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Development of Augmented Reality Edu-Spinner to Enchance Cultural Diversity of Fifth-Grade Elementary School Students

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ABSTRACT

This study was motivated by the suboptimal implementation of the "Keragaman Budaya Indonesiaku" (My Indonesian Cultural Diversity) learning material at SD Negeri Bringin 02 due to limited technological facilities and a lack of variation in instructional media. The learning process was still dominated by the Problem Based Learning (PBL) model, utilizing simple media such as pictures, with technology use limited to PowerPoint, Kahoot, and Quizizz. This study aimed to develop and examine the feasibility and effectiveness of an Augmented Reality (AR)-based Edu-Spinner learning media for fifth-grade students. The study applied a Research and Development (R&D) methodology utilizing the ADDIE model combined with a mixed-methods approach through a one-group pretest–posttest design. The participants involved were 28 students. The validation findings showed that the developed media was rated as "very good," achieving a score of 92% from the media expert and 88% from the material expert. Furthermore, the effectiveness analysis using the Paired Sample T-Test produced a significance value of 0.00 < 0.05, which demonstrates a significant difference between the pretest and posttest scores. The N-Gain result of 0.7634 fell into the high category. Thus, the AR-based Edu-Spinner media is deemed valid and effective in enhancing students' learning outcomes on the topic "Keragaman Budaya Indonesiaku."

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INTRODUCTION

Education is a series of planned processes aimed at improving individuals' knowledge, attitudes, and abilities, as well as serving as a foundation for contributing to social life. Article 31 of the 1945 Constitution of the Republic of Indonesia emphasizes that every citizen has the right to obtain education with the purpose of advancing the intellectual life of the nation and forming individuals with noble character. This article confirms that education aims to improve the nation's intellectual capacity and develop moral character. The provision in Article 31 of the 1945 Constitution serves as evidence of a nationally applicable legal basis. Further explanation is regulated in Law Number 20 of 2003 concerning the National Education System, which states that through education, students' abilities are developed, character is formed, and a dignified national civilization is built (Jayanti et al., 2024).

Education prepares the younger generation to face the digital era while simultaneously shaping character; therefore, strengthening character education remains essential. Character

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education aims to improve the quality of educational processes and outcomes in schools by emphasizing the formation of positive character and moral values in students in an integrated and balanced manner, in accordance with graduate competency standards (Suarningsih et al., 2024). Through Pancasila Education, students' character can be optimally developed. Based on the Decree of the Head of BSKAP Kemendikbud Ristekdikti Number 033/H/KR/2022, this subject plays an important role in instilling Pancasila values in every citizen(Sekarwati et al., 2023).

The topic "My Indonesian Cultural Diversity" in Pancasila Education aims to instill tolerance, respect for differences, and strengthen national unity. Therefore, the learning process needs to utilize interactive media to make it more effective and aligned with technological developments. Based on observations and interviews at SD Negeri Bringin 02, learning has not been implemented optimally due to limited technological facilities and is still dominated by the Problem Based Learning (PBL) model using simple media such as pictures, PowerPoint, Kahoot, and Quizizz. One potential effort that can be implemented is the development of Augmented Reality (AR)-based learning media combined with an Edu-Spinner game. Augmented Reality is a technology capable of integrating the physical world with digital environments, where the real environment functions as a platform to display digital objects such as images, 3D models, and similar elements (Saca, 2021).

Several studies indicate that Augmented Reality learning media are highly beneficial in supporting learning processes. Research shows validation results from material experts of 81.60% and media experts of 96.60%, both categorized as very feasible (Rahayu & Wulandari, 2024). This is supported by (Dendodi et al., 2024) who state that AR-based learning media significantly improve students' understanding of science concepts through interactive visualization. Furthermore, Alfi et al. (2024) reported media validation results of 97.5%, material expert validation of 95%, and language expert validation of 80.5%. The gain score of 0.96 (high category) indicates an improvement in students' visual-spatial abilities, suggesting that AR media are highly feasible for use in improving these abilities among elementary school students in Blitar Regency.

