

Innovation In Sociology Learning Using Augmented Reality Media Based On Local Wisdom

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Abstract

This study aims to develop and examine the effectiveness of innovation in Sociology learning using Augmented Reality (AR) media based on local wisdom. The integration of local wisdom with AR technology is expected to improve learning outcomes, student interest, and cultural awareness among students. The research method used was Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The results of the study showed the following: (1) AR media based on local wisdom is suitable for use in learning, as evidenced by the assessment results of subject matter experts and media experts, which categorised it as highly suitable. Teachers' and students' responses to the use of AR media based on local wisdom were easy to understand and very interesting in helping the learning process. (2) The AR media based on local wisdom that was developed was effective in improving student learning outcomes. The results of the paired sample t-test showed a significance value of 0.000 or a sig value <0.05, indicating a significant difference between the pre-test and post-test learning outcomes, which means that the use of learning media has an effect on improving learning outcomes. The N-gain value for the experimental class was 0.44, indicating a moderate improvement, while the results of the independent sample t-test on the n-gain value showed a significance value of 0.043 or a sig value <0.05, indicating a difference in the average learning outcomes of students between the experimental class and the control class. These findings confirm that the use of Augmented Reality media based on local wisdom is an effective learning innovation.

Keywords: Augmented Reality, sociology learning, local wisdom.

INTRODUCTION

Technological developments have penetrated almost every aspect of human life, bringing about real and profound changes. Among various innovations, the advancement of smartphones stands out with its rapid pace of development. These devices have become essential tools thanks to their ability to provide widespread internet access, which has led to a continuous increase in the number of users from year to year. In daily routines, smartphones have become an integral part of the lives of secondary school and primary school students. Through their internet connection, students can easily access various information, learning resources, and references needed for daily assignments and the learning process. In addition, smartphones not only make our lives easier but also open up new opportunities through various applications, social networks, and instant access to

information. They facilitate real-time communication, the latest news updates, and flexible learning opportunities (Sipaayung & Munawaroh, 2025: 167). The learning process, as a fundamental part of human life, cannot be separated from this dynamic. As children grow into teenagers and adults, most of their time is spent at school absorbing knowledge. Here, in addition to the role of teachers and supporting facilities, learning media plays a crucial role in shaping an effective learning experience. As teaching methods evolve, learning media must also adapt in order to provide more lively and beneficial learning for both students and educators (Andrew Fernando, et al., 2020). Learning media can be a reliable bridge for conveying messages, thereby reducing the risk of misunderstanding during communication. Basically, learning is the process of transferring material from the sender (teacher) to the receiver (student), and to make it effective, learning must be interactive, enjoyable, challenging, and motivating while providing space for students to develop their creativity and independence according to their talents and interests. Teachers, as the main facilitators, need to create an engaging classroom atmosphere to encourage students to be more actively involved. Factors such as the selection of interesting and interactive media that remain focused on the core material are key to building enjoyable learning activities.

Social science learning in schools often feels monotonous and fails to inspire students. One of the main reasons for this is that social science material requires strong reading skills and tends to focus solely on memorisation (Hidayati & Salamah, 2022: 39). This is especially true for sociology at the upper secondary level, as this discipline has characteristics that distinguish it from other social science subjects (Pratiwi, 2017: 202). The study of sociology is closely related to the realities of everyday life, which actually makes it feel abstract and difficult for students to understand. Many students find it difficult to understand these concepts, especially when the material requires direct observation of community life. Often, disinterest arises because students feel that sociology is too close to their experiences as members of society, yet it is presented without any touch that makes it relevant. As a result, this weak understanding hinders the overall learning process. This is where the role of sociology teachers becomes important; they must be able to present the material in an interesting and easy-to-understand manner. Learning media, in particular, can be a solution to help students understand the essence of the material while stimulating their interest in class. Based on observations and direct interviews with students, material on local wisdom in community empowerment is still difficult to understand. Students rely solely on textbooks and teacher lectures, which makes the learning process feel rigid. Most students admit that this approach is not very interesting, so learning does not reach its optimal potential. This is reinforced by the finding that teachers' teaching methods are still conventional, with minimal use of media, resulting in low student understanding and interest. As a result, students often fail to achieve the desired learning objectives and benefits, especially on the topic of local wisdom in community empowerment. The lack of media in the learning process makes students less enthusiastic and engaged. To achieve optimal educational targets, teachers need to work harder,

starting from designing a holistic learning process, fair assessment, relevant material presentation, to the selection of appropriate media. As stated by Arsyad (2015), learning media can be a source of inspiration for students, improving their psychological aspects through motivation and interest.

