
Development of augmented reality-based *E-Cergam* and students' understanding of information texts

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Abstract

This research aims to describe (1) the development design, (2) determine the feasibility, and (3) determine the effectiveness of the *Ketep Pass* picture book learning media based on augmented reality. This research uses the ADDIE model of research and development (R&D). The research population was 31 students: 9 students for small group trials (class IV A) and 22 students for large group trials (class IV B) of SD Negeri Banyuroto 1 Magelang, Central Java. Data was collected through interviews, observations, questionnaires, tests, and documentation, with qualitative and quantitative analysis. The media development design integrates local wisdom content into information texts. The validation results show that this media has a high feasibility level. The results of the paired sample t-test confirm significant differences before and after using the developed media. Then, the N-Gain test on the small and large group showed a high category which prove that the *Ketep Pass* picture book media based on augmented reality is efficacious in improving students' reading comprehension.

Keywords

Augmented reality, picture books, comprehension of reading information.
Introduction

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Introduction

Humans need education to live their lives. This has become the basis on which humans who live will gain knowledge. One aspect of the world of education is literacy. Literacy is a process of improving the competence possessed by students regarding knowledge of Indonesian, so the development of literacy skills is needed; in other words, literacy skills in education need to improve in a better direction.

The reading ability of elementary school students is currently still relatively low. This can be seen from research by the Program for International Student Assessment (PISA) in 2022, which revealed that Indonesia was ranked 68th with a reading score of 371 out of 81 countries. Indonesia's reading literacy score in 2022 has decreased compared to 2018. In other words, out of 1000 people in Indonesia, only one person is interested in reading. Based on this statement, it is estimated that there is still a phenomenon of intellectual unemployment in Indonesia because people have a low interest in reading. Reading ability is crucial for every individual because broad insight can be obtained by understanding information from an existing reading. Reading is seen as one of the basic needs, especially in academic circles, which increases the competitiveness and quality of humans in the future (Karatay, 2017). With reading activities, students get much helpful information.

SD Negeri Banyuroto 1 Magelang has a comfortable environment and adequate facilities. The school is one of the things that creates a conducive environment. The school's teachers are education graduates and have good professional teaching qualities. However, teachers generally still rely on facilities provided by the government in the form of textbooks, lack of variation in learning methods, and minimal use of learning media, especially in the Indonesian language subject. The learning observed was Indonesian language learning material on understanding the objectives and messages conveyed by the author in his writing. The achievement of this learning is that students are expected to be able to understand information about everyday life in printed or electronic form.

The lack of utilization of learning media, especially in Indonesian language subjects, makes students uninterested in participating in learning activities (Hidayati & Wuryandari, 2012). Students tend to feel bored, resulting in students being less able to understand learning materials, especially in understanding the objectives and messages in information texts. Students are only able to read without knowing the intent of the story reading. This is evidenced by the low Indonesian language test scores for reading comprehension of information texts, which are still low.

Based on these problems and the analysis of the needs of teachers and students in the fourth grade, the researcher decided to develop learning media for picture books about *Ketep Pass* based on augmented reality for reading comprehension skills. This problem needs to be overcome by using the right learning media; students are predicted to understand the contents of the stories in the school environment better. The school is at the foot of Mount Merapi, close to the *Ketep Pass* tourist location.

An electronic picture book (*e-Cergam*) combines text and images, usually presented to convey a story or information. This book's target is children; picture books play an important role in supporting and clarifying the story in the text, allowing readers to understand and enjoy

the story with engaging visuals. The combination of text and images is one of the characteristics of this picture book because it has illustrations accompanying the narrative. Images are hand-drawn digital illustrations or collages that help tell a story. Picture books are suitable for children, especially elementary school children, because they are still in the language and cognitive development stage; the illustrations in picture books support them in a story. The use of learning media appropriate to student development can be done so that the effectiveness of the learning process can be achieved. This can be done, for example, by using picture books as learning media. Picture books will later be developed using augmented reality software.

Augmented reality in Indonesian can be interpreted as increased reality, which means technology that can add real things that interact with virtual objects in the real world so that it looks as if there are no boundaries between the real world and the virtual (Saripudin et al., 2022). Augmented reality is one of today's technologies that can be used to solve teacher problems to display innovative, informative, and engaging learning. It can also display virtual objects in 3D in concrete form so that they can present abstract designs that look real (Aripin & Suryaningsih, 2019). The supporting software for creating augmented reality is Assemblr EDU. Assemblr EDU is an augmented reality (AR)-based learning platform designed to help teachers and students create interactive and engaging learning experiences; more realistic or contextual visualizations can help elementary school students understand the abstract concept of picture books.

