



Development of Augmented Reality Integrated Handouts for Strengthening Independence Character of Junior High School

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Abstract: This study aims to develop Augmented Reality integrated handouts to strengthen the independent character of junior high school students on the material of the relics of Hindu-Buddhist kingdoms in Indonesia. The research used the Research and Development method with the 4D development model (Define, Design, Develop, Disseminate) carried out at SMPN 1 and SMPN 2 Mojowarno, Jombang Regency. The research instruments included material and media expert validation sheets, student response questionnaires for practicality testing, observation sheets and independent character questionnaires to measure product effectiveness. Data were analyzed using quantitative descriptive techniques for validity and practicality with score interpretation criteria, while the effectiveness of strengthening independent character was analyzed using the N-gain test comparing the results of initial and final measurements in the experimental class. The validation results by material experts, media experts, and practitioners showed that the product validity level reached 94.5% which was included in the very valid category. The practicality test obtained a score of 97% in the initial test and 98% in the large-scale implementation of 60 students, both in the very practical category. Measurement of independent character showed a significant increase in both experimental classes with N-gain values reaching 0.92 and 0.90 which were categorized as very independent. This study proves that the Augmented Reality integrated handout effectively strengthens students' independent character while improving understanding of the material of the relics of Hindu-Buddhist kingdoms. This learning media offers an innovative solution that is aligned with the objectives of the Merdeka Curriculum and the Pancasila Student Profile, especially in fostering student independence through the use of digital technology.

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Introduction

Indonesian education is organized according to the applicable curriculum guidelines (Emidar & Indriyani, 2023), with the Merdeka Curriculum as a response to the impact of the COVID-19 pandemic which resulted in a learning crisis (Aegustinawati & Yaya Sunarya, 2023). This curriculum aims to create a more flexible learning environment (Haq & Fitriani, 2024), emphasizing a less rigid learning process so that students can optimally develop their potential while responding to the demands of technological advances (Hamzah et al., 2023).

The independent curriculum leads to the Pancasila Student Profile (P3) which offers solutions to contemporary educational challenges, including aspects of faith, independence, critical thinking, creativity, cooperation, and global diversity (Setyowati & Putri Yanuarita Sutikno, 2024). One of the most inclined is student independence, the ability to manage



oneself in learning without constant supervision is highly emphasized and needs to be integrated into all learning activities, including Social Science (IPS) (Cristina et al., 2024).

Social studies at the junior high school level help students understand community problems and develop important skills for modern life (Camposano et al., 2021). However, understanding of social studies material is still not optimal, with students' perception that this lesson is contextual understanding and memorization of facts (Susanti et al., 2024). This challenge was observed at SMPN 1 and SMPN 2 Mojowarno, where students showed minimal interest in social studies, resulting in distracted focus and limited active participation.

More seventh-grade students score below the Minimum Completion Criteria (KKM), especially when they struggle with historical topics that are considered abstract such as the relics of Hindu-Buddhist kingdoms in Indonesia. Teachers have varied teaching approaches, but the constraints of limited teaching resources, and reliance on government textbooks with inadequate visual support contribute to this difficulty. Students' ongoing need for teacher guidance and external help to complete tasks indicates weak independent character. Students admit to not doing independent learning at home, often leaving textbooks at school because they are too heavy. This lack of independence affects understanding of the material, which ideally develops gradually through consistent learning.

Students need multimedia learning tools that combine text, images, sound, animation, and video to bridge educational content with student understanding while fostering independence (Abdulrahman et al., 2020). Augmented Reality (AR) integrated handouts, which integrate virtual elements with the physical world, create rich interactions and authentic experiences that students can access independently (Nurliasari et al., 2022).

The combination of accessible handouts and AR technology can address this challenge by providing an engaging learning medium that encourages self-directed learning and improves understanding of the material. Previous research has shown the effectiveness of handouts in increasing students' enthusiasm for learning, with 83% of students expressing satisfaction with this approach (Rambe et al., 2024). Similarly, the implementation of AR showed a significant increase in learning motivation, with students showing a high level of effectiveness of 90.01% and academic achievement of 84.03% (Sulthon et al., 2022).

This research presents a novelty in the form of developing a combined Augmented Reality (AR) integrated handout media for Hindu-Buddhist kingdom heritage material aimed at VII-grade students at SMPN 1 and SMPN 2 Mojowarno, as a solution to students' low interest and understanding of historical material which is considered abstract. The main objective is to create innovative learning media that not only improves understanding of historical material through three-dimensional visualization and interactive experiences but is also specifically designed to foster the character of learning by the Pancasila Learner Profile in the Merdeka Curriculum while overcoming practical obstacles such as limited learning resources and students' reluctance to carry textbooks that are too heavy.