In this era of increasingly sophisticated technology, teachers must transform themselves into competent facilitators who utilise media and tools to make learning more efficient, effective, and enjoyable. According to Rustamana H.A. (2020: 139), educators need to equip students with critical, cooperative, creative, and communicative thinking skills to face the challenges of the 21st century, with a priority on student participation in understanding the concepts of the material. Teachers can utilise various media to actively engage students, as student satisfaction with the subject matter also affects overall learning performance (Sebastião Periera et al., 2015: 108). Every individual goes through four stages of cognitive development from birth to adulthood, as described by Piaget: sensorimotor, preoperational, concrete operational, and formal operational. In the concrete operational stage, students find it easier to understand material through real or concrete objects, such as artefacts, recordings, videos, or images specifically designed for learning (Rismawati & Salamah, 2022: 135). Therefore, the learning approach must be designed to be enjoyable, taking into account procedures that make students feel involved. Attractive and concise learning media—without sacrificing the essence of the material—are very important here. One promising innovation is the development of Augmented Reality (AR)-based media. Augmented Reality is a technology that combines the real world with virtual elements in 2D or 3D form, which are displayed simultaneously in a physical environment. As an alternative learning medium, AR is expected to stimulate students' interest and curiosity. By utilising the latest technological advances, we can create more sophisticated and interactive media (Ilmawan Mustaqim & Nanang Kurniawan, 2017). Recently, AR has gained attention as a tool to revive social science learning. Through AR, we can “insert” stories into the real world of students, making it more participatory and lively. Students do not just see or hear, but also interact directly with events, making abstract concepts feel real. AR works by placing 2D or 3D virtual objects into physical objects, such as interactive 3D animations that combine the real and virtual worlds in real time (Ayudhia et al., 2023: 115). This technology inserts photos, text, and 3D objects into the surrounding environment, which is ideal for students who are already familiar with the digital world through smart devices and instant information. Education must also adapt, utilising this technology to meet modern learning needs.

Research on AR in education continues to evolve, with evidence that this technology has great potential. For example, Ying-Shao et al. (2017: 12) studied students' perspectives on AR, and the results showed that students had a positive view of lessons that used AR simulators. Furthermore, Theodorou et al. (2018) applied AR applications in education and found significant additional learning effects as a learning tool support, including an increase in students' knowledge and their appreciation of the learning experience with AR. Therefore, the use of media such as AR is essential in learning because it can make students more interested in understanding the material.

The development of AR-based learning media for local wisdom in Sociology subjects has not been widely done by teachers in schools. This opens up opportunities for innovation to present learning that is informative, educational, enjoyable, and relevant to students' lives. With AR, students can interact directly with digital representations of local culture, such as regional dances, historical buildings, culinary specialities, or traditional clothing that were previously difficult to access directly. The development of AR media based on local wisdom not only addresses technological challenges in education but also strengthens cultural values in students. Thus, this initiative is an important step towards learning innovation, fostering cultural awareness, and shaping a young generation with strong roots in local identity. This study aims to develop and test AR learning media for local wisdom material in Sociology, with a focus on increasing students' understanding and interest. Its main contributions are replicable learning media and recommendations for teachers on media innovation integrated with technology.

METHOD

This learning innovation uses the research and development (R&D) research method. This research method aims to produce a specific product and test its effectiveness. The development model used by the researcher is the ADDIE development model. This development model is widely used by educators to develop learning and learning media, which first appeared at the University of Florida in 1975 (Spatioti et al., 2022: 2). The ADDIE development model is an acronym that describes five steps for designing and developing learning experiences, namely: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009:3). The researcher uses this development model because it does not have strict rules regarding the progress of each stage, as shown in this figure.

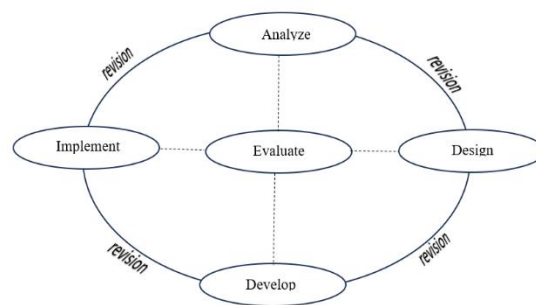


Figure 1.
ADDIE Development Model (Source: Branch, 2009)

The research and development procedure will be carried out in accordance with the ADDIE framework, which consists of five main stages, namely Analysis, Design, Development, Implementation, and Evaluation. Each stage in this procedure has a specific role to ensure the

successful development of a product or innovation. First, the analysis stage involves identifying problems and analysing the needs of learners, especially those related to the product to be developed. This development is initiated by the problems encountered. The analysis also considers the characteristics of the students, the subject matter, and the achievement indicators to be attained. The analysis stage in this research consists of performance analysis, needs analysis, and curriculum analysis. Next, the design stage in this design process is carried out with maximum creativity, aiming to attract the attention of students. In addition, at the design stage, it is necessary to ensure that the source material used is relevant so that it can effectively support the learning process. This research design includes designing the product and creating product research instruments.

After the analysis and design stages were completed, several facts indicating the significant influence of the research stages on the quality of learning began to emerge, particularly based on student feedback and complaints. In this context, students often expressed their challenges in understanding abstract concepts in Sociology. The Augmented Reality media development stage was introduced as a solution to these complaints, with the hope of facilitating a clearer and more interesting understanding of the concepts. Augmented Reality was designed to explain the material visually, thereby overcoming students' difficulties in understanding abstract concepts and increasing their engagement in learning. This stage was also a direct response to complaints from students who felt uninterested and unengaged in learning, as well as helping to meet the learning needs of students who are more visual and practical learners. This stage is carried out after the analysis and design have been completed. The activities carried out are product creation, validation, and improvements to the product based on expert revisions. Next is the implementation stage, where the product is tested on students. The results of this test are used to revise the product. Testing in large groups is carried out until a product is ready for effectiveness testing. At this stage, students are also given a questionnaire to assess their evaluation of the developed teaching materials. The next stage is evaluation, where the researcher conducts an evaluation to measure the achievement of the objectives of developing local wisdom media based on Augmented Reality. This evaluation is used to determine the effectiveness of the developed learning media.