Informational text is a type of text that conveys information, explanations, or facts about a topic accurately and objectively (Rowan, 2003). Informational text must meet several criteria: accuracy, clarity, objectivity, and readability. In education, informational text is important as a source of learning and a means of conveying knowledge to support the learning process, develop reading and understanding skills, and convey new knowledge. Researchers developed augmented reality-based picture book learning media as an innovation. The development of learning media to provide students with experience regarding technology to achieve successful reading comprehension. This augmented reality-based picture book media is presented as attractively and clearly as possible with the addition of 3-dimensional image elements so that students will be interested and can help students understand the reading easily.

Methodology

This research used a research and development (R&D) method that aims to design and evaluate the effectiveness of the *Ketep Pass* Magelang picture book learning media based on augmented reality in learning to understand the contents of messages and information in an information text for the fourth-grade students of SD Negeri Banyuroto 1 Magelang. R&D is used to produce specific products and test the effectiveness of these products (Sugiyono, 2021). According to Borg and Gall, development research is a study that seeks to develop a product in the field of education. The development procedure used in this research was the ADDIE development procedure put forward by Dick and Carry in 1996, which consists of five stages, namely analysis, design, development, implementation, and evaluation (Waruwu, 2024).

This research was conducted at SD Negeri Banyuroto 1 Magelang. This research was conducted in the even semester of the 2024/2025 academic year. The research subjects consisted of two groups, namely small groups and large groups. In the small group, the subjects were students of class IV A of SD Negeri Banyuroto 1 Magelang, with the determination of subjects using the purposive sampling technique, which is a sampling technique with specific considerations (Sugiyono, 2021) by taking three top-ranking students, three middle-ranking students, and three bottom-ranking students. The subjects in the large group are all students in class IV B of SD Negeri Banyuroto 1 Magelang. In addition, the researcher conducted a trial of the pre-test and post-test questions in class V B of SD Negeri Banyuroto 1 Magelang, which consisted of 22 students.

Data collection methods in this research included test and non-test techniques. Test techniques were carried out through pre-tests and post-tests, while non-test techniques include observation, interviews, document analysis, and questionnaires or surveys. Data collection techniques in this research included (1) tests (pre-tests and post-tests) aimed at measuring students' ability to understand reading before and after using augmented reality-based learning media, (2) observations to observe student involvement in learning with augmented reality-based learning media, (3) interviews to obtain further information from teachers regarding the effectiveness of learning media, (4) questionnaires to collect data on student and teacher responses, as well as validation from media experts and material experts, and (5) documentation to support research results with photographic evidence, test results, and evaluation records.

Data analysis in this research used quantitative and qualitative methods, as follows: (1) a normality test was used to determine whether the pre-test and post-test data were normally distributed, (2) a paired sample t-test was used to analyze whether there was a significant difference between the pre-test and post-test results, and (3) an n-gain test was used to measure the increase in student learning outcomes after using the *Ketep Pass* Magelang picture book media based on augmented reality. Using this research method is expected to produce valid, feasible, and practical learning assessments to improve the reading comprehension of the fourth-grade students at SD Negeri Banyuroto 1 Magelang.

Results

Design of learning media development for picture books about Ketep Pass based on augmented reality

The data from the teacher needs questionnaire were interpreted descriptively. The questionnaire filled out by the class IV B teachers of SD Negeri Banyuroto 1 Magelang found that students still had difficulty understanding information texts in the Indonesian language subject. This difficulty indicates that the learning carried out so far has not been fully effective in helping students understand information texts well. Teachers stated that the available learning resources were not sufficient to support learning. This indicates that textbooks and other teaching materials still need to be completed or updated to suit students' needs better. In addition, the questionnaire data shows that teachers have not used media in learning. Students tend to get bored quickly when learning information texts, mainly if they only rely

on conventional teaching materials such as printed books without any additional interesting media.

In line with these problems, teachers need additional teaching materials and innovative learning media. One form of learning media proposed is an augmented reality-based picture book. From the questionnaire results, teachers agreed that learning media should be developed in this form because it can improve student understanding and make the learning more interactive and enjoyable. Augmented reality can help students become more interested in reading and understanding material through attractive and interactive visual elements. Teachers emphasize the importance of compiling systematic and easy-to-understand materials. Teachers also want the learning media developed to have a clear structure, including learning objectives, material explanations, and evaluations based on the learning outcomes that have been set so that students can understand information texts more focused and in-depth.

