

Research Article

Development of augmented reality media based on Assemblr Edu to enhance the learning outcomes

La Shita Ardia Damayanti^{a,1,*}, Galih Mahardika Christian Putra^{a,2}

^aDepartment of Elementary School Teacher Education, Faculty of Education and Psychology, Universitas Negeri Semarang, Jl. Raya Beringin No.15, Wonosari, Semarang, Central Java 50244, Indonesia

¹lashitaardia@students.unnes.ac.id*; ²galihputra@mail.unnes.ac.id

*Corresponding author

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Abstract: This study focuses on the development and evaluation of augmented reality (AR) learning media based on the Assemblr Edu application, aimed at enhancing the learning experience of fifth-grade students at SDN Tambaharjo 01. The AR media covers the subject of Community Economic Conditions and Natural Resources and Supporting Factors for Community Economic Activities. The research process included designing the AR content, validating it with experts, and conducting small and large group trials. This study investigates the development and effectiveness of AR learning media based on the Assemblr Edu application to improve learning outcomes in Natural Science and Social Studies for fifth-grade students at SD Negeri Tambaharjo 01. The research employs a quantitative approach with a Research and Development (R&D) method, utilizing the ADDIE development model to create and assess the learning media. The study addresses low student performance in Natural Science and Social Studies by integrating interactive AR technology to make learning more engaging and effective. The developed AR media, which includes 3D and 2D interactive content, was validated by material and media experts, yielding a high validity score of 90.31%. Small and large group trials were conducted, showing significant improvements in student learning outcomes. Pretest and posttest results demonstrated an average score increase from 50 to 85, with a student response rate of 88.46% indicating the media's feasibility. Teachers also rated the AR media highly, with a response score of 91.34%, confirming its practical application in educational settings. The study concludes that the Assemblr Edu-based AR learning media is highly feasible and effective in enhancing student learning outcomes in Natural Science and Social Studies.

Keywords: augmented reality; Assemblr Edu; learning outcome

1. Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state, as stated in the Law of the Republic of Indonesia concerning the National Education System No. 20 of 2003. Currently, 21st century education requires the use of technology and balance with the demands of the times in learning. In accordance with Greenstein in. (Sugiyarti et al., 2018) states that students who live in the 21st century must master science, have metacognitive skills, be able to think critically and creatively, and be able to communicate or collaborate effectively. Integration of technology and adaptation to changing times, by emphasizing mastery of material, the ability to think independently, critically, and creatively, as well as good communication and collaboration skills (Arifin et al., 2021; Elisa et al., 2022; Firdaus et al., 2022). To remain relevant to today's development, teachers must be able to adapt and innovate to create a learning environment and learning process that fosters students' potential (Hermita et al., 2021; Kim et al., 2019).

In a learning process, choosing the right and effective learning media is very important. Learning media must clarify concepts and facilitate students' understanding in learning (Bahri et al., 2020; Bereczki & Kárpáti, 2021; Cynthia et al., 2022). Therefore, the utilization of learning media is one of the things that needs to be considered. The utilization of learning media can help teachers in the teaching process at school and be a solution to make students feel happy and not bored while learning (Arifin et al., 2022). In addition, the use of learning media can also increase students' learning motivation and even have an impact on the psychological aspects of students and can improve students' understanding of the subject matter and play an important role in designing an effective and interesting learning process for them (Alalwan, 2022; Amir et al., 2020; Bakkiyaraj et al., 2021).

But in the reality, the learning process that occurs in the field has not yet run according to the applicable standards. Based on the results of initial research conducted by researchers at SD Negeri Tambaharjo 01, problems were found about the learning outcomes of students. From this research, it was found that the lowest class average score was class V in Natural Science and Social Studies subjects. Natural Science and Social Studies subjects have low average scores compared to other subjects. This learning outcome has a low average, which is indicated by 62.06% of students who get a score below the Criteria for Achieving Learning Objectives (CALO) which is 75, while the remaining 37.93% get a score above CALO.

These problems indicate that there is a need to improve Natural Science and Social Studies learning outcomes. To be able to improve Natural Science and Social Studies learning outcomes can be done by developing interactive learning media. In the learning process according to (Azhar, 2014) media is used to convey messages or information in the teaching and learning process so that it can stimulate the attention and interest of students in learning. In this study, researchers chose to develop Assemblr Edu-based AR (Augmented Reality) learning media. According to (Haller et al., 2007), the purpose of Augmented Reality is to develop technology that allows the merging in real time between digital content created by computers and the real world. Augmented reality technology has now been developed on smartphones in addition to computer media (Li et al., 2023; López-Faicán & Jaen, 2020). Therefore, Augmented Reality can be the right solution to improve students' understanding of materials related to the real world. Augmented Reality media will display material with 3 dimensions or 2 dimensions in real time and seem real.