Data collection techniques in the development of local wisdom media based on Augmented Reality use two data collection techniques, namely tests and non-tests. Test techniques are used to collect data on learning outcomes. Non-test techniques include interviews, questionnaires and observations. Interviews are used to collect information on needs analysis. Questionnaires are used to test product feasibility, product practicality and product readability. Product feasibility testing is carried out using several instruments, including product validation sheets by subject matter, media expert validation sheets, practicality questionnaires by social studies teachers, and readability questionnaires by students. The classroom observation instrument is an observation sheet consisting of several predetermined indicators and descriptions that have been adjusted to general learning applications. These observation sheets can be used for various learning models. The observation sheets for the experimental class and the control class are the same. Observation assessment uses a

dichotomous scale assessment technique. In the observation sheets, the researchers have made specific descriptions in accordance with what will be observed.

Instrument validity is the accuracy of an instrument in measuring what it is intended to measure (Lestari & Yudhanegara, 2018: 180). In this study, the validity tests conducted were content validity and empirical validity tests. Before the questions were tested, they were first tested for content validity by senior teachers. Content validity is the suitability of the material to the questions created. Meanwhile, empirical validity is the validity obtained from the results of the test analysis, which is then compared with certain criteria. Empirical validity was conducted for each question so that the results of the analysis could be obtained for each question. In this study, the following formula was used for item validity.

$$r_{xy} = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\{N\Sigma X^2 - (\Sigma X)^2\}\{N\Sigma Y^2 - (\Sigma Y)^2\}}}$$

Keterangan:

r_{xy} : Koefisien korelasi skor butir soal (X) dan skor total (Y)

N : Banyaknya subjek

X : Skor butir soal atau skor item pernyataan/pertanyaan

Y : Skor total

Criteria for validity testing using the product moment correlation technique on a table with asignificance level of 5%, i.e. if $r_{xy} > r_{tabel}$, then the item is said to be valid. In measuring the reliability of this research instrument, the Kunder-Richardson (K-R) 20 method. This method is suitable for determining the reliability of instruments with two types of answer choices. The value range is between 0 and 1. In this study, overall reliability was calculated using the (K-R) 20 formula as follows:

$$(K - R)20 = \left(\frac{n}{n - 1} \right) \left(\frac{s^2 \sum pq}{s^2} \right)$$

Keterangan:

(K-R) 20 : reliabilitas tes secara keseluruhan

p : proporsi subjek yang menjawab benar

q : proporsi subjek yang menjawab salah

$\sum pq$: jumlah hasil perkalian p dan q

n : banyaknya item

s : standar deviasi tes

Lynn (1986:108) states that the value criteria used for reliability tests are as follows.

Table 1.
Tes Reliabilitas

Reliability Test	Classification
(K-R) 20 \geq 0,7	High reliability

(K-R) $20 < 0,7$	Low reliability
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The data from the validation of AR media based on local wisdom by subject matter experts, media experts, and sociology teachers consists of quantitative and qualitative data. The data obtained from the validation and product assessment sheets are dichotomous values with certain conditions. A score of 1 is given for YES statements and a score of 0 is given for NO statements. Quantitative data analysis of subject matter and media expert assessment scores is analysed descriptively with reference to an adapted value conversion table, resulting in guidelines as presented in Table 2 below.

Table 2.
Categorization table

No.	Score Range	Categori
1	$\bar{X} > xi + 1,8 SBi$	Sangat Layak
2	$xi + 0,6 Sbi < \bar{X} \leq Mi + 1,8 SBi$	Layak
3	$xi - 0,6 Sbi < \bar{X} \leq Mi + 0,6 SBi$	Cukup Layak
4	$xi - 1,8 Sbi < \bar{X} \leq Mi - 0,6 SBi$	Tidak Layak
5	$\bar{X} \leq Mi - 1,8 SBi$	Sangat Tidak Layak

(Sumber: Andi Rustandi, 2021:59)

Keterangan:

\bar{X} = skor akhir rerata

xi = rerata ideal yang dicari dengan rumus

= $\frac{1}{2}$ (skor maksimal + skor minimal)

SBi = Simpangan baku ideal yang dicari dengan rumus

= $1/6$ (Skor maksimal = skor minimal)

In this study, it was determined that the minimum acceptable rating for the developed product was 'Acceptable'. Thus, if the final rating given by media experts, subject matter experts, and teacher responses was 'Acceptable', then the developed product was deemed acceptable for use as a learning medium.

The analysis of product effectiveness was conducted based on data from the learning scores of students before the treatment (pretest) and after the treatment (posttest) (Sugiyono, 2019:114). The results of the pretest and posttest average scores were used to measure the effectiveness of using Augmented Reality (AR)-based learning media. The effectiveness of the product was declared effective if it met the following criteria: (1) there was a significant difference in learning outcomes in the experimental class before and after using local wisdom-based AR media, (2) there is an increase in learning outcomes after using AR-based learning media based on local wisdom, (3) there is a significant difference in learning outcome improvement between the control class and the experimental class.

RESULTS AND DISCUSSION

RESULTS

Initial Development Results

The results of this media development research are in the form of a local wisdom-based AR application that runs on smartphones on local wisdom material. Media development was carried out using the ADDIE model in the form of a simple Android application design. ADDIE development consists of the analyse, design, development, implementation, and evaluation stages. The following are the results of the development of Augmented Reality (AR) learning media based on local wisdom.

Analyse Stage

Preliminary analysis was the initial activity of this research. The purpose of the preliminary analysis was to obtain data that could be used as consideration in the development of learning media. At this stage, the researcher carried out several steps, namely needs analysis, material determination, and student characteristic identification.

