



Development of Augmented Reality-Based Learning Media to Enhance Students' Understanding of Diversity Values in Civic Education

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Abstract: This study aims to develop an Augmented Reality (AR)-based learning media for Civic Education and evaluate its effectiveness in improving seventh-grade students' understanding of diversity within the context of Bhinneka Tunggal Ika (Unity in Diversity). The study employed a Research and Development (R&D) approach based on the Borg and Gall model, implemented up to the seventh stage (Operational Product Revision). Data were collected through learning achievement tests, questionnaires, and classroom observations. Qualitative data were analyzed descriptively, while quantitative data were analyzed using descriptive statistics, validity and reliability testing, a paired-samples t-test, and normalized gain (N-gain) analysis. The findings indicate that the development of the AR-based learning media was motivated by the abstract nature of diversity-related learning, which resulted in approximately 70% of students failing to achieve the minimum learning mastery standard. The developed media incorporates marker-based AR features, three-dimensional (3D) representations of Indonesia's cultural diversity, interactive quizzes, and a glossary. The effectiveness evaluation demonstrated a substantial improvement in students' learning achievement, with the mean score increasing from 35.19 on the pretest to 94.21 on the posttest. The paired-samples t-test further confirmed that the improvement was statistically significant ($p < 0.001$). In addition, students rated the media positively, with an overall acceptance score of 70.5%, indicating good usability and attractiveness. These findings suggest that the AR-based learning media is valid, practical, and effective in enhancing students' understanding of diversity while supporting Civic Education learning grounded in the values of Bhinneka Tunggal Ika.

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Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students can develop their potential optimally (Law of the Republic of Indonesia Number 20 of 2003). The development of digital technology has brought changes in various aspects of life, including education (Yadav, 2024). The use of technology in learning is expected to improve the quality of the learning process and help students understand the material more effectively (Timotheou et al., 2023). One of the technologies that is growing rapidly and is starting to be widely applied in education is Augmented Reality (AR) (Koumpouros, 2024). With the use of Augmented Reality technology, users are able to see and interact with digital things in their actual surroundings by seamlessly merging virtual and real-world elements. (Azuma, 2021). A more tangible representation of abstract ideas may be provided by this technology in the form of interactive 3D object visualisation. According to (Mudri et al., 2021), By providing information in a more engaging, interactive,



and immersive manner than traditional learning media, augmented reality (AR) has the potential to enhance students' learning experiences. Students in seventh grade, who are moving from the concrete-operational stage of cognitive development to the formal-operational stage, are the ones who benefit most from the use of augmented reality (AR) in relevant learning. While they still need visual aids and practical experience to fully grasp complicated ideas, kids in the 11th and 12th grades start to gain the ability to think abstractly, logically, and hypothetically, according to Piaget's theory of cognitive development. (Feldman, 2004). Cerovac & Keane (2024) describe how, as they move into the formal operational stage of their learning journey, students may benefit from incorporating technology into their lessons by improving their ability to think abstractly and solve problems.

One of the subjects that requires abstract thinking skills is Civic Education (PKn). PKn is a subject that aims to form students into citizens who understand their rights and obligations and have character according to the values of Pancasila and the 1945 Constitution of the Republic of Indonesia. At the junior high school level, one of the important materials in PKn is diversity in the context of diversity. This material teaches students to understand the diversity of ethnicities, cultures, religions, races, and intergroups as the identity of the Indonesian nation as well as social capital in maintaining the unity and unity of the nation. Diversity is a condition that shows the difference in the characteristics of individuals and groups in society. In the Indonesian context, diversity is the wealth of the nation which is reflected in the motto of *Bhinneka Tunggal Ika*. Understanding diversity is very important to be instilled from an early age so that students have an attitude of tolerance, mutual respect, and are able to coexist in a pluralistic society. Understanding itself can be interpreted as the ability of individuals to grasp meaning, re-explain, interpret, and apply the information obtained to different situations. Therefore, diversity learning is not enough to only emphasize the memorization aspect, but must also be able to build a deep understanding of diversity values (Moisiu, 2024). However, diversity material in the context of diversity is still often delivered through lecture methods and the use of textbooks so that the concepts learned tend to be abstract and less interesting to students. The results of observations at MTs Negeri 10 Kuningan show that students' learning outcomes in diversity materials are still relatively low.