Based on the identification above, the author offers learning media that will be able to improve student learning outcomes. (Sadiman, 2008) defines learning media as everything that can be used to convey messages from the source to the intended person. In this case, it can be interpreted as actions taken to encourage ideas, interests, attention, and focus of students in learning (Putra et al., 2023). The learning media that will be developed by the author is AR (Augmented Reality) based on Assemblr Edu (Chairudin et al., 2023; Ilafi, 2022; Mursyidah & Saputra, 2022; Prasetiawati et al., 2023).

Some researchers focus on the visual presentation of media, but there are some studies that have limitations related to the presentation of the material displayed. Therefore, this study aims to improve student learning outcomes using Assemblr Edu-based Augmented Reality media. Through the design of learning media products in the form of 3D images, as well as videos to reinforce the material as a form of presentation of originality. In the learning media, a barcode will be added to connect with other applications that are used as evaluations, namely Quizizz.

2. Materials and Methods

2.1 Types of research

The research approach used in this study is a quantitative approach. (Sugiyono, 2019) states that quantitative research is research based on the philosophy of positivism and is considered a scientific or scientific method because it meets scientific standards systematically, objectively, measurably, rationally, and concretely. While the research method used in this research is the development method or Research and Development (R&D). (Sugiyono, 2019) revealed that the development research method or (Research and Development) is a research method used to produce certain products, and test the effectiveness of these products. (Okpatrioka, 2023) states that R&D is a process or steps to make new products or improve existing products by developing them.

Development research can serve as a link or vice versa between basic research and applied research. R&D is the process or steps to create a new product or improve an existing product by developing it. Development research can serve as a link or vice versa between basic research and applied research. This type of research has various research products developed. The products developed in this study used the ADDIE development model.

The ADDIE development model, which stands for Analyze, Design, Develop, Implement, and Evaluate is a model that can be used to create media, open sources, learning models, and learning methodologies. The ideas of the ADDIE model are very suitable for building basic learning materials, especially product design concepts. The choice of this research design is in accordance with the research objectives that produce Assemblr Edu-based Augmented Reality learning media development products on Natural Science and Social Studies material for grade V SDN Tambaharjo 01. There are five stages in the ADDIE development model, namely: 1) analysis, 2) design, 3) development, 4) implementation, 5) evaluation (Safitri & Aziz, 2022).

The research and development stages were carried out using a model developed and modified by (Borg & Gall, 1983). In full Borg & Gall's ten proposed R&D steps include: 1) Potential and Problems by making initial observations at elementary schools 2) Data collection; in this process the information from the observations is used as a hypothesis for the preparation of needs 3) Product design; after compiling the needs analysis, the production process of the media results enters stage 3, 4) Design Validation; when the learning media is ready for use, it is necessary to test its feasibility to material and media validators 5) Design Revision; improvements need to be made as a media improvement process, 6) Product Trial; at this stage the product is tested on several students as a small group in elementary schools, 7) Product Revision 8) Usage trial; then the product will be used for one class as a learning media 9) Product revision; if it is deemed that a final revision is still needed on the product, it will be refined at this stage before reaching the last stage, 10) Mass Production; the product will be developed as a learning media for other materials or grade levels.

2.2 Research Subjects and Objects

Research subjects are people involved in research (informants or sources) to obtain information about sample research data (Sugiyono, 2019). People who know clearly, in detail, and based on existing information usually get information about indirect subjects. The subjects of this study were fifth grade students of SD Negeri Tambaharjo 01 Pati Regency totalling 29 students, consisting of 17 male students and 12 female students. In addition, there is a fifth-grade teacher as a supporting subject to obtain information related to the subject to be studied. Because the class teacher has understood the characteristics of the students, the researcher can request information about the research topic based on real data.

2.3 Data Types and Sources

The data used in this study are qualitative data and quantitative data. The qualitative data in the form of interviews with homeroom teachers of grade V SD Negeri

Tambaharjo 01, the results of observations during Natural Science and Social Studies learning, documentation, questionnaires of teacher and student needs, validation questionnaires of material experts and media experts, questionnaires of teacher and student responses. While the quantitative data of this study are pretest posttest data, and Natural Science and Social Studies learning outcomes of fifth grade students of SD Negeri Tambaharjo Pati Regency.

