

Augmented Reality Media Based on Moral Ethics to Increase High School Students Learning Motivation

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ABSTRACT

Background. The transformation of global digital technology is in line with the increasing cases of juvenile delinquency in East Java, while education still focuses on cognitive aspects and pays less attention to students' moral aspects.

Purpose. This research aims to develop Augmented Reality (AR)-based learning media that contains moral ethics and test its effectiveness on high school students' learning motivation.

Method. The study used the Lee & Owens Research and Development model approach, combining a quasi-experimental nonequivalent control group design, involving 41 high school students in East Java (Class A=20 as the experiment, Class B=21 as the control). Data were analyzed using N-Gain and Independent Sample t-test.

Novelty. Unlike previous AR research, which generally focused on cognitive subjects (mathematics, science, and social studies), this study strengthens the integration by integrating AR into the affective domain, namely moral ethics education.

Results. The product was declared highly feasible based on expert validation (average score 4.3/5.0). The experimental group showed a moderate increase in learning motivation (N-Gain=0.58) compared to the low control group (N-Gain=0.18), with a significant difference ($t=4.12$; $p=0.001$).

Conclusion. AR media contains appropriate moral ethics and effectively increases high school students' learning motivation, although generalization is still limited given the small sample scale.

KEYWORDS : Augmented Reality; High school students; Learning media; Learning motivation; Moral ethics

Citation: Sanria, P., Veen, V. M., Ramos, N., & Sudirman, Sudirman. (2026). Augmented Reality Media Based on Moral Ethics to Increase High School Students Learning Motivation. *Journal Of Paddisengeng Technology*, 2(3), 239-247. <https://doi.org/10.65224/jopate.v2i3.291>

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Received: July 24, 2026

Accepted: September 15, 2026

Published: September 30, 2026

INTRODUCTION

The development of digital technology has transformed the educational paradigm globally, with Learning Management Systems, artificial intelligence, big data, and Augmented Reality (AR) becoming pillars of educational transformation in various countries, although their impact varies depending on the readiness of each country's infrastructure. AR and Virtual Reality (VR) technologies, in particular, provide more immersive learning experiences and enable students to explore difficult concepts in interactive and engaging ways (Gkoutis et al., 2025).



In the classroom, teachers are beginning to utilize these technologies to present interactive simulations, such as exploring the solar system in science class or simulating historical events in social studies (Gonzales, 2025; Yang et al., 2025). More specific research also shows that AR, as an interactive 3D medium, is effective in increasing the learning motivation of digital generation students (Chang, 2021). This phenomenon confirms that AR is no longer merely an experimental technology, but rather part of a global shift in learning design for the digital generation.

In Indonesia, this technological shift has been accompanied by a non-technical issue: moral decline among adolescents. Easy access to information without adequate controls has been linked to increased cases of brawls, drug prevention, promiscuity, and bullying among adolescents, a condition exacerbated by the fact that education in Indonesia still focuses on cognitive/academic aspects, while soft skills as a key element of educational character have not received adequate attention (Jusubaidi et al., 2024). Specifically in East Java, data from the SITAPA Education enforcement operation by the East Java Provincial Public Order Agency in collaboration with the East Java Provincial Education Office recorded dozens of high school/vocational high school students caught truant in several districts/cities throughout 2023-2024, such as in Tulungagung, Lamongan, and Mojokerto (Arfina, 2025). This data confirms that the moral issues of students in East Java are not marginal issues, but rather require concrete and measurable educational intervention.

On the other hand, research into AR media development in Indonesia has focused heavily on cognitive subjects such as mathematics, science, and social studies (Bantun et al., 2026; Dewi et al., 2025; Saripudin et al., 2022). Interactive multimedia-based AR has been shown to be effective in increasing the learning motivation of digital native students in general learning contexts (Pratiwi et al., 2025; Qi, 2026; Staneviciene & Žekienė, 2025), and its implementation in elementary education institutions has shown increased digital competence and learning enthusiasm among trainees (Alarfaj & Alrashidi, 2025; Michos et al., 2022; Stumbrienė et al., 2024). Meanwhile, findings on educational character reveal a disconnect between cognitive and non-academic/character development in Indonesian schools (Perdana, 2018). This imbalance indicates a gap: AR technology, while proven to enhance learning motivation, has not been widely utilized for educational/moral content, even though this domain is a pressing issue for high school students in East Java, based on existing juvenile delinquency data (Arfina, 2025). This gap underlies the need to develop AR-based learning media that incorporates moral ethics for high school students.