Table 1. Recapitulation of PKn Scores in Grade 7 Diversity Materials

Year	Total Students	Low Grade Students (<70)	Low Grade Percentage
2023	162	125	77,16%
2024	155	150	96,77%
2025	162	135	83,33%

Source: Summary of PKn MTs Negeri 10 Kuningan Teacher Scores

The data in Table 1 shows that despite a decrease in the percentage of students who obtained grades below the KKM from 2023 to 2025, more than 50% of students still have difficulty in understanding diversity material. This condition shows that the learning that has been carried out has not been able to optimize students' understanding of diversity materials in the context of diversity. One of the factors that causes low understanding of students is the characteristics of PKn material which tends to be abstract and theoretical. Students still have a hard time seeing the connection between diversity and real life since most education is based on textbooks and lecture formats. Actually, seventh graders are still in the process of moving from the concrete operational stage to the formal operational stage of cognitive development, which means they still need visual aids to fully grasp abstract ideas. (Feldman,



2004). Therefore, learning media that is able to visualize the material in a more concrete, interactive, and interesting way is needed.

Various previous studies have shown that AR is able to improve the quality of learning. Ferrari et al. (2024) found that the use of AR in astronomy learning significantly improves student learning outcomes compared to conventional methods. Zhang & Yao (2025) state that AR helps learners understand complex concepts through interactive three-dimensional visualization. Michel-Acosta et al. (2024) show that AR has a positive impact on learning outcomes while helping to manage students' cognitive load. In addition, Faria (2024) found that the integration of AR in learning is able to increase students' understanding of abstract materials. Previous studies have shown that Augmented Reality (AR) enhances students' engagement and improves cognitive learning outcomes in various educational contexts, including Civic Education. However, most studies have focused primarily on knowledge acquisition rather than fostering values of diversity, tolerance, and inclusivity. More so, there is a dearth of literature on the use of augmented reality (AR) as a teaching tool for seventh grade civic education lessons on diversity. This research fills that need by creating an augmented reality (AR) learning medium that boosts students' knowledge and promotes diversity and inclusion principles. The information provided here calls for the creation of AR-based educational materials that may depict diversity in a more tangible, engaging, and participatory light. Consequently, the purpose of this research is to examine the background and possibilities of AR-based educational media, detail its creation, and evaluate its efficacy in enhancing PKn seventh graders' comprehension of diversity-related content within the context of diversity education.

Research Method

This research uses the Research and Development (R&D) method with the Borg & Gall development model. The research aims to develop Augmented Reality (AR)-based learning media on diversity materials in the context of diversity for grade VII MTsN 10 Kuningan students and test the effectiveness of its use in improving students' understanding. The development stage is limited to the seventh stage of Borg & Gall, which includes: (1) gathering information and doing research; (2) making a plan; (3) creating a prototype; (4) testing the prototype in the field; (5) making revisions to the main product; (6) testing the main product in the field; and (7) making revisions to the operational product (Mesra, 2023). Combining qualitative and quantitative techniques, the study employs a mixed-methods strategy. Expert validators' feedback, in-depth interviews, and participant observation all contributed to the collection of qualitative data. Questionnaires and assessments of learning outcomes provided the quantitative data. This study was conducted during the 2025–2026 school year at MTsN 10 Kuningan in West Java. One hundred and twenty-eight seventh graders made up the study's population. Class VIIA (60 students) was chosen at random to serve as the control group, while Class VIIB (68 students) was chosen as the experimental group, using a cluster random selection approach. The effectiveness test design uses a pretest-posttest control group design as presented in Table 1.

Table 1. Pretest-Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experiment	O1	X	O2
Control	O1	–	O2

Remarks: X = learning using Augmented Reality media.



Learning outcome exams with thirty multiple-choice questions, student interest surveys, and validation sheets from media, material, and design specialists make up the study tools. Validity and reliability testing have been conducted on the instrument. All of the questions were valid and reliable according to the test findings; the r-count value was more than the r-table value (0.349), and the Cronbach's Alpha score was 0.721. Both descriptive and inferential methods of data analysis were used. The outcomes of the expert validation are used to evaluate the media's viability. The media's attractiveness was assessed by calculating the proportion of students who scored well on the questionnaire. By comparing the pre- and post-test results using normalised gain (N-Gain), we were able to assess the media's efficacy. An Independent Samples t-test was performed on the N-Gain scores at a significance threshold of 0.05 to analyse any differences in learning improvement between the experimental and control groups. The experimental group was deemed to have received effective media if they acquired N-Gain scores that were substantially higher than the control group (Sig. < 0.05) and fell into the moderate N-Gain category or above.