Using simple language but still following language rules will help students understand the contents of the story and information text better. In addition, teachers also want to learn media that have attractive images and color designs. This aims to increase students' interest in reading so that they are more motivated to learn and understand the material presented.

Based on the teacher needs questionnaire results, the following points were obtained as a reference for researchers in designing picture books based on augmented reality: (1) Augmented reality-based picture books must be interactive and engaging to help students understand information texts more effectively. (2) Augmented reality technology must be flexible and used independently or with teacher guidance. (3) The material is arranged systematically, starting from learning objectives and material explanations to evaluations. (4) The language used must be standard, by Indonesian language rules, and easy for students to understand; (5) the book design must be attractive with illustrations and colors that increase student appeal; and (6) the design of the augmented reality animation is arranged in an attractive manner and as similar as possible to the *Ketep Pass* location.

The information text material compiled by researchers based on the local wisdom of *Ketep Pass* in Magelang and the geographical beauty of Mount Merapi is designed to provide a more contextual learning experience for students. This augmented reality-based picture book provides a story describing the uniqueness of *Ketep Pass* as an educational tourist destination, with information about the history, location, and natural beauty around *Ketep Pass*. Students learn to understand the information text in theory and can relate it to the surrounding environment, making learning more meaningful. The visualization in the book is attractive, with colorful illustrations and augmented reality elements where students can see the Mount Merapi museum, observe the mountain scenery through the observation post, camp, and explore outbound tourism at *Ketep Pass*. Through technology integration, this book is expected to increase students' learning motivation and help students understand the structure of the information text better. This picture book is presented in digital/electronic form with an attractive design, equipped with a QR code that can be accessed using the Assemblr EDU application so that students can explore the material digitally and interactively.

The following is a display of the *Ketep Pass* picture book based on augmented reality, designed using the Canva and Assemblr EDU applications.

Table 1. Preliminary content



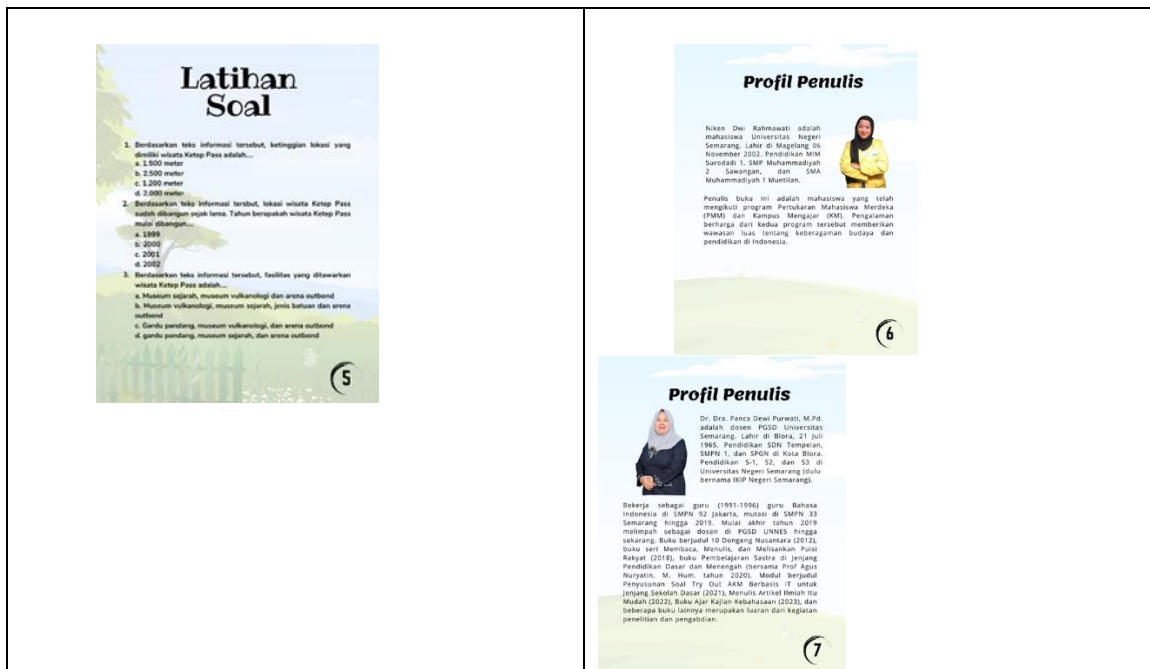
The first part covers the *Ketep Pass e-Cergam* based on augmented reality, which was designed by considering the characteristics of elementary school students so that it looks attractive, educational, and appropriate for elementary school age. The book cover has a clear identity, including the title, logo, class, and author's name, making it easier for students to recognize and use this *e-Cergam*. Instructions for using the augmented reality *e-Cergam* function to help users understand how to access and utilize the available interactive features. These instructions can be used optimally to make the learning experience more interesting, interactive, and enjoyable. The foreword contains the background of creating the *e-Cergam*, hopes that students will use it, and appreciation to those who have contributed to its preparation. The table of contents contains the arrangement of the material in this *e-Cergam* so that readers can easily find the topics they need.