2.4 Data collection technique

Data collection techniques in this study are the methods used to obtain empirical data with research objectives. To obtain sufficient data and in accordance with the subject matter under study, the researchers used test and non-test techniques. Tests were given to students individually to determine the cognitive abilities of students in small group trials and large group tests. While non-test techniques in this study are in the form of 1) observation, during learning, observations can be made of students' behavior in participating in learning. This includes students' activeness, their ability to answer tasks carefully, especially when reading, and the results they achieve after learning (Arikunto, 2014). 2) interviews, The interview was conducted with the resource person who is the fifth grade homeroom teacher, Mrs. Nur Sa'adah, S.Pd, used by researchers to find out the problems that exist in the field, namely in Class V of SD Negeri Tambaharjo 01. 3) questionnaires, Questionnaires or surveys distributed by researchers during the study were student response questionnaires and teacher response questionnaires to the development of learning media used during learning and 4) documentation The documentation collected by researchers is in the form of documents, images, and videos. The documents that become documentation in this study are in the form of teaching modules and recap of students' scores. While the pictures and videos taken during the research were classroom conditions, the atmosphere of learning with homeroom teachers, learning with researchers, large groups, small groups, using AR learning media, working on pretest post-tests, working on evaluations, presenting work paper results, and filling out student response questionnaires.

This research will use observation sheets, validation sheets for material experts and media experts, and interview guidelines. The material expert validation sheet will be used to measure how well students understand the material presented and how it is related to the expected competencies. The media expert validation sheet will be used to determine how well the media is made to be used in learning. Researchers use observation sheets to determine the use of media in the learning process. Interview guidelines are used to find out responses, responses, comments, and suggestions from teachers and students after the use of media in learning.

2.5 Data Analysis Techniques Data Analysis Techniques

Data analysis is the process of systematically searching and compiling data obtained from field notes, interviews, and documentation. This process includes organizing data into categories, breaking it down into units, synthesizing, arranging into patterns, selecting what is important and what will be studied, and making conclusions so that it is easily understood by individuals and others (Sugiyono, 2019).

In this study, the data obtained from the trial instrument were analyzed using qualitative descriptive statistics to show the results of product development which is augmented reality learning media. The focus of this analysis is to provide an overview of the characteristics of the data for each variable. There are three stages of data analysis in this study, namely initial data analysis, product data analysis contains feasibility data analysis and teacher response questionnaire analysis to test the feasibility of learning media developed by researchers. The media feasibility criteria table refers to (Karunia & Yudhanegara, 2017), shown in Table 1.

Table 1. Media Feasibility Criteria

Percentage (%)	Qualification
75 - 100	Very valid
50 - 75	Valid
25 - 50	Quite Valid
0 - 25	Invalid

The final data analysis was done by t-test and N-Gain test. The T-Test test to determine the effectiveness of augmented reality learning media based on the Assemblr Edu application. The N-Gain test was conducted to calculate the average increase in student learning outcomes before and after using Assemblr Edu application-based augmented reality learning media. The results of the N-Gain test are classified into four criteria which can be seen in [Table 2](#).

Table 2. N-Gain Criteria

N-Gain Value	Qualification
> 0.70	High
0.30 – 0.70	Medium
< 0.30	Low

3. Results

3.1 Result of Augmented Reality based on Assemblr Edu Media Development

The final product of Assemblr Edu application-based augmented reality learning media is an application that can be accessed via Android devices and the web, so it can be used via cellphones or laptops/computers. ([Rusli et al., 2022](#); [Sugiarto, 2022](#)) Assemblr Edu application-based augmented reality learning media displays interesting animations, learning videos, and interactive material exposure that is easy to understand. Here are the details of the Assemblr Edu application-based augmented reality learning media.

3.2 Augmented Reality based on Assemblr Edu Media Design

Augmented reality media developed based on the Assemblr Edu application contains material on the Economic Conditions of the Community in my area. The choice of media resources This choice of learning media resources has been adjusted to meet the needs of students ([Rizky et al., 2023](#); [Irmy et al., 2023](#); [Tuta et al., 2022](#)). This Assemblr Edu-based AR media can be used as a support for students to learn independently. The media is prepared by utilizing the Assemblr Edu application. Assemblr Edu is a platform that allows learning sessions to be more interesting and interactive by using 3D and AR displays. In this application, it can allow turning boring learning exercises into fun with features that are easy to access and use. For Augmented Reality content is created through the utilization of Assemblr Edu application.