Results and Discussion

Potential and Conditions for the Development of Augmented Reality-Based Learning Media

21st century learning requires students to have critical thinking skills, creativity, collaboration, communication, and digital literacy. Therefore, learning media that is able to facilitate these skills through the use of innovative and interactive technology is needed. The results of initial observations at MTsN 10 Kuningan show that students' understanding of diversity materials in the context of *Bhinneka Tunggal Ika* is still low. Of the 60 students, only 18 people (30%) have achieved completeness, while 42 people (70%) have not completed it. This condition is influenced by the delivery of material that is still abstract, the lack of concrete visualization, the use of monotonous media, and the limited learning time. Based on these conditions, Augmented Reality (AR)-based learning media was developed as a solution to improve students' understanding (Siki & Leba, 2025). This media is able to present three-dimensional objects interactively so that diversity materials become more concrete and interesting. The results of the trial showed that students were very enthusiastic because they could see the representation of Indonesian culture more realistically, so that learning became more fun, interactive, and easy to understand. Students also hope that AR media can be developed in other PPKn materials.

Augmented Reality-Based Learning Media Development Process

The Borg and Gall research and development strategy, which includes 10 steps, is used to create instructional media that use Augmented Reality (AR). Finding students with learning disabilities at MTsN 10 Kuningan was the first step in the study and data collection process. The study's findings reveal that traditional teaching practices, such as relying on textbooks and worksheets, continue to dominate education, failing to cater to the demands of pupils who grow up with computers and other digital devices. Furthermore, more tangible and participatory visualisation is needed for diversity content within the framework of abstract diversity. Furthermore, at the planning stage, the researcher designed media development with the aim of increasing students' understanding of diversity materials in the context of *Bhinneka Tunggal Ika* and encouraging students' active involvement in the learning process. Planning is carried out by formulating Learning Outcomes (CP) and Learning Objectives (TP) as the basis for the preparation of content and features in AR-based learning media.

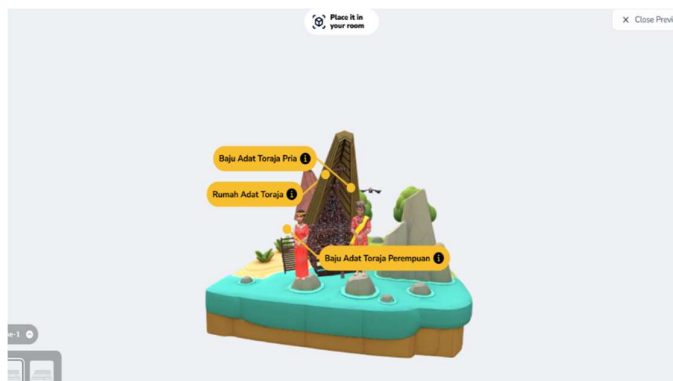


Figure 1. Initial Products

Table 3. Learning Outcomes (CP) - Phase D (Grades VII-IX)

Learning Outcomes

During this stage, students gain knowledge about the following: the origins of Pancasila, its principles, and how to put them into practice. They also learn about racial, ethnic, religious, and intergroup diversity within the context of *Bhinneka Tunggal Ika*, as well as how to accept cultural change and diversity on a local, national, and global scale. Students also gain an understanding of Pancasila's position, the history, functions, and position of the Republic of Indonesia's Constitution from 1945, as well as the order of laws and regulations. They realize the significance of preserving local wisdom, traditions, and culture, and how to map out the territory of the Unitary State of the Republic of Indonesia within the context of archipelago insights. Lastly, they learn about the relationship between Pancasila and the 1945 Constitution of the Republic of Indonesia.; analyze the rights and obligations of citizens; practicing freedom of opinion; fostering an attitude of responsibility and playing an active role in maintaining and preserving traditional practices, local wisdom, and culture; and actively participate in maintaining the territorial integrity of the Unitary State of the Republic of Indonesia.