Table 2. Content of the book



In this e-*Cergam*, learning achievements and learning objectives have been adjusted to the learning tools that have been prepared. Learning achievements contain competencies that students are expected to master after studying the material on identifying information texts in this e-*Cergam*. This page has supporting images that display the natural beauty and various tourist attractions in *Ketep Pass*, such as views of Mount Merapi, observation posts, and available educational facilities. To facilitate access to the augmented reality feature, each QR code included in this e-*Cergam* is given special instructions, such as scanning the QR code using a device that supports augmented reality or clicking on the available link.

Table 3. Post content



At the end of the material, there are practice questions designed to measure students' understanding of the material that has been studied. The last page of this e-*Cergam*, presents the author's profile, including the researcher's and supervisor's profiles.

Results of validation test of development of Ketep Pass picture book learning media based on augmented reality

Validation of the feasibility of product assessment using the *Ketep Pass* Magelang E-*Cergam* learning media was done by two expert validators: material and media experts. The expert validators provided assessments, suggestions, and input on the media developed by the researcher. The expert validators provided input and suggestions on the model so the media could be adequately tested. Validation was carried out using a questionnaire instrument approved by the supervising lecturer to be used as a reference in assessing the feasibility of the material and media, which the validator would then fill in.

Validation of the feasibility of the material in the *Ketep Pass* picture book learning media based on augmented reality was carried out by lecturers of elementary school teacher education, Faculty of Education and Psychology, UNNES. Material experts assessed five aspects: the suitability of the material (four statements), the accuracy of the material (three statements), the benefits of the material (two statements), the language (four statements), and the presentation (two statements).

The assessment by material experts was carried out by calculating the total score based on a Likert scale, where a score of 4 indicates a very good category, a score of 3 is good, a score of 2 is quite good, and a score of 1 is not good. The score is processed as a percentage, with 76% - 100% highly feasible, 51% - 75% feasible, 26% - 50% quite feasible, and 0% - 25% not highly feasible.

The results of the material expert assessment of the *Ketep Pass* picture book learning media based on augmented reality are presented in the following table.

Table 4. Results of the material expert validation questionnaire

No	Assessment aspect	Total score	Percentage	Criteria
1.	Suitability of material	16	100%	Highly feasible
2.	Accuracy of material	9	75%	Feasible
3.	Benefits of material	8	100%	Highly feasible
4.	Language	14	87.5%	Highly feasible
5.	Presentation	7	87.5%	Highly feasible
The average percentage of material suitability in AR-based picture books 90%			90%	Highly feasible

Based on the results of the validation questionnaire, it was obtained that the material in the *Ketep Pass* picture book learning media based on augmented reality had an overall average of 90%, which was included in the criteria of "highly feasible." The assessment was carried out based on five aspects, namely, the material's suitability, the material's accuracy, the material, the benefits of the material, language, and presentation. Considering input and suggestions for improvement from the material expert validator, this learning media was declared feasible to apply in the field. Based on suggestions from the material expert validator regarding the *Ketep Pass* picture book learning media based on augmented reality, improvements were made regarding the content of the material or the *Ketep Pass* Magelang story reading, where paragraph sentences need to be made into effective sentences that are not convoluted.

Meanwhile, validation of media suitability in the *Ketep Pass* picture book learning media based on augmented reality was carried out by lecturers of elementary school teacher education, faculty of education and psychology, UNNES. The material experts assessed three aspects: the suitability of the media's five statements, the appearance of six statements, and the use of four statements. The assessment by media experts was carried out by calculating the total score based on the Likert scale, where a score of 4 indicates a very good category, a score of 3 is good, a score of 2 is quite good, and a score of 1 is not good. The score is processed as a percentage with 76% - 100% highly feasible provisions, 51% - 75% feasible, 26% - 50% quite feasible, and 0% - 25% not good.