The researcher distributed questionnaires to 28 students and 1 teacher on November 19, 2025. The results indicated that the teacher was interested in using AR-based Edu-Spinner media. Additionally, 63% of students strongly agreed and 33% agreed that engaging media could increase enjoyment and learning outcomes. This study presents novelty in integrating

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educational games and AR-based 3D visualization in Pancasila Education learning using the ADDIE model at SD Negeri Bringin 02, where learning is still dominated by conventional media. The questionnaire results also showed that 59% of students strongly agreed and 26% agreed to try technology-based learning media. Interest in images, animations, and interactive media was also high, with 63% strongly agreeing and 19% agreeing, indicating that most students have visual and interactive learning styles. Furthermore, 41% strongly agreed and 37% agreed with the use of AR-based Edu-Spinner media, demonstrating strong student interest in new, interactive, engaging, and easy-to-understand learning media as a solution to learning challenges. These findings highlight the importance of developing AR-based Edu-Spinner media that meets students' needs and enhances engagement and learning motivation

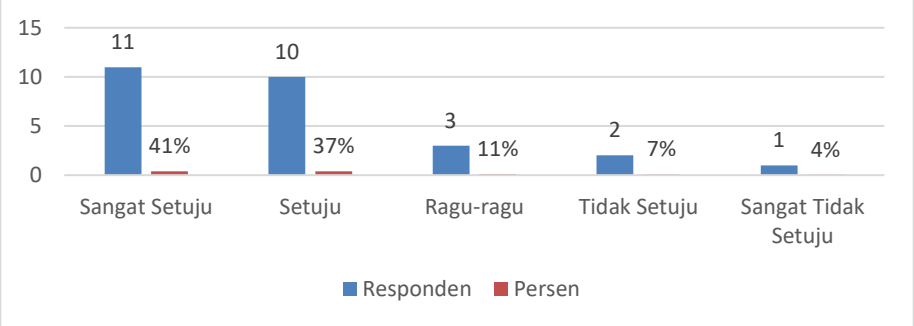

Figure 1. Grade V Student Needs Analysis Questionnaire

To determine students' initial understanding of the topic "My Indonesian Cultural Diversity," the researcher administered 20 multiple-choice questions to Grade V students of SD Negeri Bringin 02 based on the Minimum Competency Achievement Criteria (KKTP).

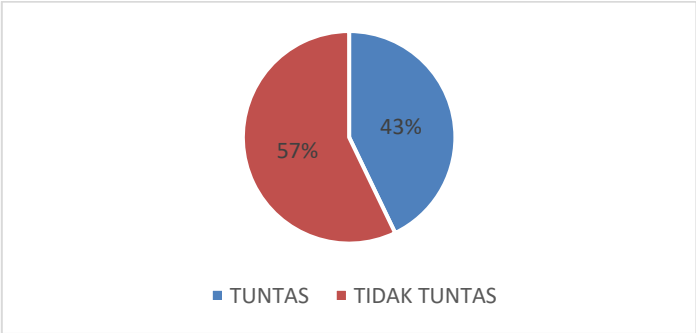

Figure 2. Initial Learning Mastery of Grade V Students

The results showed that 43% of students achieved mastery while 57% did not, indicating that the majority of students had not yet achieved mastery. Therefore, innovative media such as Augmented Reality-based Edu-Spinner are needed to improve students' understanding and learning motivation.

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RESEARCH METHOD

This study employed a mixed-methods approach, combining quantitative data (pretest-posttest and expert validation) to assess the effectiveness and feasibility of the media, and qualitative data in the form of interviews and response questionnaires from teachers and students. The type of research used was R&D referring to the ADDIE model, which consists for the following stages : 1) Analyze, 2) Design, 3) Development, 4) Implementation, 5) Evaluation. This research was conducted during the even semester of the 2025/2026 academic year in Grade V at SD Negeri Bringin 02, Semarang City, involving 28 students on February 12–13, 2025.