Needs analysis was carried out by interviewing sociology teachers. Based on the results of interviews with sociology teachers at the school, it was found that teachers rarely use learning media and more often teach using conventional methods. Teachers do this because of the limited facilities and infrastructure available at the school. The determination of the material to be used in the learning media was based on the results of the needs analysis, particularly the interviews with teachers. Based on the results of the interviews that had been conducted, the material to be used in the learning media was local wisdom. In local wisdom material, there are several materials that require explanations that connect with real life, so they require media with attractive images and visualisations that are easier for students to understand. Material analysis was carried out with the aim of developing material to be included in the learning media.

The researcher distributed questionnaires to students who had received local wisdom material in community empowerment. The data sought focused on exploring information about the material and learning media. Based on the results of the needs analysis questionnaire, it can be seen that 87% of students who had studied local wisdom material had difficulty understanding the material because it was abstract. The learning media that had been used was not very interesting, so students hoped for learning media that could combine images, animations, and audio. The learning media expected by most students was that which could be run on smartphones, because students liked and believed that using smartphones in learning could increase their motivation when studying. Therefore, Augmented Reality learning media was developed to build students' enthusiasm for learning and attract their interest when studying local wisdom material. Identifying student characteristics can be done using the results of a needs analysis questionnaire. Based on the results of the questionnaire, an overview of student characteristics was obtained, including that 80% have Android phones and 90% of students are more interested in media that can be accessed via mobile phones.

Design Stage

The next stage in the Augmented Reality learning media development process is the design stage. This stage involves several activities to design Augmented Reality learning media. The design to be carried out includes designing flowcharts and storyboards, compiling a design for AR media based on local wisdom, and compiling research instruments. A flowchart is a diagram containing the stages of learning media development created by researchers or a flow that explains how the product to be developed works. The function of the storyboard is to facilitate the

implementation of the media design that has been prepared at the beginning or to explain the layout design of the product (application name and main menu display) on the main menu display, which consists of the play menu, material menu, quiz menu, info menu, and exit option.

Local wisdom-based AR media is designed using PC software, namely Blender and Unity. Blender is used to create 3D assets, while Unity is used to integrate these 3D assets so that they can be run virtually. The media is designed in the form of learning media that provides an immersive and interactive experience containing the local wisdom of the PALI community. The immersive experience can be realised through realistic 3D visuals and audio. Interactivity can be realised through manipulation and navigation. The design of this media follows the guidelines that have been created. This assessment instrument was created for students, teachers, media experts, and subject matter experts. The research instruments consist of validation sheets by media and subject matter experts, practicality questionnaires, readability questionnaires, pre-test and post-test questions, observation sheets, and teaching tools, including lesson plans.

Development Stage

There are three steps in the development stage, namely media development, media validation, and research instrument validation. The development of learning media is then divided into several steps, namely the preparation of resources needed to develop the media. The resources needed include Blender 3D software, Unity, Visual Studio 2022, CorelDRAW, and a Canva account. The creation of AR media based on local wisdom is made using software on a computer, namely by creating 3D assets, which are 3D objects, using Blender software. The scenes built in Unity include the main menu scene, info scene, material scene, quiz scene, and play AR scene. The AR book is designed using Canva, which is modified using CorelDraw.

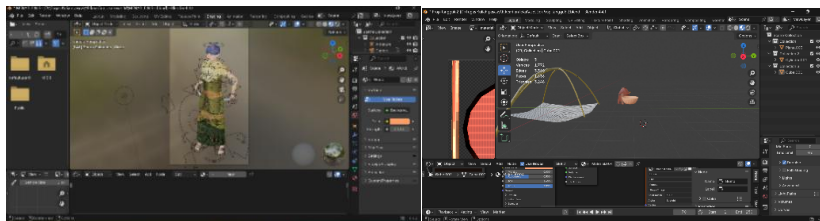


Figure 2.
Creating 3D Objects Using Blender

AR media based on local wisdom is validated by media experts and subject matter experts. Subject matter experts review aspects related to the material to be delivered. Subject matter experts assess the material, suitability of objectives, clarity of user instructions, and clarity of performance. Based on validation by subject matter experts, the following results were obtained.

Table 3.
Results of Expert Validation of Materials

Aspect	Average score (\bar{X})	Interval	Categori
Appropriateness of objectives	3	$\bar{X} > 2,4$	Highly Suitable
Clarity of User Instructions	2,5	$\bar{X} > 2,4$	Highly Suitable
Clarity of Performance	3,5	$\bar{X} > 3,2$	Highly Suitable
Material	5,5	$\bar{X} > 3,2$	Highly Suitable

Based on the table above, when displayed in the form of a percentage diagram, the results of the expert assessment of AR media based on local wisdom can be seen in the following image:

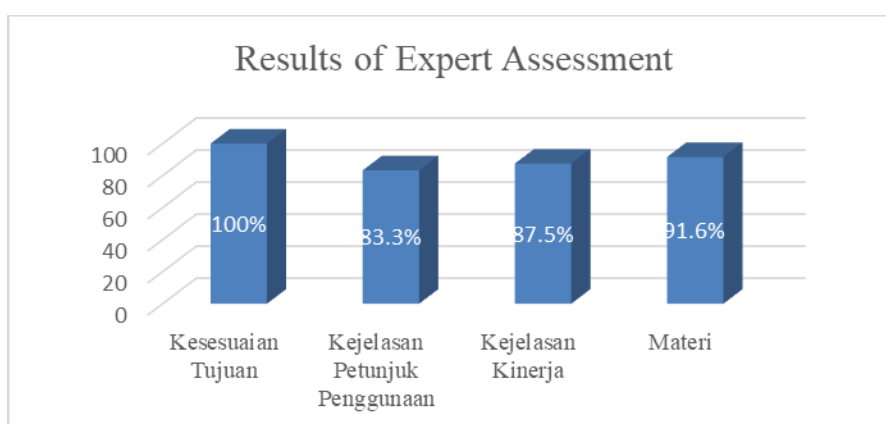


Figure 3.
Results of Subject Matter Expert Validation

Based on the above data, it can be seen that in terms of suitability of purpose, an average score of 3 was obtained, falling into the 'highly suitable' category; in terms of clarity of usage instructions, an average score of 2.5 was obtained, falling into the 'highly suitable' category; in terms of clarity of performance, an average score of 3.5 was obtained, falling into the 'highly suitable' category; and in terms of material, a score of 5.5 was obtained, falling into the 'highly suitable' category. Therefore, it can be concluded that based on the assessment by material experts, AR media based on local wisdom obtained the category of highly feasible in all aspects of assessment. Based on the percentage calculation, it obtained an average score of 90.6%, which falls into the very feasible category. Looking at the results of the material expert validation, it can be concluded that AR media based on local wisdom has good quality with a category of very feasible in every aspect. Although this media is feasible for use, there are several suggestions for improvement.

Based on the suggestions from the subject matter experts, improvements were made to this local wisdom-based Augmented Reality learning media, namely: (1) adding markers to the AR book so that users know which parts of the book can be scanned, (2) simplifying the sentence structure to make it easier for users to understand, (3) adding material and quizzes for learning and user evaluation. Media expert validation tests were conducted to determine the suitability of the developed media in terms of visual, audio, navigation, and manipulation aspects. Two media

experts participated in this study, consisting of a lecturer from the Master of Social Studies Education programme and a practitioner. Based on the media validation, the following results were obtained:

Table 4.
Media Expert Validation Results

Aspect	Average score (\bar{X})	Interval	Categori
Visual	8,5	$\bar{X} > 7,2$	Very Good
Audio	1	$\bar{X} > 0,78$	Very Good
Navigation	1,5	$\bar{X} > 1,5$	Good
Manipulation	2	$\bar{X} > 1,5$	Very Good

Based on the table above, when displayed in a bar chart, the results of media experts' assessments of AR media based on local wisdom can be seen in the following image

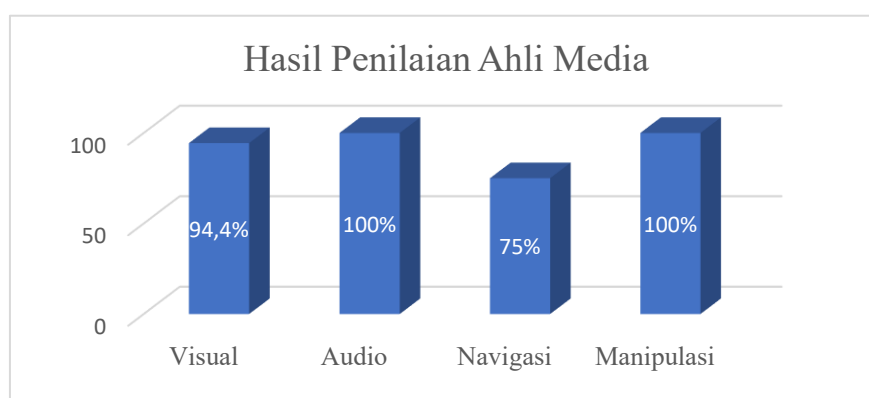


Figure 4.
Media Expert Validation Results

Based on the above data, it can be seen that in terms of visual aspects, an average score of 8.5 was obtained, which falls into the 'very feasible' category; in terms of audio aspects, an average score of 1 was obtained, which falls into the 'very feasible' category; in terms of navigation aspects, an average score of 1.5 was obtained, which falls into the "feasible" category; and in terms of manipulation aspects, an average score of 2 was obtained, which falls into the 'very feasible' category. Based on the feasibility assessment criteria by media experts, the development of AR media based on local wisdom is categorized as 'very feasible', but there are several suggestions for improvement. Based on the suggestions from media experts, improvements were made to this local wisdom-based AR learning media, namely: (1) creating voice dubbing and adding it to AR objects, (2) adding a material menu in the media containing a summary of the material, (3) adding material and quiz buttons to the main menu button.

Implementation Stage

The next stage is the implementation of learning media for students and teachers. This process involves distributing response questionnaires to teachers and students to determine the

practicality and readability of the media developed. The steps in the implementation stage of this study include trials with teachers and limited trials with students. Limited trials were conducted to determine the practicality for sociology teachers and readability for students. Based on the data from the teacher assessment questionnaire on the practicality of the media, the average percentage was 92.35%, which falls into the ‘very feasible’ category. Next, student response data was collected as a readability test applied to 12 students. The results of the readability test applied to students obtained an average percentage of 85.41%. The average percentage results provided a good response. During the limited trial, it was found that several types of Android phones did not fully support this media, so the researcher took follow-up action by adjusting the settings on the AR application developed so that it could run on all versions of Android smartphones with various versions and specifications. This improvement was made so that students, as users, would be more interested in using this local wisdom-based Augmented Reality learning media as a learning aid.