The purpose of this stage is to make the teaching materials developed more interesting for students and make them more enthusiastic in learning activities. This stage includes the preparation of learning materials, media selection, and initial design. Product preparation is carried out during the initial design before being tested by preparing the design of teaching materials and instruments, which include the design of the media format and the preparation of instruments ([Nur et al., 2024](#); [Suci & Tri, 2023](#)). While at this stage of development, researchers have used the previous design to develop Augmented Reality media. The results of the validation questionnaire assessment conducted by

material experts and media experts show the validity of Augmented Reality material about the economic conditions of the people in my area. At this stage, researchers began compiling learning media. Once created, this media is tested by material experts and media experts.

3.2.1 Material Content

Augmented Reality learning media based on the Assemblr Edu application on the Natural Science and Social Studies subject matter of Community Economic Conditions in my area developed by researchers consists of 3 main components, namely as follows.1) The introduction section which contains: cover, material identity, developer identity, and introductory video 2) The content section consists of: concept map (learning outcomes, indicators of competency achievement, flow of learning objectives, learning objectives), triggers (problem orientation video, literacy text), PBL learning syntax, and learning materials 3) The closing section contains: developer profile, identity and bio of the media developer.

3.2.1.1 Introduction Section

This section contains a cover, material title, developer identity, and an introduction video to enter the material (Figure 1).



Figure 1. The introduction section of the development of Augmented Reality learning media based on Assemblr edu application.

3.2.1.2 Content Section

This section contains material that will be learned in two meetings. It starts with information from the concept map and then continues with a lighter in the form of videos and text according to the material and according to the steps of PBL learning syntax, and ends with a conclusion video and evaluation in the form of a Quizizz that can be accessed through scanning the barcode listed (Figure 2).



Figure 2. Content Section of the development of Augmented Reality learning media based on Assemblr Edu Application.

3.2.1.3 Closing Section

The closing section contains: developer profile, identity and bio of the media developer (Figure 3).



Figure 3. Closing Section of the development of Augmented Reality learning media based on Assemblr Edu Application.

3.3 Feasibility Augmented Reality learning media based on Assemblr edu Application

3.3.1 Validity Test

After developing Augmented Reality media products using the Assemblr Edu application is complete, it is necessary to test media validation by material experts and media experts. Material expert validation is reviewed from the media display design, ease of use of the media, and suitability. Media expert validation is reviewed from the accuracy of the material with learning objectives, suitability to the level of student thinking, support for the content of learning evaluations, and stimulus for understanding the material.

The validity test was conducted by two expert validators, namely material experts and media experts. The material expert validator is Dr. Kurotul Aeni, S.Pd., M.Pd., who is a lecturer at the Department of Elementary School Teacher Education, Semarang State University. Validation by material experts was conducted on May 14, 2024. While the media expert validator is Drs. Sigit Yulianto, M.Pd. is a lecturer at the Department of Elementary Teacher Education, Semarang State University. Validation by media experts will be conducted on May 14, 2024. The results of the validation questionnaire analysis of Augmented Reality learning media based on Assemblr edu Application are in Table 3.

Table 3. Validity Test Results

Aspect	Percentage (%)	Categorical
Material Validation	83.75%	Very Valid
Media Validation	96.87%	Very Valid
Average	90.31%	Very Valid

Based on Table 3 shows that the average validity by material and media experts is 90.31% which is a very valid category. This indicates that the Augmented Reality learning media based on the Assemblr Edu application developed is considered very feasible to use in learning because it has met the specified criteria. The data from the validity test results conducted by material experts and media experts state that the products developed are considered very feasible without revision.

At this implementation stage, the researcher uses Augmented Reality learning media using the Assemblr Edu application in reality. Product trials will be conducted in small and large groups at SDN Tambaharjo 01 Pati.

Before being tested on a large scale, the product was tested in a small group trial. The product trial of Augmented Reality learning media based on Assemblr Edu application was conducted on 6 fifth grade students of SDN Tambaharjo 01. In the product trial, researchers used purposive sampling technique, which uses certain considerations. There were six heterogeneous students selected for the trial: two upper ability students, two medium ability students, and two lower ability students. This was done to represent the whole sample. The small group trial started with pretest questions. After that, students do learning with Augmented Reality learning media through the Assemblr Edu application. After that, students work on posttest questions and teachers fill out student response questionnaires.