The ADDIE model was chosen because it provides a systematic approach to instructional development (Zamsiswaya et al., 2024). According to Mulyatiningsih, 2016 in (Wibowo et al., 2022) the ADDIE model framework was designed by Branch :

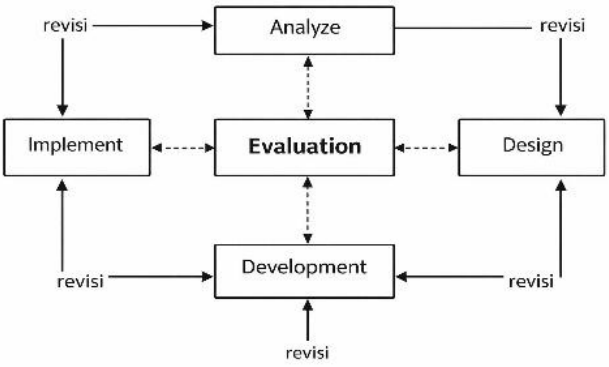

Figure 3. ADDIE Model Development Stages

The analysis stage aims to identify problems and needs through interviews, observations, and questionnaires, supported by data on students' initial abilities. The design stage includes media design, preparation of pretest–posttest questions, validation instruments, and response questionnaires. The development stage focuses on product realization and expert validation, as well as instrument testing including validity, reliability, difficulty level, and discrimination index. The validation process was conducted by experts to assess the validity of the development learning media (Mayada & Widodo, 2025).

The Implementation stage was carried out by applying the media that had been validated through a small group test with 6 students and a large group test with 22 Grade V students of SDN Bringin 02, using the pretest–treatment–posttest procedure along with teacher and student response questionnaires. The Evaluation stage was conducted to measure the

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media's performance through normality testing, paired t-test, and N-Gain analysis, as well as response analysis to assess its appropriateness and ease of use.

Data collection was conducted through observation, interaction, questionnaires, and pre- and post-evaluations. Observation and interaction were used to understand the initial conditions, problems, and needs for the teaching aid. Questionnaires were used to assess the needs and responses of teachers and students to the teaching aid. On the other hand, pre- and post-evaluations were used to assess improvements in learning outcomes before and after using the tool. Data analysis techniques were applied to evaluate the feasibility and effectiveness of the Edu-Spinner media using AR in improving the learning achievements of fifth-grade students on the topic of Cultural Diversity in Indonesia. The analysis was conducted using a mixed methods approach, through expert feasibility tests, normality tests, t-tests, and N-Gain based on pretest–posttest, as well as analysis of teacher and student response questionnaires to determine the level of acceptance and effectiveness of the media.

A quantitative approach was used to measure the effectiveness of learning media through a one-group pretest–posttest design. One group of fifth-grade students was given a pretest to determine their initial abilities, then given treatment using Augmented Reality-based Edu-Spinner media, and finally given a posttest to see the improvement in learning outcomes.

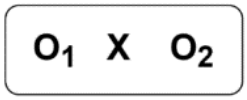

Figure 4. One Group Pretest-Posttest Design

Description:
O1 : Pretest (before using media)
X : Treatment (use of media)
O2 : Posttest (after using media)

The research used a Likert scale to measure the feasibility and effectiveness of the media, both through assessments by subject matter experts and media experts as well as responses from teachers and students. The details of the assessment criteria are presented as follows:

Table 1. Feasibility Test Score Criteria

Score Range	Percentage Range	Category
43 – 50	81% - 100%	Very Valid/Very Good
35 – 42	61% - 80%	Valid/Good
27 – 34	41% - 60%	Fair
19 – 26	21% - 40%	Poor
10 – 18	0% - 20%	Very Poor

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Statistical testing was conducted through normality testing based on the Shapiro–Wilk method, as the sample size was less than 50 students. This test was conducted using SPSS version 26. The basic criteria for interpreting the test results are set out below:

- If the significance value (Sig.) > 0.05, then the data is considered to be normally distributed.
- If the significance value (Sig.) < 0.05, the data is considered to be non-normally distributed.