The results of the media expert assessment of the *Ketep Pass* picture book learning media based on augmented reality are presented in the following table.

Table 5. *Results of media expert validation*

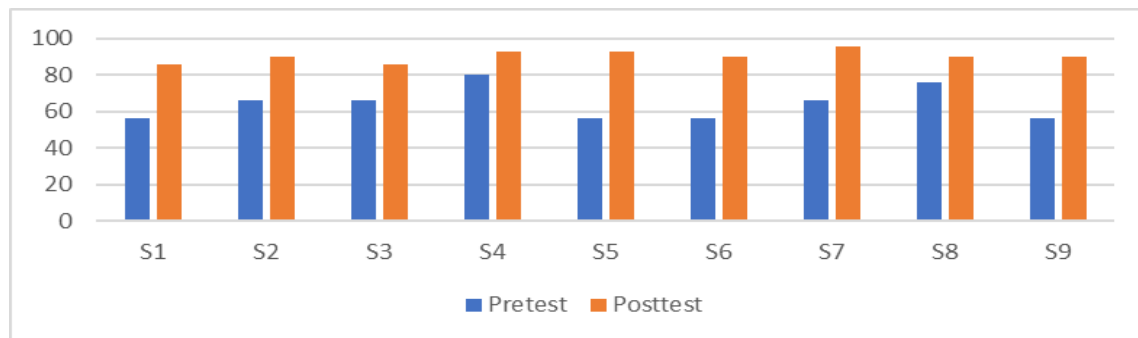
No	Assessment aspect	Total score	Percentage	Criteria
1.	Media suitability	20	100%	Highly feasible
2.	Appearance	21	87.5%	Feasible
3.	Usage	15	93.75%	Highly feasible
The average percentage of media suitability in AR-based picture books			93.3%	Highly feasible

Based on the results of the validation questionnaire, it was obtained that the media in the *Ketep Pass* picture book learning media product based on augmented reality had an overall average of 93.3%, which was included in the criteria of "highly feasible." The assessment was based on five aspects: media suitability, appearance, and use. By considering input and suggestions for improvement from expert media validators, this learning media product was declared feasible to apply in the field.

Effectiveness test results

The effectiveness test results on small groups were obtained through the analysis of pre-test and post-test scores conducted before and after the use of learning media. The data collected showed differences in values as indicators of increased student understanding after participating in learning with the *Ketep Pass* picture book based on augmented reality. Details of the pre-test and post-test results are presented as follows.

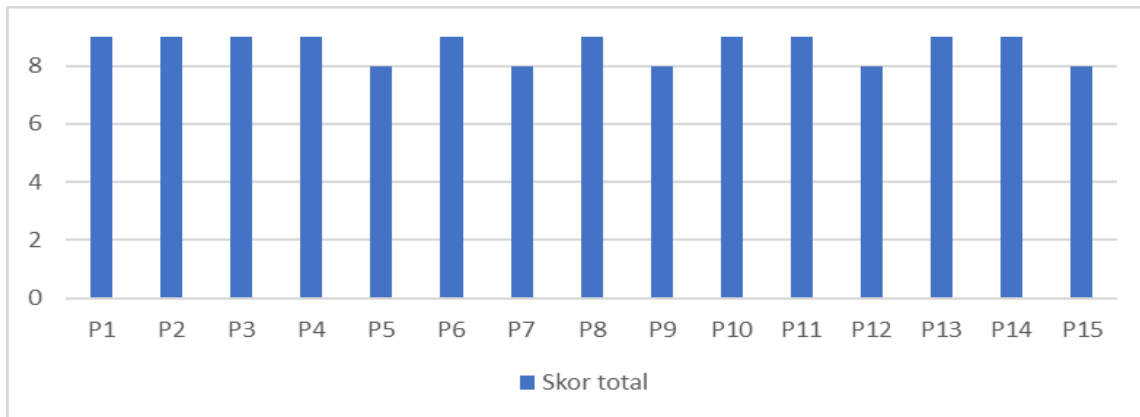
Figure 1. *Learning results of pre-test and post-test small groups*



The figure above shows a significant increase in students' pre-test and post-test scores. Two students scored above 70, while the remaining seven scored below 70. In the post-test assessment, it is known that all students scored above 70 with the *KKTP* criteria stated in the good (80-89) and very good (90-100) categories.