Furthermore, researchers distributed a response questionnaire to students after using Assemblr Edu application-based Augmented Reality media to evaluate their responses to it. The results of this student response questionnaire are then analyzed with the criteria very feasible from a percentage of 81% -100%, feasible from 61% - 80%, enough from 41% - 60%, not feasible from 21% - 40%, and very not feasible from a percentage of 0% - 20%. . The results of the questionnaire recapitulation in the student response table, obtained a percentage of 88.46%. indicates that the Augmented Reality media based on the Assemblr Edu application is very feasible. Students do not provide additional or revision suggestions so that the Augmented Reality media based on the Assemblr Edu application can continue the large group product trial.

The trial process begins with the giving of pre-test questions to students then students are given learning using Augmented Reality Media based on the Assemblr Edu application. After the implementation, then students work on posttest questions and finally fill out a student response questionnaire. And the teacher also filled out a teacher response questionnaire.

This research was conducted in two learning meetings, namely the first meeting with the concept of Community Economic Activity material that discusses the concept and understanding of community economic activities in the region, while the second meeting with the material of Natural Resources and Supporting Factors for Community Economic Activities that discuss natural conditions and supporting factors for community economic activities. The results of the questionnaire recapitulation in the student response table, obtained a percentage of 89.42%, indicating that the Augmented Reality media based on the Assemblr Edu application is very feasible. Students do not provide additional or revision suggestions so that Augmented Reality media based on Assemblr Edu application.

Researchers also distributed questionnaires to teachers for the evaluation stage of the media that had been used. The results of the questionnaire recapitulation in the teacher response table, obtained a percentage of 91.34%, indicating that the Augmented Reality learning media based on the Assemblr Edu application is very feasible. Teachers do not provide additional or revision suggestions so that Augmented Reality media based on Assemblr Edu application.

The recapitulation of assessments from material experts, media experts, and user responses shows that Augmented Reality learning media based on Assemblr Edu Application has met the criteria for selecting learning media. Augmented Reality learning media based on Assemblr Edu Application is practical because it is easily accessible and flexible so that it can be used by students when learning anywhere and anytime. It can be concluded that Augmented Reality learning media based on Assemblr Edu Application is very feasible to use in learning.

Figure 4 and Figure 5 show the aspects assessed in the validation test.