Table 4. Learning Objectives (TP) and Goal Achievement Indicators (IPT)

Learning Objectives (TP)	Learning Objective Flow (ATP)
TP 1: Analyzing the concept of diversity in the context of diversity in Indonesia	ATP 1.1: Identify various forms of diversity (ethnic, religious, racial, inter-group, language, cultural) in Indonesia. ATP 1.2: Explain the meaning of <i>Bhinneka Tunggal Ika</i> as a unifying motto of the nation.
TP 2: Assessing the importance of diversity in strengthening the unity and unity of the nation	ATP 2.1: Analyze the positive impact of diversity on the life of society, nation, and state. ATP 2.2: Present examples of tolerant behavior in daily life that reflect the spirit of diversity.

The developed product consists of an AR application and a learning guide module that incorporate 3D objects representing Indonesia's diversity, interactive learning materials, audio narration, inquiry-based features, and learning evaluation components.

Table 5. Usage Guide

Augmented Reality-Based Learning Media	Learning Guide Module
The initial part of the AR application contains the big title, madrasah logo, developer identity, and the main selection menu (Start, Materials, Markers, Competency Test, About)	The front cover contains a large title, the identity of the madrasah (MTsN 10 Kuningan), and selected menus in AR learning media
The inside (after scanning the <i>marker</i>) displays 3D objects of Indonesian diversity, such as traditional	Identity section (name of researcher, supervisor, institution)



clothing, traditional houses, traditional weapons, and regional dances from various tribes, accompanied by menus:- Materials (text & audio narrative about diversity)

Each *scanned marker* displays a 3D object that can be *rotated*, zoomed, and equipped with voice and text explanations about the diversity of ethnicities, religions, cultures, and regional languages

There is an inquiry mode feature where students are given a lighter question before scanning the marker, then they have to find the answer themselves through 3D object exploration

After completing the exploration, students are given interactive competency test questions that appear on the screen with direct feedback

Instructions section :

use of AR media (how to download applications,

How to print markers,

how to scan markers, navigation in the app)

The inquiry-based learning activities section contains the steps:1. Problem orientation, 2. Self-explore with AR, 3. Group discussions, and 4. Conclusion Presentation

AR app download link section, marker collection (printable or displayed on the screen), and answer key for teachers

The validation results showed that the media obtained a very feasible category, with a percentage of validation of media experts of 88.10% and material experts of 92.33%.

Table 6. Percentages Media Expert Validation Results

Media Expert	Persentase
1	88,57%
2	83,57 %
3	92,14%
Average	88,10%

Based on the data from the validation results of media experts, it is known that the percentage of assessments received an assessment response of 88.10% with the classification of "very feasible" or "very interesting".

Table 7. Percentage of Subject Matter Expert Validation Results

Subject Matter Expert	Persentase
1	91%
2	92%
3	94%
Average	92,33%

Based on the data from the validation results of the material experts, it is known that the percentage of assessments received an assessment response of 92.33% with the classification of "very interesting" / "very feasible". The suggestions given by the validation experts are as follows:

Table 8. Advice and Input of Media Experts for AR Media Development

Validation Expert	Suggestions	Conclusion
Media Matter 1	- For 3D object sections to be made more attractive and detailed- Marker sections plus clearer scanning instructions- Add audio narration to each diversity object	Marker section plus clearer scanning instructions
Media Matter 2	- Can be piloted to research subjects (students of grade VII MTsN 10 Kuningan)- Ensure AR compatibility with various smartphone brands	Worth a trial
Media Matter 3	Marker section plus clearer scanning instructions	Worth a trial



Table 9. Advice and Input of AR Media Developer Material Experts

Validation Expert	Suggestions	Conclusion
Subject Matter 1	- Continued	Worth a trial
Subject Matter 2	- Inquiry questions have not yet appeared in the exploration of AR objects- The nature of interaction between students and AR objects has not been optimal- Improve inquiry	Worth testing with improvements as suggested
Subject Matter 3	- Continued	Worth testing with improvements as suggested

Based on the input of experts, revisions were made to the aspect of the 3D object display, instructions for the use of markers, audio narration, and strengthening inquiry activities. The results of the assessment recapitulation show that the media is in the category of being very feasible to be tested. In the initial field test of 10 students, the media obtained a feasibility percentage of 81% with the category of very interesting and very feasible.