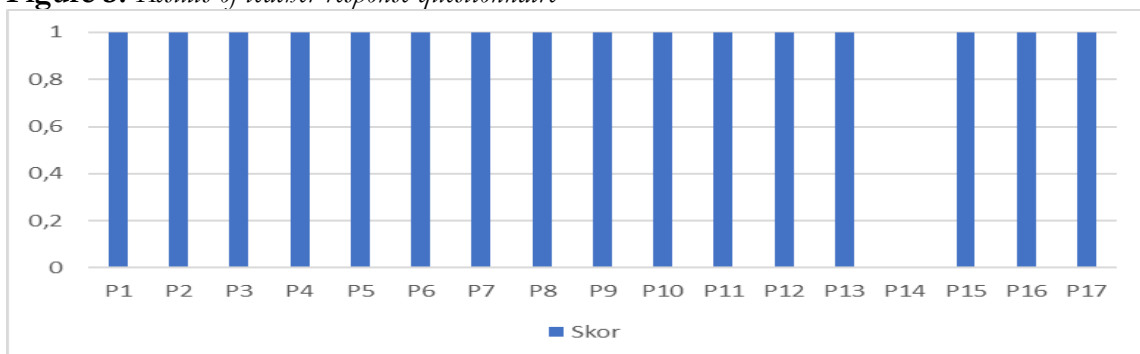
The results of the student response questionnaire, which was administered during the product trial in small groups, were used to determine the feasibility of the product developed by the researcher before the product was used for research. The total score from the small group trial was 130 out of a maximum score of 135. The percentage obtained was 86.7%, with a highly feasible category. The recapitulation of the results of the student response questionnaire for the small group product trial for each aspect can be seen in the following figure.

Figure 2. *Obtaining the results of the student response questionnaire*



In addition to providing a questionnaire to students, researchers can provide a questionnaire to teachers. The teacher's questionnaire contains 17 questions using the Guttman scale: "yes" or "no." If the answer is "yes", it gets a score of 1; if the answer is "no," the score is 0. Based on the teacher's response questionnaire results in the small group trial, the total score was 16 out of a maximum score of 17. The percentage obtained was 94%, with a very decent category. A recapitulation of the results of the teacher's response questionnaire in the small group product trial for each aspect can be seen in the following figure.

Figure 3. *Results of teacher response questionnaire*

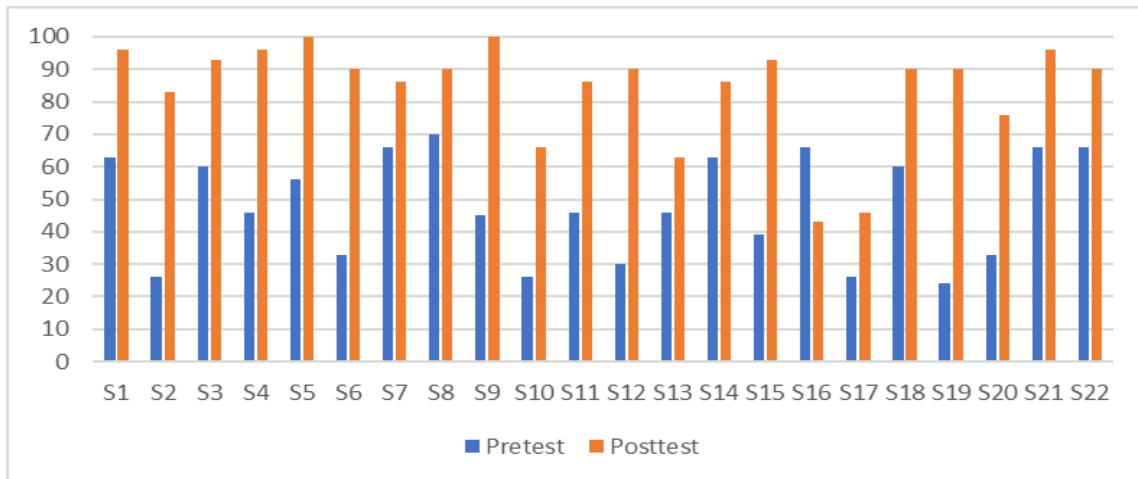


The large group product trial sample was conducted on all students of class IV B of SD Negeri Banyuroto 1 Magelang, namely 22 students. The significant group effectiveness trial

results were obtained by analyzing the pre-test and post-test scores conducted before and after using learning media. The pre-test and post-test cognitive assessment included levels C3 to C6 with various question forms to measure students' understanding of the material. Questions 1 to 5 were in the form of single multiple choice with a total score of 5, and questions 6 to 10 were in the form of complex multiple choice with the same score, namely, 5. Questions 10 to 15 used the matching form with a score of 5, and questions 16 to 20 were true/false with a score of 5. Questions 21 and 22 were filled in with fill-ins with a total score of 10. The final score was obtained from the total score obtained by the students, then divided by a maximum score of 30, and then multiplied by 100 to get the percentage of the final score.