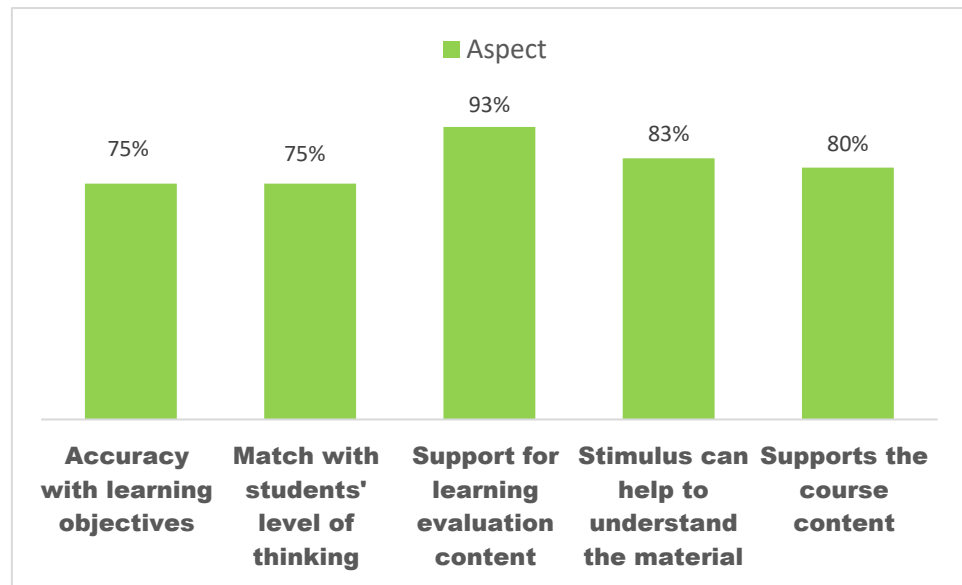


Figure 4. Material Expert Validation

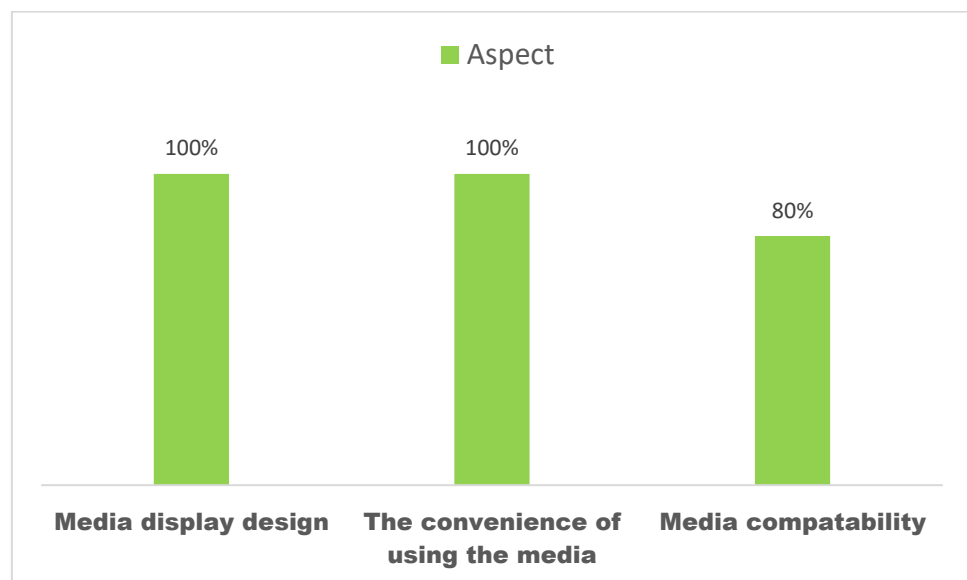


Figure 5. Media Expert Validation

3.4 Effectiveness Augmented Reality learning media based on Assemblr edu Application

A research can be said to succeed if the research is effective in improving learning outcomes. The effectiveness of Augmented Reality learning media based on Assemblr Edu Application can be seen from the results of data analysis of learning outcomes of fifth grade students of SDN Tambaharjo 01 on the material of Economic Conditions in my area. The increase in student learning outcomes can be seen from the pretest and posttest scores obtained before and after the implementation of learning.

The changes that occur in students that include cognitive, affective, and psychomotor aspects are called learning outcomes. Small-scale product trials show differences in learning outcomes before and after using Augmented Reality learning media used through the Assemblr Edu application. The average pretest score is 50, and the average posttest score is 85. Then student completeness is also different. At the time of the pretest, the number of students who were complete students was 0%. At the time of the posttest, the number of students who completed 100%. A recapitulation of the learning outcomes of the small-scale groups can be seen in [Table 4](#) below.

Table 4. Recapitulation of the learning outcomes of the small-scale groups

Action	Lowest Score	Highest Score	Average	Number of Students Completed	Students Completeness
Pretest	40	60	50	0	0%
Post-test	80	90	85	6	100%

The large group trial showed differences in student learning outcomes before and after using Augmented Reality learning media created by the Assemblr Edu application. Student learning outcomes before the trial were an average of 44.57 with 0% completeness, and student learning outcomes after the trial were an average of 87.17 with 95.65% completeness. A recapitulation of the learning outcomes of the large-scale groups can be seen in [Table 5](#).

Table 5. Recapitulation of the learning outcomes of the large-scale groups

Action	Lowest Score	Highest Score	Average	Number of Students Completed	Students Completeness
Pretest	30	65	44,57	0	0%
Post-test	70	100	87,17	22	95,65%

3.4.1 Normality Test of Pretest and Posttest data

Furthermore, the pretest and posttest scores obtained from the large group product trial results were used to calculate the normality test using the Shapiro-Wilk test. The normality test is used to determine whether the learning outcomes test is normally distributed or not. . Based on the normality test assisted by SPSS Statistics 25, the results of the data normality test are shown in [Table 6](#).

Table 6. Normality test results

Tests of Normality					
Kolmogorov-Smirnova			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.170	23	.083	.926	23	.089
.164	23	.110	.946	23	.236

a. Lilliefors Significance Correction

Based on the results of [Table 6](#) above, it is found that the results of the large group pretest data normality test have a significant value of $0,089 > 0.05$ with this it can be said that the value of all data is normally distributed. Furthermore, the results of the small group posttest data normality test have a significant value of $0.236 > 0.05$ with this it can be said that the value of all data is normally distributed.