The next test is a T-test conducted in data analysis using SPSS version 26. This t-test is conducted with decision-making criteria: if H0 is rejected, then the significance value is $< \alpha = 0.05$, and it can be concluded that there is a statistically significant difference. If the significance value is ≥ 0.05, then the difference is not statistically significant. The hypothesis formulation in this research is as follows:

- H0 = There is no significant difference in student learning outcomes between the pretest and posttest conducted.
- H1 = There is a significant difference in student learning outcomes between the pretest and posttest conducted.

The N-Gain test was continued as a tool to measure the effectiveness of learning efforts to improve student learning outcomes (M. I. Sukarelawan et al., 2024) with the following Normalized N-Gain criteria:

Table 2. Normalized Gain Criteria

N-Gain value	Interpretation
$0{,}70 \leq g \leq 100$	High
$0{,}30 \leq g < 0{,}70$	Moderate
$0{,}00 < g < 0{,}30$	Low
$g = 100$	No increase
$-100 \leq g < 0{,}00$	Decrease

Table 3. Criteria for Determining Effectiveness Levels

N-Gain Value	Interpretation
<40	Ineffective
40-55	Less Effective
56- 75	Moderately Effective
<76	Effective

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RESULTS

a. Analysis Stage

The Analyze stage was conducted through observation, interviews, and identification of the needs of teachers and students in grade V of Bringin 02 Public Elementary School in Semarang City. The data obtained shows that the use of media is still limited to print-based PBL and simple technologies such as PowerPoint, Quizizz, and Kahoot. A needs survey (November 19, 2025) shows that 41% of students strongly agree and 37% agree with the development of AR-based Edu-Spinner. Preliminary tests also show that 57% of students have not yet completed the course, so AR media is considered a solution to improve learning effectiveness.

b. Design Stage

The Design stage focuses on designing media and research tools. The Edu-Spinner AR-based media is designed in accordance with the learning outcomes and objectives of Grade 5 on the subject of Indonesian Cultural Diversity, with AR displays created using Canva and combining images, videos, and material descriptions. The media contains six provinces that present regional cultural information, equipped with QR codes and interactive quizzes assisted by the Assemblr Edu website. In addition, a grid and pretest-posttest questions were compiled in accordance with learning indicators, validation instruments for validation by experts, and responses from teachers and students to assess the feasibility, practicality, and attractiveness of the media. After the AR layout design stage, the researchers designed the Spinner concept to be used as a learning medium.

c. Development Stage

The Development stage is the process of realizing the designed media, accompanied by validation through assessment by media and material experts. The next stage is testing the feasibility of the instruments. The media design was created using Canva and integrated into AR through the Assemblr Edu website. The results of the Augmented Reality-based Edu-Spinner development are shown below:

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Figure 5. AR Website Display

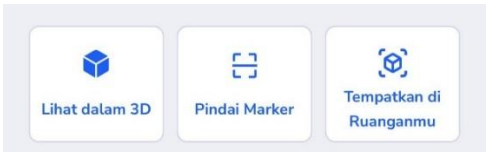

Figure 6. Display Options

Figure 7. Play Display

Figure 8. Province Introduction Scene

Figure 9. Food Introduction

Figure 10. AR-based Edu-Spinner Media

Figures 5–9 present the AR developed via Assemblr Edu for six provinces, while Figure 10 shows the physical AR-based Edu-Spinner. Its feasibility was tested through expert validation of media and materials, and the experts' suggestions guided improvements. Validation used a Likert scale, with results summarized below:

Table 4. Expert Validation of AR Edu-Spinner Media

Assesment	Maximum Score	Score Achieved	Percentage	Category
Media Expert	50	46	92%	Very Good
Subject Matter Expert	50	44	88%	Very Good

Expert assessments in Table 4 show that the AR Edu-Spinner media received 92% from media validators and 88% from subject matter experts. Both rated it "Very Good," and

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researchers have since implemented the validators' suggestions for improvement. In addition to media and material validation, a 50-question multiple-choice instrument test was conducted to assess validity, reliability, difficulty level, and discrimination. The following is a summary of the item analysis results:

Table 5. Summary of Item Analysis Results

Analysis	Results
Validity	There are 20 valid questions with a correlation coefficient value > 0.05.
Reliability	0,06 < 0,828 Cronbach's Alpha 0,828
Level of difficulty	3 difficult category questions 29 medium category questions 16 easy category questions 2 The questions are too easy.
Differential power test	2 very high category questions 15 high category questions 15 medium category questions 18 low category questions

d. Implementation Stage

The Implementation stage was carried out through a small-scale trial involving six students to determine the efficiency of use, readability, and initial user response, as well as to identify any shortcomings in the media before it was applied more widely. Next, a large-scale trial was conducted on 22 fifth-grade students at SDN Bringin 02 Elementary School in Semarang through a pretest, use of AR-based Edu-Spinner media, and a posttest, then concluded with teachers and students filling out a response questionnaire using a Likert scale. The following are the results of the teacher and student response assessment in the small-scale trial:

Table 6. Small Scale Response Assessment Results

Assessment	Maximum Score	Score Achieved	Percentage	Category
Teacher	50	50	100%	Very Good
Students	300	264	88%	Very Good

Table 6 reflects positive responses to the AR Edu-Spinner, with teachers highlighting its effectiveness for Pancasila Education. Classified as "Very Good," the media proceeded to small-scale testing without revision.

Table 7. Results of Large Scale Response Assessment

Assessment	Maximum Score	Score Achieved	Percentage	Category
Teacher	50	50	100%	Very Good
Students	1.100	1.013	92%	Very Good

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Table 7 shows "Very Good" ratings from students (92%; 1,013) and teachers (100%; 50). These results warrant a large-scale trial to further assess media effectiveness and student skill acquisition.

e. Evaluation Stage

The evaluation stage is the final phase for assessing the quality and effectiveness of the media through normality tests, t-tests, and N-Gain based on implementation data. This test was conducted using Shapiro–Wilk considering that the sample size was less than 50 students. The data met the prerequisite with a significance value (sig) greater than 0.05. Conversely, if the sig value was less than 0.05, the results were considered to have a non-normal distribution (Sari et al., 2024). Normality testing was performed using IBM SPSS version 26. The results of the normality test can be seen in Table 8:

Table 8. Normality Test Results

Test	Statistic	Df	Sig.	Criteria
Pretest	.939	22	.187	Normal
Posttest	.922	22	.086	Normal

Based on the normality test results, the significance value for the pretest was 0.187 and for the posttest was 0.086. Since both significance values exceeded 0.05 (Sig. > 0.05), the distribution of pretest and posttest scores met the normality criteria. Thus, the analysis could be continued using the t-test to determine the difference between the pretest and posttest. The t-test results can be seen in Table 9.