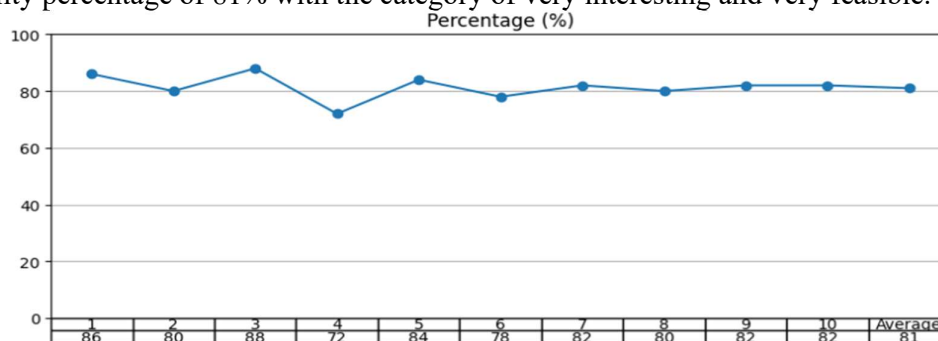


Figure 2. Graph of Initial Field Test Results

After a limited revision, the media was tested on 128 students. The results of the effectiveness test showed that classes that used AR media obtained better learning outcomes than classes that used conventional learning, so that the media was declared effective and feasible to be used in learning diverse materials in the context of *Bhinneka Tunggal Ika*.

Table 10. Pretest and Posttest Results for Class VII A and VII B

Class	Classification			Quantity
	Low / Less Effective	Moderate/Moderately Effective	High / Effective	
Control (VII A)	0	48	12	60
Experiment (VII B)	1	41	20	68

Table 11. Average Value of Control and Experiment Classes

Class	Value		
	Highest	Lowest	Average
Control (VII A)	88,89	37,74	61,10
Experiment (VII B)	95,00	25,00	63,52

At this stage, the experimental class did not encounter significant obstacles during the main field trial, so there were no fundamental product revisions. Because at the time of the trial, the data showed the average understanding of students in the experimental class in the Medium/Quite effective category. Augmented Reality-based learning media is declared feasible for operational use in PKN learning diversity materials in the context of diversity at MTsN 10 Kuningan



Effectiveness of Augmented Reality-Based Learning Media

By comparing the pre- and post-test scores of the control and experimental groups, this research determined how successful the AR-based learning medium were. In the control group, the improvement in learning outcomes after instruction was relatively limited. Most students remained in the moderate and low categories, indicating that conventional learning methods were not sufficient to optimally enhance students' understanding. In contrast, the experimental group demonstrated greater improvement in learning outcomes after using the AR-based learning media. The proportion of students in the low category decreased, while those in the moderate and high categories increased. These findings indicate that AR media helped students understand the concept of diversity within the framework of *Bhinneka Tunggal Ika* more concretely through 3D object visualization and interactive learning features.

Table 12. Paired Samples Statistics

		Paired Samples Statistics			
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	47,84	68	6,942	0,842
	Posttest	81,16	68	6,832	0,828

Table 13. Paired Samples Correlations

		Paired Samples Correlations		
		N	Correlation	Sig.
Pair 1	Pretest & Posttest	68	0,205	0,093

Table 14. Paired Samples Test

Table 14. Paired Samples Test									
		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-33,324	8,683	1,053	-35,425	-31,222	- 31,649	67	0,000

With a significance value of 0.000 (< 0.05), the paired sample t-test revealed that the mean score went up from 47.84 in the pretest to 81.16 in the posttest. These results show that there is a statistically significant change in the learning outcomes of the students both before and after the augmented reality learning media were used.

Attractiveness of the Augmented Reality-Based Learning Media

The attractiveness of the Augmented Reality (AR)-based learning media was evaluated to determine students' interest, engagement, and motivation during learning activities. The assessment involved 32 seventh-grade students of MTsN 10 Kuningan using a 20-item Likert-scale questionnaire.