3.4.2 Paired Samples T-Test

The T test in this study was used to prove the significance of differences in pretest and posttest scores from Augmented Reality media based on the Assemblr Edu application on the understanding of the concepts of normally distributed and homogeneous students. To determine the effectiveness of using Augmented Reality media based on Assemblr Edu application on student learning outcomes, it was analyzed using paired t-test. Paired t-test is used to test the hypothesis as follows:

Ho: The development of Augmented Reality media based on the Assemblr Edu application in Natural Science and Social Studies subjects is not effective for improving the learning outcomes of fifth grade students of SDN Tambaharjo 01.

Ha: The development of Augmented Reality media based on Assemblr Edu application in Natural Science and Social Studies subjects is effective for improving the learning outcomes of fifth grade students of SDN Tambaharjo 01.

The result of the t test results is shown in [Table 7](#).

Table 7. Result Paired Samples T-Test

		Paired Samples Test					t	df	Sig. (2-tailed)
		Paired Differences			95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pretest - Posttest	-42.60870	6.71998	1.40121	-45.51463	-39.70276	-30.408	22	.000

Based on [Table 7](#), the sig.(2-tailed) value is 0.000. When compared, sig. (2-tailed) $0.000 < 0.05$, it can be concluded that Ha is accepted and H0 is rejected so that it can be known that there is a significant difference in student learning outcomes between before and after using Assemblr Edu Application-based Augmented Reality learning media. This shows that the use of Assemblr Edu-based Augmented Reality learning media on Natural Science and Social Studies subject matter of the economic conditions of the community in the region so that the media is effective on improving the learning outcomes of fifth grade students of SDN Tambaharjo 01.

3.4.3 Average Improvement Test (N-Gain)

The n-gain test in this study was used to see and confirm the increase in students' concept understanding from the acquisition of pretest and posttest scores using digital infographic media. The following is the calculation of N-Gain for small group and large group trials. The results of this test will show an increase in learning outcomes by using Augmented Reality media based on the Assemblr Edu application. The data is presented in [Table 8](#).

Table 8 N-Gain Test Analysis Results Pretest and Posttest.

Class	Category	Score
Small-Scale Group	Average pretest	50
	Average post-test	85
	N-gain	0.70
	Criteria	Medium
Large-Scale Group	Average pretest	44.57
	Average post-test	87.17
	N-gain	0.77
	Criteria	High

After the calculations were carried out using the n-gain formula, the results of the small group trial were 0.70 which stated the medium criteria. Then for the results of n-gain in the large group is 0.77 which states high criteria. The value of N-Gain states that in the results of using Augmented Reality media based on the Assemblr Edu application in this study there was an increase in pretest and posttest scores.

4. Discussion

This research has produced an Augmented Reality learning media development product based on the Assemblr Edu application that can improve student learning

outcomes in the Natural Science and Social Studies lesson content. The development of this media through 5 stages of ADDIE. The initial activity before the development was carried out was to conduct a needs analysis by teachers and grade V students. The product was tested for validity by researchers before being given to students. The product validity test is carried out by experts to determine how feasible the product is and provide recommendations for the product (Rozhana et al., 2023). Two experienced validators conducted the validity test of Augmented Reality learning media created by Assemblr Edu application. The results show that the media is in the "Very Valid" category. The validation results from material experts reached 83.75% while the validation results of media experts reached 96.87%. Based on this, it can be stated that the Assemblr Edu application-based Augmented Reality learning media is feasible to use in the learning process at school without revision because it has fulfilled the suitability of the product developed, including aspects of material content, presentation, language, graphics, and technical.

Learning with media makes it easier for teachers to convey information, so that learning goes well and improves learning outcomes because learning messages are conveyed in an attractive, clear, sequential, and tailored to student needs (Prasetyo et al., 2022). Thus, students gain a broad understanding of learning concepts (Yonanda et al., 2019). The use of Augmented Reality learning media based on the Assemblr Edu application is carried out because researchers want to develop AR learning media whose material is easily understood and learned by students. So in accordance with the opinion (Yamtinah et al., 2023), Augmented Reality (AR) media can be the right choice because it allows seamless interaction between the real and virtual worlds. According to (Yamtinah et al., 2023), AR also allows educators to improve their students' understanding in the classroom by augmenting physical props with virtual annotations and illustrations, as well as creating learning experiences related to the formal classroom, so that students can access learning materials outside of class hours and outside of school. The development of the Assemblr Edu application in an effort to improve student learning outcomes creates various learning media innovations, one of which is as seen in research (Suhati et al., 2023).