Research Method

This research applies the method of Research and Development through the 4D model (Define, Design, Develop, Disseminate) developed by Thiagarajan (Salsabila & Ninawati, 2022). The research was conducted at SMPN 1 Mojowarno and SMPN 2 Mojowarno, Jombang Regency in the odd semester of the 2024/2025 school year. The research subjects were seventh-grade students in both schools.



The 4D model goes through several stages, Define (Defining) researchers conduct an initial-end analysis to identify social studies learning problems, analyze the characteristics of grade VII students, analyze tasks to determine the skills that need to be developed, analyze the concept of Hindu-Buddhist kingdom heritage material, and formulate learning objectives. The Design stage includes the preparation of assessment instruments, selection of handouts and augmented reality learning media, selection of handout format and AR content, and initial design of AR-integrated handouts. The Development stage includes expert validation by material experts and media experts, product revisions based on validator input, limited trials, revisions based on limited trial results, and field trials. At the dissemination stage, final product packaging and product distribution to two target schools were carried out (Yusuf, 2023).

Data collection was conducted through expert assessment, monitoring of the learning process, learner responses, and evaluation of understanding before and after the activity (Putrawijaya & Nurcholish Arifin Handoyono, 2022). Data analysis includes validity analysis obtained from the average expert validation score with the criteria:

Table 1. Validation Categories

Achievement Level	Category	Test Decision
85,01% - 100%	Very valid	Can be used without revision
70,01% - 85%	Valid enough	Usable with minor revisions
50,01% - 70%	Less valid	Usable with major revisions
01% - 50%	Invalid	Not to be used

Source: Creswell & J. David Creswell (2018)

Practicality analysis was carried out based on data analysis of learning implementation and student responses with criteria:

Table 2. Categories of practicality and independence

Achievement Level	Category	Test Decision
86% - 100%	Very practical/interesting	Can be used without revision
70% - 85%	Quite practical/interesting	Usable with minor revisions
60% - 69%	Less practical/interesting	Usable with major revisions
0% - 59%	Not practical/interesting	Unusable

Source: (Sari et al., 2024)

Effectiveness was measured by comparing the change in the level of understanding before and after the intervention through a quantitative approach that considered the proportion of relative improvement. These results were then interpreted by category:

Table 3. Categories N-gain Value

N-Gain Value	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

Source: (Isdayanti et al., 2022)

The analysis of the character of independence uses an observation sheet with indicators of learning independence which is analyzed descriptively quantitatively to see the increase in student independence (Fatma Rahmawati, 2023). his research applies data triangulation from various sources to ensure the validity and reliability of the research results.

Results and Discussion

This development research was carried out using the 4D model (Define, Design, Develop, Disseminate) to create learning media that suits the needs of junior high school students in the digital era. The research process begins with the defining stage to identify learning problems faced by students.

At the defining stage (Define), the results of the needs analysis show that students of SMPN 1 and SMPN 2 Mojowarno, although included in the digital generation category, still experience obstacles in learning independence and interest in social studies material, especially the material on the heritage of Hindu-Buddhist kingdoms in Indonesia which tends to be abstract. The results of the potential and problem questionnaire show a percentage of 79.93%, which indicates an urgent need for innovative learning media that can visualize abstract concepts and at the same time encourage learning independence. This finding is in line with the opinion of Haleem et al., (2022) who emphasized that the use of technology in education is a must to create a more interactive and meaningful learning process in the digital era.

Based on the results of the problem identification, researchers proceeded to the design stage by developing two integrated learning media, namely conventional handouts and Augmented Reality applications.

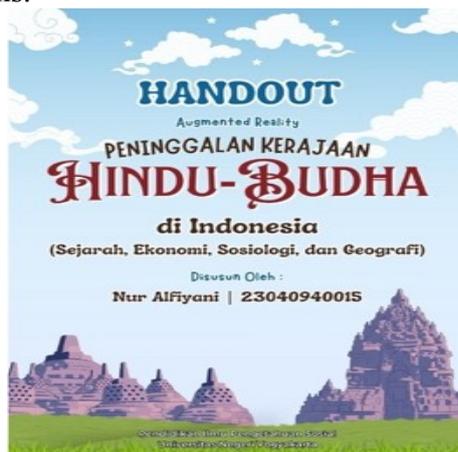


Figure 1. Cover Handout



Figure 2. Augmented Reality Application Menu



Figure 3. 3D visualizations

The handout media is designed with an attractive appearance, equipped with a themed cover of the relics of the Hindu-Buddhist kingdom as shown in Figure 1, while the AR application is designed with various interactive features such as instructions for use, galleries, learning modules, evaluations, and other supporting features displayed through interactive buttons as shown in Figure 2. The integration of these two media is intended to create a comprehensive learning experience, where students can access interactive multimedia content



such as 3D visualization of Hindu-Buddhist heritage buildings through scanning codes or images on physical handouts using mobile devices as shown in Figure 3. This is in accordance with the opinion of Fitria, (2023) that augmented reality media offers a learning experience that combines the real world with digital elements, thus creating a more interesting learning environment and increasing student motivation.