Table 15. Product Attractiveness Test Results in the Large Group (n = 32)

Num	Questionnaire Item	Score
1)	How attractive do you find the concept of inquiry-based Augmented Reality learning	120



	media?	
2)	Are you interested in learning more about how AR media can support learning about diversity?	122
3)	How confident are you that AR media can improve your understanding of complex diversity concepts?	123
4)	What do you think about the potential of AR media to increase your motivation to learn Civic Education?	122
5)	To what extent are you interested in participating in learning activities using AR media?	122
6)	How attractive would you rate AR media as a learning tool?	120
7)	How strongly do you believe that AR media can make diversity-related content more engaging?	121
8)	How interested are you in integrating AR media into Civic Education learning?	122
9)	How attractive do you find the concept of personalized learning through AR that adapts to your learning needs and pace?	125
10)	How confident are you that AR media can improve your learning skills related to diversity?	123
11)	Are you interested in learning more about how AR media can enhance collaboration in Civic Education learning?	125
12)	To what extent do you think AR media can change your perception of the teaching and learning process in Civic Education?	126
13)	What is your opinion of a more enjoyable learning experience through AR media?	128
14)	How interested are you in exploring the potential of AR media for teaching abstract concepts of diversity?	123
15)	How attractive would you rate the use of AR media in improving your understanding of complex diversity topics?	125
16)	How confident are you that AR media can help you better understand diversity concepts?	125
17)	Are you interested in learning more about how AR media can enhance motivation and interest in Civic Education?	118
18)	To what extent are you interested in exploring the potential of AR media to improve critical thinking skills related to diversity?	116
19)	How attractive would you rate the potential of AR media in helping solve diversity-related issues in your surrounding environment?	118
20)	What is your overall impression of the development of Augmented Reality-based learning media?	120
Description		Value
Total Score		2,444
Percentage		95.47%
Category		Very Attractive

The results showed an overall score of 95.47%, which falls into the “Very Attractive” category. These findings indicate that the AR-based learning media received highly positive responses from students and were successful in creating an engaging and enjoyable learning experience for understanding diversity within the framework of *Bhinneka Tunggal Ika*.

Efficiency of the Augmented Reality-Based Learning Media

The efficiency of the AR-based learning media was measured by comparing the instructional time required using AR with conventional learning. Both approaches required four learning sessions, with a total duration of 180 minutes. The efficiency ratio obtained was 1.00, which is categorized as moderately efficient. This result indicates that the



implementation of AR media can be carried out without requiring additional instructional time while still providing enhanced learning experiences for students, which is consistent with previous studies reporting that AR supports effective learning within regular classroom time allocation (Ruhama et al. 2025).

The developed AR-based learning media was designed to present diversity-related content through interactive 3D visualizations that can be accessed using smartphones. The media includes marker cards, learning materials, audio narration, quizzes, and user guides. Through direct interaction with virtual objects, students can explore cultural diversity concepts more concretely and independently (Alabi, 2024). In addition, the application can be used offline after installation and is compatible with Android and iOS devices, making it practical and accessible for classroom learning.

Conclusion

The results showed that the development of AR-based learning media was motivated by the abstract nature of the learning process, which resulted in 70% of students not achieving learning mastery. The AR media was developed with marker features, 3D objects representing Indonesian diversity, interactive quizzes, and a glossary. From a pre-test average of 35.19 to a post-test average of 94.21, the effectiveness test showed a significant improvement. The results of the paired sample t-test showed that students' knowledge significantly improved after using the AR media, with a significance value of $0.000 < 0.05$. With a score of 70.5%, the media were also considered appealing. Consequently, the use of AR-based learning materials is both practical and efficient in enhancing students' comprehension of variety within the framework of diversity unification. The media enhances students' awareness of diversity and encourages active involvement in the learning process by turning theoretical ideas into interactive visual experiences. In sum, augmented reality (AR)-based educational materials provide a fresh perspective on bolstering civic education.

Recommendation

To facilitate the use of augmented reality (AR) in the classroom, schools should make sure that students have access to digital devices and provide appropriate training. Future researchers are recommended to evaluate the long-term effects of AR on students' diversity awareness, tolerance, and inclusivity values, involve larger and more diverse samples, and compare AR with other interactive learning technologies to strengthen the evidence of its effectiveness.

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