Based on the description, this study aims to develop Augmented Reality-based learning media that contains moral ethics to increase high school students' learning motivation, while also testing its effectiveness through a quasi-experimental design with a control group.

RESEARCH METHODOLOGY

Research Design

This research uses a quantitative approach with a Research and Development (R&D) model combined with a quasi-experimental design. Sugiyono (2019) explains that the R&D method aims to produce a specific product while simultaneously testing its effectiveness. The R&D approach was used to produce an AR learning media product containing moral ethics, while the quasi-experiment was used to test its effectiveness on student learning motivation.

Research Location and Subjects

The population of this study was 41 high school students in East Java, divided into two classes: Class A (n=20) as the experimental group and Class B (n=21) as the control group. The sample was taken using a purposive sampling technique, considering that both classes were parallel classes (intact groups) with relatively equivalent characteristics in terms of level and curriculum taken (Sugiyono, 2019).

Development Procedure

This study uses the Lee & Owens model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation, with a particular emphasis on technological requirements analysis (front-end analysis) before multimedia product development is carried out (Lee & Owens, 2004). This model was chosen because it is more relevant to interactive multimedia-based products such as AR than general development models.

The design used is a nonequivalent control group design, namely a quasi-experimental design in which the experimental group and control group are not selected randomly (nonrandom), because both are taken from previously formed classes/intact groups (Sugiyono, 2019).

Table 1. Experimental design

Group	n	Pretest	Treatment	Posttest
Experimental Group (Class A)	20	O ₁	X (AR-based moral and ethical learning media)	O ₂
Control Group (Class B)	21	O ₃	- (conventional learning media)	O ₄

Instrumen

The learning motivation instrument adapts the ARCS (Attention, Relevance, Confidence, Satisfaction) as a framework for measuring learning motivation that has been widely used in educational research (Wang et al., 2025). This instrument needs to be tested for validity and reliability before being used for the pretest and posttest. Swimmer's test: normality (Shapiro-Wilk, because $n < 30$) and homogeneity. Hypothesis testing: independent samples t-test (if data are normal) or Mann-Whitney U (if not normal), calculated from the N-Gain scores of each group.

RESULT AND DISCUSSION

The Augmented Reality (AR) learning media integrated with moral and ethical values was developed using the Lee and Owens (2004) instructional development model, which consists of five main stages: analysis, design, development, implementation, and evaluation. During the needs analysis stage, it was found that students required learning media that could present ethical dilemmas in a more concrete, visual, and interactive manner so that abstract moral issues could be more easily understood, discussed, and reflected upon.

Based on these findings, a marker-based AR learning product was developed to display three-dimensional (3D) character models in various everyday moral dilemma scenarios. The media was designed to provide students with contextual learning experiences through interactive visualizations, audio narration, and reflective quizzes presented in each learning session. The scenarios included situations such as finding lost money, witnessing a friend cheating, borrowing an item without returning it, responding to bullying, and choosing between personal interests and honesty. These scenarios were selected because they represent moral situations that students may encounter in their daily lives.

The developed AR media consists of several main components, including a main menu, marker-scanning feature, 3D moral dilemma scenarios, audio narration, reflective questions, and interactive quizzes. Students begin the learning process by scanning an AR marker using a mobile device. After the marker is detected, a 3D scenario appears on the screen, followed by audio narration explaining the situation. Students are then encouraged to observe the scenario, reflect on the moral problem presented, and respond to reflective questions or quizzes related to the ethical decision that should be taken.



Figure 1. Display of the Developed Moral Ethics-Based Augmented Reality Learning Media

The visualization of the developed product demonstrates that the media was designed not only to provide technological interactivity but also to create meaningful learning experiences. The combination of 3D visualization, contextual moral scenarios, audio narration, and reflective activities enables students to connect abstract moral concepts with real-life situations. Therefore, the AR media is expected to support students' active engagement while encouraging moral reasoning, reflection, and learning motivation.

Before being implemented in the learning process, the developed product was validated by three experts consisting of a media expert, a content expert, and a language expert. Expert validation was conducted to determine the feasibility and quality of the product in terms of media design, content suitability, and language use. The results of the expert validation are presented in Table 1.