The development stage (Develop) includes product validation and limited trials. The AR-integrated handout media was validated by four validators consisting of one media expert, one material expert, and two practitioners. Validation includes five main aspects, accessibility, visualization, interactivity, learning autonomy, and material.

Table 4. AR-Integrated Handout Validation Results

Indicator Validation	Validator Research Results				Average Score
	Validator 1	Validator 2	Validator 3	Validator 4	
Accessibility	22	23	22	21	22
Visualization	21	21	23	23	22
Interactivity	20	21	23	22	21,5
Learning Autonomy	23	20	21	20	21
Material	23	22	22	22	22,25
Achievement level	94,7%	93%	96,5%	93,9%	94,5%
Test decision	Can be used without revision				

The validation results showed an average achievement level of 94.5%, with the decision that the product could be used without revision. This validation confirms that the developed AR-integrated handout has excellent quality and is ready to be tested. Furthermore, a limited trial was conducted with 30 students to evaluate the effectiveness and practicality of the media.

Table 5. Trial Results

No	Assessment Indicator	Total score Answer "Yes"	Percentage	Categories of Analysis Results
1	Practicality of use	174	96%	Very practical
2	Attractiveness	178	98%	Very interesting
Average				97%
Test Decision				Can be used without revision

Based on the data in Table 5, the trial results showed a level of practicality of use of 96% and attractiveness of 98%, with an average practicality of 97%. Thus, the AR-integrated handout product is declared feasible to use in learning without the need for further revision. This finding reinforces the opinion of Laela & Risnaningsih, (2021). that handouts are comprehensive learning aids and contribute significantly to learning effectiveness, especially when integrated with AR technology.

At the Disseminate stage, large-scale trials were conducted involving 60 students consisting of 30 students of SMPN 1 Mojowarno and 30 students of SMPN 2 Mojowarno.



Table 6. Disseminated Results

No	Assessment Indicator	Total score Answer "Yes"	Percentage	Categories of Analysis Results
1	Practicality of use	351	97%	Very practical
2	Attractiveness	355	98%	Very interesting
		Average		98%
Test Decision				Can be used without revision

The results of the large-scale trial showed an increase in practicality to 98%, with details of 97% for practicality of use and 98% for attractiveness. In addition, the measurement of students' independent character was carried out through pretest and posttest in two experimental classes.

Table 7. Recapitulation of Average Results of Independent Character

No	Class	Average		N-Gain	Criteria
		Pretest	Posttest		
1	Experiment 1	33	96	0,92	Very independent
2	Experiment 2	32	93	0,90	Very independent

Based on Table 7, in experimental class 1, the pretest score of 33 increased dramatically to 96 in the posttest, with an n-gain value of 0.92 which is included in the very independent category. Experimental class 2 also showed a significant increase, from a pretest score of 32 to 93 in the posttest, with an n-gain value of 0.90 which is also included in the highly independent category. These results are in line with the opinion of Septiadevana et al., (2020) on the importance of independent character assessment to determine the effectiveness of learning media in increasing student independence.

Based on the overall research results, it can be concluded that the development of Augmented Reality-integrated handout learning media for the relics of Hindu-Buddhist kingdoms in Indonesia has succeeded in creating learning media that are valid, practical, and effective in improving students' independent character. The integration of AR technology with conventional handouts proved to be able to bridge the digital generation's need for visualization of abstract concepts while encouraging independence in learning. This shows that an innovative approach to learning media development can be an effective solution to overcome various challenges in social studies learning in the digital era.

Discussion

The results showed that the development of Augmented Reality integrated handouts for the material of the relics of Hindu-Buddhist kingdoms in Indonesia successfully answered the need for a variety of learning media identified through a needs questionnaire with a level of need reaching 79.93% at SMPN Mojowarno District. This finding is in line with the shift in the educational paradigm in the digital era which emphasizes the importance of technology integration in learning to facilitate more active and independent learning (Asmayawati et al., 2024).