The collected data shows the difference in values as an indicator of increased student understanding after participating in learning with the *Ketep Pass* picture book based on augmented reality. Details of the pre-test and post-test results are presented as follows.

Figure 4. Results of the large group pre-test and post-test assessment



The figure above shows a significant increase in students' pre-test and post-test scores. The data shows that one student scored 70, while the remaining 21 got below 70. According to the criteria in *KKTP* interval, 21 students need guidance on the results of the pre-test assessment. In the post-test assessment, it is known that three students got a score below 70, while 19 others got a score above 70 with the *KKTP* criteria stated in the category of relatively good (70-79), good (80-89), and very good (90-100).

Based on the results of the pre-test and post-test scores, it can be seen that learning outcomes increased from the pre-test score to the post-test score, with the average passing *KKTP* increasing from 4.5% to 86.3%, with a difference in increase of 81.8%. Therefore, using *Ketep Pass* picture book learning media based on augmented reality has proven effective in improving the understanding of information texts in class IV of SD Negeri Banyuroto 1 Magelang.

Normality test

Based on the results of SPSS 29 data processing in the small group trial, the sig. The pre-test value was 0.064, and the sig. The post-test value was 0.311 with the sig. Pre-test and post-test results > 0.05 so that the data from the small group's pre-test and post-test values can be said to be normally distributed. The normality test results in the significant group test were obtained—pre-test results of 0.531 and post-test results of 0.613 with sig. Pre-test and post-test > 0.05 means that the data from the pre-test and post-test values of the large group trial are normally distributed.

Table 6. Results of the SPSS 29 normality test

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest_KelompokKecil	.208	9	.200*	.844	9	.064
Posttest_KelompokKecil	.223	9	.200*	.909	9	.311
Pretest_KelompokBesar	.168	9	.200*	.935	9	.531
Posttest_KelompokBesar	.157	9	.200*	.943	9	.613

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

T-test

The paired sample T-test is a method used to compare two groups of means from two paired samples, where the same subject receives different treatments. Hypothesis testing is carried out using paired sample T-test analysis using the SPSS 29 program. Decision-making is done by interpreting the SPSS t-test output results as follows: If the sig. (2-tailed) value > 0.05 , then H_0 is accepted, and H_a is rejected, which means there is no difference in the average student learning outcomes between before and after treatment. If the sig. (2-tailed) value is < 0.05 , then H_0 is rejected, and H_a is accepted, which means there is a difference in the average student learning outcomes between before and after treatment (Sujarweni, 2014). H_0 = There is no difference in the average learning outcomes of students before and after using the *Ketep Pass* picture book learning media based on augmented reality. H_a , there is a difference in the average learning outcomes of students before and after using the *Ketep Pass* picture book learning media based on augmented reality. Based on the SPSS 29 application, the results of the paired sample T-test for small groups were obtained; the sig. value (2-tailed) was obtained at 0.000, which is $0.000 < 0.05$. Based on the basis for decision-making in the paired sample t-test, there is a difference in the average learning outcomes between the pre-test and post-test in the small group test.

Table 7. Results of the paired sample t-test for small groups

		Paired Samples Test							
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
Pair					Lower	Upper			
1	Pretest - Posttest	-26.222	8.899	2.966	-33.063	-19.382	-8.840	8	.000

Based on the SPSS 29 application calculations, the results of the paired sample T-test for the large group were obtained; the sig. (2-tailed) value was obtained at 0.000, which is $0.000 < 0.05$. Based on the basis for decision-making in the paired sample t-test, there is a difference in the average learning outcomes between the pre-test and post-test in the large group test.

Table 8. Results of the paired sample t-test for the large group

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
Pair					Lower	Upper			
1	Pretest - Posttest	-38.318	16.617	3.543	-45.686	30.951	-10.816	21	.000

Based on the paired sample t-test, using the *Ketep Pass* picture book media based on augmented reality has proven effective in improving the understanding of information texts in the Indonesian language subject for the fourth grade of SD Negeri Banyuroto 1 Magelang.