The main field trial was conducted after the local wisdom-based AR media underwent revisions based on suggestions obtained from the initial field trial. The main field trial aimed to determine the students' response to the revised local wisdom-based AR media. The main field trial was conducted in the Experiment class. The subjects of the field trial were 26 students. Based on the data collected, it can be seen that the overall score obtained from student responses to the local wisdom-based AR media in the main field trial reached 89.61, which is in the ‘very feasible’ category. Thus, it can be concluded that according to student responses, the local wisdom-based AR media is very interesting and easy to understand. When viewed from the average student response, the field trial had a higher average. This shows that there was a positive change in the field trial of the AR media based on local wisdom. The following explains the comparison of the average student response results.

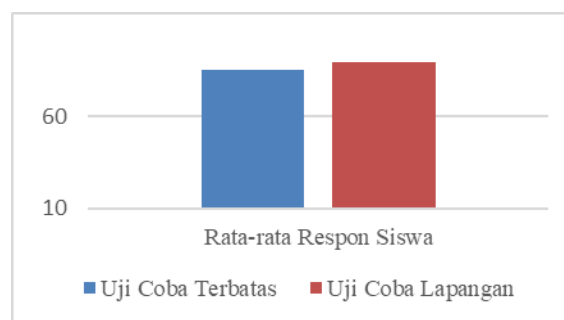


Figure 5.
Graph Comparing Student Responses

Based on the graph above, student responses after field testing the local wisdom-based AR media showed an increase compared to the limited testing. The field test results almost achieved the maximum average score, which means that the responses given by the students were very good even though they did not reach the maximum score. To determine the effectiveness of AR media based on local wisdom in improving student learning outcomes, a pretest and posttest were conducted. The pretest and posttest were carried out by giving multiple-choice questions in both the control class and the experimental class. Based on the pretest and posttest results, it was found

that students' sociology learning outcomes improved in both the control class and the experimental class.

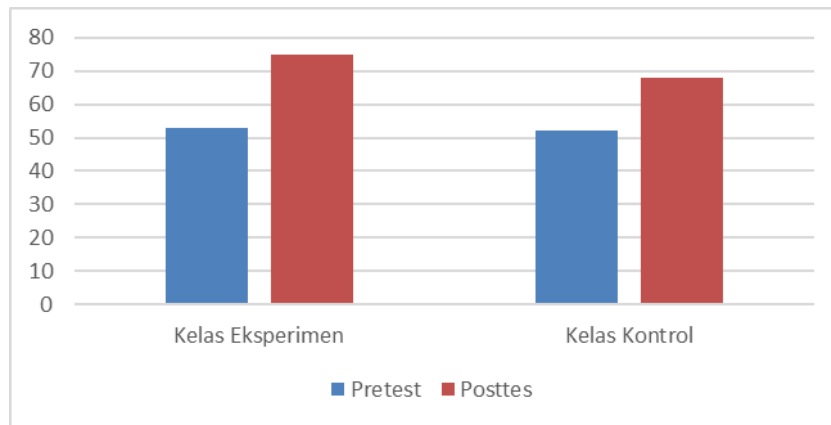


Figure 6.
Pretest and Posttest Results

As can be seen in the figure, both the pretest and posttest scores in the control class and experimental class increased. The average pretest score in the experimental class was 52.77, which increased to 75.12 in the posttest results. Meanwhile, the control class obtained an average pretest score of 51.77, which increased to 67.69. Based on the average pretest and posttest scores in the experimental class and control class, both classes experienced an increase, but the increase in the experimental class was much higher than the increase in the control class. The presentation of data and analysis of observation results are divided into two categories, namely the control class and the experimental class. These observations were conducted by an observer, in this case a subject teacher who taught in another class. These observations were conducted to determine the level of student motivation in participating in learning. The data from the observer's observations of student motivation before learning are as follows.

Table 5.
Observation results

Aspek	Jumlah skor		Persentase	
	Sebelum	Sesudah	Sebelum	Sesudah
Kelas eksperimen	147	202	63,36	87,06
Kelas kontrol	144	165	62,06	71,12

Based on the results of observations of the experimental class conducted before learning, the percentage score was 63.36%. Meanwhile, after the learning process ended, there was an increase to 87.06%. The control class showed observation results of 62.06% before learning, which increased to 71.12% after learning was completed. It can be concluded that students' interest in learning sociology using AR media based on local wisdom in the experimental class was higher than in the control class.

The effectiveness test was conducted using a *quasi-experimental* method with a *nonequivalent control group design*. This design was used to compare the control class with the

experimental class. The control class conducted conventional learning without using learning media, while the experimental class was given treatment to conduct learning with AR media based on local wisdom. In addition to comparing the conditions of the control class and the experimental class, this research design also aimed to determine the increase in learning outcomes in the experimental class after conducting learning with AR media based on local wisdom. This study examines the improvement in learning outcomes of students who participated in learning using AR media based on local wisdom compared to students who did not participate in learning using media (control class). A t-test was used to determine whether there was a difference in learning outcomes between the two classes, while an N-Gain test was used to see the significance of the improvement in each class.

Evaluation Stage

In this stage, the researcher evaluates the entire process from the analysis stage to the implementation stage. The results of the evaluation are as follows:

- a. In the needs analysis stage, teachers obtained information related to student needs through interviews with sociology teachers. To ensure the accuracy of the needs analysis, questionnaires were also given to students so that the media created would be in line with the needs and characteristics of the students at the school.
- b. The media development planning stage was based on the results of the student needs analysis. The researchers also incorporated suggestions from subject teachers to ensure that the media developed was appropriate for the students' needs.
- c. During the media creation stage, researchers needed a considerable amount of time because they were not yet proficient in using 3D asset creation tools and AR editing tools using Unity and Blender.
- d. During the testing phase, students were enthusiastic and excited about using the application because it was something new to them, but some students were still confused about how to operate some of the features in the application.
- e. The developed media is considered appropriate by experts, practical by teachers, interesting and easy to understand by students, and effective in improving learning outcomes and student interest in sociology lessons.