The developed handout has gone through a comprehensive validation process by four experts from various fields of expertise (Yulandari & Dea Mustika, 2021). The validation covers five important aspects, namely accessibility, visualization, interactivity, learning autonomy, and material. The validation results showed a very good achievement with the average score for accessibility reaching 22, visualization at 22, interactivity at 21.5, learning autonomy at 21, and material at 22.25. Overall, the average achievement level of this product



reached 94.5% with the recommendation that can be used without revision from all validators, indicating the excellent quality of the AR-integrated handout developed. This is in line with the findings Abdulrahman et al., (2020) which state that learning media can be said to be practical if teachers and students are willing to apply learning tools that are easy to use in the field and related to the researcher's design.

Disseminate which was carried out in two stages gave very positive results. In the first test involving 30 students, the AR-integrated handout obtained an average practicality assessment of 97% which was included in the very practical category. Whereas in the large-scale test involving 60 students, the practicality assessment increased to 98% with a very practical and attractive category. These results indicate a very high level of acceptance from users and confirm that the product is ready to be implemented in learning without requiring further revisions. This finding is similar to the results of research by Adhiguna & Yaminah, (2025) which obtained a practicality score of 84.03% on the development of AR-based learning media at the elementary school level.

The effect of AR-integrated handouts on strengthening students' independent character was proven to be very significant. In experimental class 1, the pretest score of 33 increased significantly in the post-test to 96, with an n-gain score of 0.92 which was categorized as very independent. Similarly, experimental class 2, with a pretest score of 32 increased to 93 in the post-test, obtaining an n-gain score of 0.90 in the highly independent category.

The success of AR-integrated handouts in fostering independent character can be explained through several factors. AR technology provides a more engaging and interactive learning experience that increases students' intrinsic motivation to learn. Three-dimensional visualizations help students better understand abstract historical material, while interactive features encourage active exploration and constructivist learning. Students can adjust the pace of learning according to their abilities and receive immediate feedback, which reduces dependence on the teacher and strengthens learning independence. This is in line with the findings of Pamorti et al., (2024) which state that the application of AR-based learning media can significantly improve students' critical thinking skills in the classroom.

The increase in independent character in the experimental class was mainly seen in the aspects of learning initiative, self-confidence, learning responsibility, and time management skills. Students showed a better ability to find solutions independently when facing difficulties in learning and were more proactive in exploring the material. Mustika & Harahap, (2025) emphasizes the importance of educators in designing effective learning strategies and utilizing learning media to improve the quality of learning in schools.

Although the results showed significant success, it should be noted that strengthening independent character is a long-term process that requires a holistic and consistent approach. AR-integrated handouts should not be viewed as a single solution, but rather as part of a comprehensive set of strategies to build independent character. In addition, technology accessibility and digital literacy of teachers and students also need to be considered to ensure optimal implementation.

This study builds on the findings of previous research by specifically integrating AR technology in a handout format for Hindu-Buddhist heritage materials and measuring its impact on the independent character of junior high school students. The novelty of this study lies in the specific combination of AR technology, handout format, focus on Hindu-Buddhist historical materials and comprehensive measurement of independent character. The significant findings in this study extend and strengthen the results of previous research by



showing the great potential of AR technology not only to improve cognitive understanding but also to foster students' independent character.

Conclusion

The Augmented Reality integrated handout learning media developed is included in the category of highly valid, highly effective, and also practical. Based on the results of the validation test, the average score of media validation is 94.5% which is declared valid without revision from expert validators and users because it has fulfilled aspects of accessibility, visualization, interactivity, learning autonomy, and material so that it is relevant for use in social studies learning in junior high school.

The practicality test has met the criteria with the average practicality of use reaching 97% in the initial trial and increasing to 98% in the large-scale test which is in the very practical and very attractive category. These results indicate that AR-integrated handouts can be implemented in learning without requiring further revision. The effectiveness test based on the assessment of independent character shows that learning is very effective, with significant improvements in both experimental classes. Experimental class 1 showed an increase from a pretest score of 33 to 96 in the post-test with an N-gain value of 0.92, while experimental class 2 increased from a pretest score of 32 to 93 in the post-test with an N-gain value of 0.90, both of which were in the highly independent category. It can be concluded that the use of Augmented Reality integrated handouts on the material of the relics of Hindu-Buddhist kingdoms can improve the independent character of junior high school students effectively and significantly.

Recommendation

The recommendation of this research for teachers is that this Augmented Reality integrated handout can be applied as the media of choice in social studies subjects for the material of the relics of Hindu-Buddhist kingdoms in class VII junior high school. In addition, it is expected to prepare a device in the form of a cellphone that matches the specifications of the AR application that will be used so that there are no obstacles during the learning process. For future research, it is recommended to develop AR-integrated handouts for other social studies materials and measure their impact on other character aspects in the Pancasila Student Profile.

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