Table 9. T-Test Results

Paired Differences								
	Mean	Std. Deviation	Std. Eror Mean	95% Confidence Interval of the Difference		t	df	Sig (2-tailed)
				Lower	Upper			
Pretest - Posttest	-28.409	67.794	1.448	-31.421	-25.397	-19.613	21	.000

A Paired Sample T-Test was employed to evaluate pretest and posttest results from the same participant group. With a significance value of $0.00 < 0.05$, the data indicates a significant improvement in learning outcomes, confirming the media's effectiveness. Subsequently, an N-Gain test was conducted. The N-gain test is an approach often used to assess how well an educational process or intervention improves student learning outcomes (I. Sukarelawan et al., 2024). The N-Gain test was used to determine the increase in student

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understanding after using the media with the help of IBM SPSS version 26. The following are the N-Gain test results:

Table 10. N-Gain Test Results

	Descriptive Statistics				Std. Deviation
	N	Minimum	Maximum	Mean	
Ngain_Score	22	.40	1.00	.7634	.15377
Ngain_Persen	22	40.00	100.00	76.3438	15.37672
Valid N (listwise)	22				

Based on the results of the N-Gain test in Table 10, the average (mean) value obtained was 0.7634 with a minimum value of 0.40 and a maximum value of 1.00. The average N-Gain value of $0.7634 \geq 0.7$ is in the high category. This indicates that the Edu-Spinner learning media based on Augmented Reality has a high level of effectiveness as an effort to improve student learning.

DISCUSSION

The development of Edu-Spinner media based on Augmented Reality uses a systematic ADDIE model from the analysis stage to the evaluation stage, so that the media is in line with student characteristics and learning objectives. The feasibility test results showed a percentage of 92% from media experts and 88% from subject matter experts in the excellent category. This indicates that the media has met the aspects of appearance, content, language, and alignment with learning objectives, making it suitable for use as a learning aid for the subject of Indonesian Cultural Diversity.

The Shapiro-Wilk normality test showed pretest values of 0.187 and posttest values of 0.086 (sig > 0.05), indicating that the data were normally distributed. The paired sample t-test results showed significance of 0.00 < 0.05, indicating that the pre- and post-tests were significantly different. This is reinforced by an N-Gain value of 0.7634 (high category), which indicates an increase in student understanding after using the media. Theoretically, the high N-Gain is in line with the learning media theory that attractive and interactive media increase attention and understanding. This theory is in line with the theory (Pagarra et al., 2022) that engaging media is easier to understand and can improve students' abilities. The use of Augmented Reality presents material visually and contextually, making learning more concrete and immersive, which has an impact on increasing engagement and learning outcomes. The increase in pretest to posttest scores also shows changes in cognitive abilities in accordance with learning

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outcome theory. The results of this study are in line with previous studies conducted by (Alfi et al., 2024) Augmented Reality-based media is effective and categorized as very good, with a score of 0.96 in the study, which is categorized as high. These findings confirm that AR media can be an innovative solution in elementary schools, as it makes learning more interactive and concrete and increases motivation, despite some technical limitations.

CONCLUSION

Based on the results of the study, the Edu-Spinner learning media based on Augmented Reality on the subject of Indonesian Cultural Diversity for Grade 5 at Bringin 02 Public Elementary School in Semarang was designed to be interesting and interactive. The media was developed using Canva for the layout design and combined images, videos, and material descriptions. The content covers six provinces with information on cultural diversity, such as traditional foods and beverages, traditional houses, traditional weapons, dances, musical instruments, regional songs, and traditional clothing, which can be accessed through QR codes and interactive quizzes assisted by the Assemblr Edu website.

The validation results show a “Very Good” category, with a media expert percentage of 92% and a material expert percentage of 88%. This media has also been proven effective in improving learning outcomes based on pretest–posttest comparisons, with a t-test value of 0.00 < 0.05 and an n-gain score of 0.7634 (high category). Based on the research results, AR-based Edu-Spinner media is declared highly feasible and effective for use in learning.

RECOMMENDATIONS

The recommendations of this study are: (1) teachers are advised to use AR-based Edu-Spinner media as an innovative alternative to increase student engagement and understanding; (2) schools need to support the use of AR technology by providing adequate facilities; and (3) future researchers can develop similar media for other subjects or levels and use experimental designs with control groups for more comprehensive results.

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