DISCUSSION

Research and development of *Augmented Reality* learning media based on local wisdom is motivated by learning problems at SMAN 1 Penukal Utara, namely students' difficulty in understanding some abstract material, students' lack of enthusiasm in participating in learning, and students' tendency to be passive in class during the learning process. This certainly affects the level of students' understanding of the material presented. Therefore, to increase students' interest in learning the material while also making it easier for teachers to deliver the material, *Augmented Reality* learning media based on local wisdom was developed for community empowerment material based on local wisdom.

AR-based learning media developed through several stages, namely the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. The analysis stage includes needs analysis, material determination, and identification of student characteristics used to develop learning media. The design stage includes designing *flowcharts and*

storyboards, compiling media application designs, and compiling research instruments. The design is adjusted according to the results of the analysis conducted in the previous stage. The design results are then implemented in the application development. The development stage consists of preparing *resources*, creating media using *Blender* and *Unity software*, and finally compiling a book on local wisdom-based AR. The local wisdom-based AR learning media is then tested in the testing stage. The testing conducted included media expert validation, material expert validation, and media practicality testing by teachers to obtain preliminary feasibility results. Next, improvements were made according to the suggestions of media and material experts. In the next stage, the implementation stage, the media was tested on a limited number of students. The results of the limited trial were analyzed, corrected, and refined based on student input. After revising the media, the researchers conducted field trials. The field trials used an experimental class and a control class. There were 26 students in each class. The final stage was to evaluate the entire media development process that had been carried out.

AR media products based on local wisdom obtained feasibility scores from subject matter experts and media experts. Practicality assessments were also required to determine how practical the developed products would be when applied to learning. In addition, media readability was obtained from student responses. AR media products based on local wisdom were deemed suitable for use in the learning process after undergoing improvements based on suggestions and comments from media experts. The validity of AR media based on local wisdom is categorized as excellent, which means that the product is suitable for implementation. Students showed positive responses to AR media based on local wisdom based on the results of the questionnaire.

The measurement data were analyzed using pretest and posttest scores. Data analysis was performed using t-tests and *N-gain* tests. Prerequisite tests were also conducted using homogeneity and normality tests. The normality test results for the experimental class were 0.696 for the pretest data and 0.130 for the posttest data. The normality test results for the control class were 0.315 for the pretest data and 0.573 for the posttest data. All data showed normality because $sig.a > 0.05$. The homogeneity test results obtained a significance value of $0.896 \geq 0.05$ on the pretest value and a significance of $0.291 \geq 0.05$ on the posttest value, which means that the data groups have homogeneous variance. Thus, the data analysis results were declared normal and homogeneous, and the researcher could proceed to the *paired sample t-test* stage. The results of the *paired sample t-test* significance of 0.000 ($p < 0.05$) showed a statistically significant increase. The experimental class experienced an increase of 22.34, while the control class experienced an increase of 15.92. These results indicate a difference in the average pretest and posttest learning outcomes in the experimental class, which means that the use of learning media has an effect on improving learning outcomes. The effectiveness of the media can be further confirmed by looking at the *N-gain* score results in the experimental class, which is 0.44, falling into the moderate category, while the *N-gain* score in the control class is 0.28, falling into the low category. *The independent sample t-test* of the *N-gain* score was 0.043, where the sig. (2-tailed) value was < 0.05 , indicating a significant difference in the average learning outcomes between the experimental class and the control class. This confirms that the use of AR media based on local wisdom is effective in improving student learning outcomes.

Based on observations during the learning process, the application of the developed learning media was able to significantly increase student engagement, as seen from the increase in the

percentage of activity in the experimental class from 63% to 87%. In contrast, in the control class, the percentage of activity only increased from 62% to 71%. Although this shows an increase, it is still lower than in the experimental class. The difference in activity increase between the experimental and control classes illustrates that the learning strategy used in the experimental class had a greater positive impact. The 24% increase in the experimental class indicates that students were more motivated and actively involved, which has the potential to improve overall learning outcomes.

Overall, this study shows that the learning method used in the experimental class is more effective. These findings are consistent with previous research conducted by Dian Ratna Sari, Erry Hidayanto, and Aynin Mashfufah, who created *Augmented Reality-based Flashcard* media products that can improve students' cognitive learning outcomes, as well as research conducted by Wardatul Fauziah, which found that the use of *Augmented Reality* media can have an impact on student independence.