Table 1. Expert Validation Results of the Moral Ethics-Based AR Media

Validation Aspect	Average Score	Category
Media Expert	4.3	Very Feasible
Content Expert	4.1	Feasible
Language Expert	4.4	Very Feasible
Overall Average	4.3	Very Feasible

As presented in Table 1, the validation results indicate that the developed moral ethics-based AR learning media achieved an overall average score of 4.3 on a maximum scale of 5.0 and was categorized as very feasible. The language aspect obtained the highest average score of 4.4, followed by the media aspect with a score of 4.3 and the content aspect with a score of 4.1.

These results indicate that the developed media met the expected standards in terms of visual and technical quality, appropriateness of moral and ethical learning content, and clarity of language.

Although the content expert provided a slightly lower score than the other validators, the score remained within the feasible category. Therefore, after minor revisions based on expert suggestions, the product was considered appropriate for implementation and effectiveness testing with students.

The effectiveness of the developed AR media was examined using a nonequivalent control group design involving two classes. Class A served as the experimental group with 20 students, while Class B served as the control group with 21 students. The experimental group received learning using the moral ethics-based AR media, whereas the control group participated in conventional learning activities.

Students' learning motivation was measured before and after the intervention through pretest and posttest assessments. The improvement in learning motivation was subsequently analyzed using normalized gain (N-Gain). The results are presented in Table 2.

Table 2. Pretest, Posttest, and N-Gain Results of Learning Motivation

Group	Average Pretest	Average Posttest	N-Gain	N-Gain Category
Experimental Group (Class A)	62.00	84.00	0.58	Moderate
Control Group (Class B)	61.00	68.00	0.18	Low

Table 2 shows that the experimental group obtained an average pretest score of 62.00, which increased to 84.00 in the posttest. The resulting N-Gain score was 0.58 and was categorized as moderate. In comparison, the control group obtained an average pretest score of 61.00 and a posttest score of 68.00, resulting in an N-Gain score of only 0.18, which was categorized as low.

Before hypothesis testing was conducted, assumption tests were performed to determine whether the data met the requirements for parametric statistical analysis. The normality of the data was examined using the Shapiro-Wilk test because the number of participants in each group was fewer than 30. A homogeneity test was also conducted on the pretest scores of both groups. The results showed that the data were normally distributed, with significance values greater than 0.05 ($p > 0.05$), and that the variances of the two groups were homogeneous ($p > 0.05$). These findings indicate that the experimental and control groups were relatively comparable before the intervention was implemented.

Hypothesis testing was subsequently conducted using an independent-samples t-test on the N-Gain scores of the experimental and control groups. The analysis produced a t-value of 4.12 with a significance value of $p = 0.001$. Since the significance value was lower than 0.05, the null hypothesis was rejected. This result indicates a statistically significant difference in the improvement of learning motivation between students who learned using the moral ethics-based AR media and those who participated in conventional learning.

The findings therefore suggest that the use of AR-based learning media contributed to a greater improvement in students' learning motivation compared with conventional learning. However, statistical significance should not be interpreted as evidence that AR technology alone caused the observed improvement. Other instructional factors associated with the intervention should also be considered when interpreting the results.

The findings of this study demonstrate that students in the experimental group who used moral ethics-based AR learning media experienced a greater increase in learning motivation than those in the control group. The experimental group achieved an N-Gain score of 0.58, which was categorized as moderate, whereas the control group achieved an N-Gain score of 0.18, which was categorized as low. The difference was also statistically significant, as indicated by the independent-samples t-test result of $t = 4.12$ and $p = 0.001$.

These findings are consistent, who reported that Augmented Reality, as an interactive three-dimensional learning medium, has the potential to increase the learning motivation of digital-native students (Bhagat et al., 2021; Liu et al., 2022). The interactive characteristics of AR may provide students with learning experiences that differ from conventional classroom instruction because digital objects can be presented within a real-world learning environment and explored through mobile devices.

The increase in learning motivation observed in the experimental group may be associated with the ability of AR to transform abstract moral and ethical concepts into more concrete and contextual learning experiences. Ethical dilemmas are often difficult for students to understand when they are presented only through verbal explanations or written descriptions. Through 3D visualization, students are able to observe characters, situations, and possible consequences of moral decisions in a more realistic and interactive manner (Harrison, 2024; Sari et al., 2021; Shim, 2023).

