based learning media.

CONCLUSION

This research was successfully conducted and applied to class XI GMS A with a positive effect before and after the implementation of AR-based learning media in informatics subjects. This is seen based on the test results which show the difference before the application and after the application which is evidenced by students who are more enthusiastic in learning. Suggestions for further research are that it needs to be applied using AR-based learning media on other sub-materials, and can be applied not only in 1 class but using 2 or 3 classes as a comparison.

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