The development of AR media based on local wisdom is in line with the principles of constructivist learning theory, which emphasizes that knowledge is actively constructed by learners through interaction and learning experiences. According to constructivism, learning is not merely the passive reception of information, but rather a process of knowledge construction that occurs internally by learners through exploration, reflection, and collaboration. In the context of AR media based on local wisdom, this technology provides an interactive learning environment, facilitating the exploration of concepts in a concrete, and visual manner. This allows students to build a deeper and more meaningful understanding of concepts (Jonassen, 1991). The use of AR media allows students to engage in *student-centered* learning activities where they can observe, manipulate virtual objects, and receive immediate feedback, all of which are important aspects of the knowledge construction process according to constructivist theory. In addition, AR media based on local wisdom supports social interaction and collaboration among students, which are also key elements in learning. Through media-based learning, students are encouraged to discuss, ask questions, and share their understanding, resulting in a more active and meaningful learning process.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The conclusions drawn from the research conducted are as follows: (1) The locally-based AR media developed is feasible and practical for use in teaching sociology on the subject of basic concepts of local wisdom, based on expert validation and the assessment of sociology teachers, and can therefore be used as a teaching medium in the classroom. The problems of local wisdom material being considered abstract, students lacking enthusiasm in following the learning process, and students tending to be passive in class during the learning process can be overcome by using AR media based on local wisdom. (2) The results of expert assessment of the material based on the aspects of suitability of objectives, clarity of usage instructions, clarity of performance, and material obtained an average percentage of 90.6% or was included in the "Very Suitable" category. Meanwhile, the results of media expert assessment based on visual, audio, navigation, and manipulation aspects obtained an average percentage of 92.35% and were categorized as "Very Appropriate". The response of users or students to the AR learning media based on local wisdom,

as seen from the aspects of material and appearance, had an average percentage of 89.61%, which falls into the very feasible category. Thus, based on the assessments of experts, teachers, and students, the AR media based on local wisdom is very feasible to be implemented in learning. (3) There was an increase in student learning outcomes in both the experimental and control classes after being given treatment, as shown by the results of *the paired sample t-test* with a significance value of 0.000 ($p < 0.05$). The increase in learning outcomes in the experimental class was higher than in the control class. This is indicated by the average *N-Gain* score of the experimental class of 0.44 (moderate category), while the control class scored 0.28 (low category). There was a significant difference in learning outcome improvement between the experimental class and the control class, with a significance value of *the independent sample t-test* of 0.04 ($p < 0.05$). This shows that the learning applied in the experimental class was more effective than the learning in the control class. (4) The use of AR media based on local wisdom can significantly improve student learning outcomes compared to classes that do not use media or conventional learning. Based on observations in the classroom during learning, student interest in the experimental class was higher than in the control class. The average results and learning motivation of students in classes that used media were higher than in classes without media, and the increase in student learning outcomes was in the moderate category. This confirms that the use of AR media based on local wisdom is an effective learning innovation in improving learning outcomes and student interest in sociology learning.

RECOMMENDATIONS

Based on the results of the research and development that has been carried out, several recommendations can be made. (1) AR media needs to be developed for more materials, especially social studies subjects with more varied themes and a broader scope of variables studied so that the results are more comprehensive. (2) Schools are expected to support teachers in using new learning methods as alternatives to improve the quality of learning. (3) There is a need for further development by adding various features to AR media based on local wisdom in order to create effective learning.

REFERENCES

- A Widyastuti. (2021). *Perencanaan pembelajaran*. Yayasan Kita Menulis.
- Andrew Fernando. (2020). *Pengembangan Media Pembelajaran*. Yayasan Kita Menulis.
- Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer Science and Business Media. <https://doi.org/10.1007/978-0-387-09506-6>
- Hidayati, D. N., & Salamah, S. (2022). Penggunaan Kartu Peta dalam Peningkatan Motivasi dan Hasil Belajar IPS. *Proceedings Series on Social Sciences & Humanities*, 3, 39–45. <https://doi.org/10.30595/pssh.v3i.335>
- Hsu, Y. S., Lin, Y. H., & Yang, B. (2017). Impact of augmented reality lessons on students' STEM interest. *Research and Practice in Technology Enhanced Learning*, 12(1). <https://doi.org/10.1186/s41039-016-0039-z>
- Ilmawan Mustaqim & Nanang Kurniawan. (2017). Pengembangan Media Pembelajaran Berbasis Augmented Reality. *Jurnal Edukasi Elektro*, Vol. 1, No. 1.
- Lynn, M. R. (1986). *Determination and Quantification of Content Validity*. Nursing Research.

- Pratiwi, P. H. (2017). *Pengembangan modul mata kuliah penilaian pembelajaran sosiologi berorientasi HOTS*. UNY Press.
- Rismawati, R., & Salamah, S. (2022). Penggunaan Media Flash Card untuk Meningkatkan Motivasi dan Hasil Belajar IPS. *Proceedings Series on Social Sciences & Humanities*, 3, 134–138. <https://doi.org/10.30595/pssh.v3i.369>
- Rustamana H.A. (2020). Pengaruh Penerapan Model Pembelajaran Berbasis Penyelidikan untuk Meningkatkan Ketrampilan Berpikir. *Journal of Chemical Information and Modeling*.
- Sebastião Periera, Jurnal Inovasi dan Teknologi Pembelajaran Sosiologi, J., Ilmu Pendidikan Suco Marcarenhas, F., Estrada de Balide, R., Distrito Vera Cruz, S., Dili, M., & Leste, T. (2015). Pentingnya Rancangan Pembelajaran Sosiologi Bagi Dunia Pendidikan Di Timor Leste Sebastião Periera. *Jurnal Inovasi Dan Teknologi Pembelajaran*.
- Sipaayung, J., & Munawaroh. (2025). Peran Teknologi Smartphone Sebagai Media Pembelajaran Interaktif bagi Mahasiswa di Era Digital. *Trending: Jurnal Ekonomi, Akuntansi, Dan Manajemen*, 3(e-ISSN: 2962-0813; p-ISSN: 2964-5328), 167–176.
- Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A Comparative Study of the ADDIE Instructional Design Model in Distance Education. In *Information (Switzerland)* (Vol. 13, Issue 9). MDPI. <https://doi.org/10.3390/info13090402>