The integration of contextual scenarios is also important because moral learning requires more than the memorization of rules concerning right and wrong. Students need opportunities to interpret situations, identify competing values, consider possible consequences, and justify their decisions. The AR scenarios developed in this study provided students with opportunities to engage with moral dilemmas that resemble situations encountered in everyday life. This contextualization may strengthen cognitive and emotional involvement in the learning process.

Another possible explanation for the improvement in learning motivation is the multimodal nature of the developed media. The combination of 3D visual elements, audio narration, interactive scenarios, and reflective quizzes provides multiple channels through which students can interact with learning content (Lazou & Tsinakos, 2025). Such interaction may attract students' attention, stimulate curiosity, and encourage active participation compared with learning activities that rely primarily on verbal explanations and static instructional materials.

The reflective quiz component also distinguishes the developed product from AR media that merely display three-dimensional objects. Students were not positioned only as viewers of technological content but were encouraged to respond to ethical situations, make decisions, and reflect on the reasons underlying their choices. This feature strengthens the pedagogical function of AR by connecting technological interaction with moral reasoning activities.

In addition, the relatively small sample size and the use of a nonequivalent control group design limit the extent to which the findings can be generalized. Although the pretest scores and assumption tests indicated that both groups were relatively comparable, the absence of random assignment means that other uncontrolled factors may have influenced the results. Future research involving larger samples, multiple schools, randomized experimental designs, and longer intervention periods is therefore recommended.

Overall, the findings indicate that the developed moral ethics-based AR learning media is feasible and has promising potential to enhance students' learning motivation. Its effectiveness appears to be supported by the integration of interactive 3D visualization, contextual moral dilemmas, audio narration, and reflective learning activities. More importantly, the value of the media should not be understood solely in terms of technological novelty. Its pedagogical contribution lies in how AR is designed to facilitate meaningful interaction, contextual understanding, moral reflection, and active student engagement in the learning process.

CONCLUSION

Based on the results of the development and testing that have been carried out, it can be concluded that the Augmented Reality (AR) based learning media containing moral ethics that was developed is stated to be very suitable for use based on validation by media, material, and language experts with an average score of 4.3 on a scale of 5.0, and proven to be effective in increasing the learning motivation of high school students, which is indicated by the N-Gain of the experimental group (0.58, medium category) which is higher than the control group (0.18, low category) as well as significant t-test results ($t = 4.12$; $p = 0.001 < 0.05$); with such a sample, AR media containing moral ethics can be an alternative solution to the low attention to character education amidst the high number of juvenile delinquency cases in East Java, however, this finding is still limited to a relatively small sample (41 students from one school) so that generalization to a wider population of high school students needs to be done carefully, and further research with a larger sample and control of the novelty effect is needed to strengthen this validity.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to STKIP PGRI Pacitan, Indonesia, for the institutional support and academic facilities provided throughout the completion of this research. The authors also extend their appreciation to the lecturers, colleagues, research participants, and all parties who contributed valuable assistance, constructive feedback, and encouragement during the research and preparation of this manuscript.

DECLARATION OF GENERATIVE AI

During the preparation of this manuscript, the authors used ChatGPT, developed by OpenAI, to support language refinement, improve grammatical accuracy, enhance sentence clarity, and assist with academic writing organization. The AI tool was not used to generate or manipulate research data, perform statistical analyses, fabricate references, or determine the scientific conclusions of the study. After using the tool, the authors carefully reviewed, verified, and edited the generated content as necessary and take full responsibility for the accuracy, integrity, and final content of the publication.

ETHICAL STATEMENT

This study was conducted in accordance with established ethical principles for research involving human participants. Participation in the study was voluntary, and all participants were informed about the purpose, procedures, potential benefits, and their right to withdraw from the study at any time without any academic consequences. Informed consent was obtained from all participants prior to data collection. The confidentiality and anonymity of participants were strictly maintained, and all collected data were used exclusively for research purposes. The research procedures were designed to minimize potential risks and to ensure the protection, dignity, privacy, and well-being of all participants throughout the study.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; Investigation.

Author 3: Data curation; Investigation.

Author 4: Conceptualization; Data curation; Investigation.

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