Augmented Reality learning media based on Assemblr Edu application is considered feasible to use in the learning process also by looking at the results of teacher and student response questionnaires to this media (Triana & Hariyastuti, 2024). The results of the questionnaire recapitulation in the teacher response table, obtained a percentage of 91.34% indicating that the learning media Augmented Reality based on Assemblr Edu application is very feasible. Likewise, the results of the questionnaire recapitulation in the student response table, obtained a percentage of 89.42% indicating that the Augmented Reality media based on the Assemblr Edu application is very feasible. Neither teachers nor students provide additional or revision suggestions for Augmented Reality media based on the Assemblr Edu application. (Mursyidah & Saputra, 2022) stated that AR is a product of technology that can combine the virtual world and the real world, so educators can use it to project abstract concepts interactively. Assemblr Edu is an application designed for use in the field of education. According to (Nugrohadi & Anwar, 2022) this application is easy to use by teachers and students because with Augmented Reality (AR) technology, this application can create various interactive teaching materials. Interesting two-dimensional and three-dimensional images with various themes are available in this application. Positive responses indicate that the Assemblr Edu application-based Augmented Reality learning media is ready to be used in learning. This shows that the development of learning media based on the Assemblr Edu application has fulfilled the feasibility and effectiveness aspects in the learning process, thus affecting student learning outcomes.

The discussion confirms that the results are in line with the original goal of using Augmented Reality (AR) via the Assemblr Edu app to improve learning outcomes for

fifth-grade students. The AR tool effectively increased student engagement and significantly boosted test scores, with the average score rising from 50 to 85. This demonstrates that AR can make lessons more interactive and enhance student understanding. Expert validation scores, averaging 90.31%, further support the practicality and effectiveness of the AR media in real classroom settings. The study's findings are also consistent with previous research, which shows that AR technology helps students grasp complex concepts more easily by making learning more engaging. While Assemblr Edu may be less common in similar studies, the results align with broader research on the positive impact of AR in education. Overall, the study supports the use of AR as a successful tool for improving learning outcomes and student performance. The thing that must be noted when using this Assemblr Edu application or web is the availability of an internet network to access the platform. In further development research, Augmented Reality Assemblr Edu learning media can be developed with 3D pop up so that Augmented Reality assessment in the media is more optimal.

This research shows that integrating Augmented Reality (AR) through the Assemblr Edu app greatly improves both student engagement and learning outcomes, particularly in fifth-grade classrooms. AR makes lessons more interactive and visually engaging, which captures students' interest and enhances their understanding of the material. As a result, students show significant improvements in their test scores, demonstrating that AR can be an effective tool for reinforcing learning. Feedback from teachers and education experts supports this, highlighting AR's practicality and ease of use as a teaching aid. Moreover, the study emphasizes the growing importance of incorporating modern technology into classrooms to align with the needs of 21st-century learners. AR's ability to make complex subjects more accessible suggests its potential for broader use across various subjects and grade levels, offering a promising avenue for improving education outcomes overall.

5. Conclusion

The results of the development of Augmented Reality learning media based on the Assemblr Edu application on the material of Community Economic Conditions in my area are very feasible to use. The results of validation from material experts and media experts reached the "very valid" category so that this media is suitable for use media. The material expert obtained a percentage of 83.75% while the media expert obtained a percentage of 96.87%. Apart from the media experts and material experts, the feasibility assessment can be seen from the results of the teacher and student response questionnaires. Based on the results of the teacher response questionnaire, the percentage of 91.34% is included in the very feasible criteria. While the analysis of student responses obtained a percentage of 89.42% including very feasible criteria.

The development of Augmented Reality learning media based on the Assemblr Edu application has an effect on improving the learning outcomes of Natural Science and Social Studies class V students of SDN Tambaharjo 01 on the material of the economic conditions of the community in the region. The results of the N-Gain calculation show that there is an increase in the average learning outcomes of students by 0.77 with a very high category. Future researchers should expand the content and material in this learning media so that it is not limited and has a wider range. This is expected to bring innovation in learning and improve student learning outcomes in the Natural Science and Social Studies subject content.

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