N-Gain test

Based on the results of the N-Gain test on the small group product trial, the N-Gain score was 0.71977619 with high criteria, and the results of the N-Gain test on the large group product trial obtained an N-Gain score of 0.738219835 with high criteria. The following are the results of the N-Gain test on the small and large group product trials.

Table 9. Results of the *n-gain* test pre-test and post-test values

Group	Pre-test average	Post-test Average	Difference Between Pre-test and Post-test Mean	<i>N-Gain Score</i>	Criteria
Small group	64.23	90.45	26.22	0.71977619	High
Large group	48	86.5	38.5	0.738219835	High

Discussion

Analysis of the development of Ketep Pass picture book learning media based on augmented reality

Based on the results of research on the development of *Ketep Pass* picture book learning media based on augmented reality using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development procedure at SD Negeri Banyuroto 1 Magelang, it was found that students had difficulty understanding information texts due to the lack of interesting learning media. The teacher also said that the available learning resources were ineffective in helping students understand information texts. From the results of the needs questionnaire, it is known that students are more interested in media with an attractive and interactive visual appearance. Therefore, the development of picture book-based learning media with augmented reality features was chosen as a solution to improve student understanding. This aligns to Darmawan et al. (2024) that found that augmented reality can improve student understanding.

Dargan et al. (2023) stated that augmented reality helps take the real world as a basis by combining several virtual technologies and adding contextual data to clarify user understanding. Contextual data in written text, images, audio, location information, historical context, or other forms helps increase understanding of the surrounding environment, combining virtual and real environments into new interfaces and displaying relevant information. This can help in various fields such as training, repair, maintenance, manufacturing, military, games, and entertainment. As well as education, an intermediary tool between educators and students in learning that can connect, provide information, and channel messages to create an effective and efficient learning process.

Feasibility analysis of augmented reality-based Ketep Pass picture book learning media

Material and media experts assessed the results of the feasibility validation of the augmented reality-based *Ketep Pass* picture book learning media. Material experts were assessed based on five main aspects: material suitability, material accuracy, material benefits, language, and presentation. The augmented reality-based *Ketep Pass* picture book learning media has a very high feasibility level, with an average percentage of 90%. This shows that the material presented in the learning media has met the standards required for use in learning.

One aspect that needs attention is the accuracy of the material, which received a score of 75%. Although included in the feasible category, there is still room for improvement,

especially in ensuring that all information presented is from credible sources and is relevant to students' needs. In addition to material validation, validation of the media aspect is also carried out to ensure that the appearance and use of the media are by the standards required in learning. The validation results obtained a value of 93.3%, which shows that the design and visualization in this media are good, although they can still be improved. This media is easy to use by students and educators in teaching and learning activities.

The media validation results conclude that the *Ketep Pass* picture book based on augmented reality can be applied in Indonesian language learning to understand information texts in class IV of SD Negeri Banyuroto 1 Magelang. Improvements made based on input from the validator will further improve the quality of this media, especially in terms of ease of use and visual appearance. Based on these results, it shows that the development of learning media is by the nature of the learning media itself, namely to help teachers make it easier to convey lesson materials to students to facilitate the achievement of the learning objectives that have been formulated. [Ediyani et al. \(2020\)](#) defined learning media as all forms of intermediaries that exist and are used by someone who disseminates ideas so that ideas or ideas reach the recipient. Therefore, media is often used to make it easier for teachers to convey messages or information to students so that the material can be received well and used as a complement and supplement in the learning process. As a means of communication between educators and students, media is the primary key to conveying messages or information efficiently, facilitating understanding, providing a pleasant experience, and being helpful in meeting student needs.

Analysis of the effectiveness of the Ketep Pass picture book learning media based on augmented reality

The effectiveness of the *Ketep Pass* picture book learning media based on augmented reality can be seen through student learning outcomes in the form of increased pre-test and post-test scores. Based on the analysis conducted by the researcher, it can be seen that in learning to identify information texts with the application of the *Ketep Pass* picture book learning media based on augmented reality, the average learning outcome was initially 48 in the pre-test and increased in the post-test by 86.3, with the percentage of students who completed also increasing from initially 4.5% to 86.3%. Therefore, there was an increase of 81.8%.

The pre-test and post-test values were tested using a T-test to determine and test the differences in the pre-test and post-test averages. The t-test used in this research is the paired sample t-test, which compares two groups of means from two paired samples with the same subject but with different treatments. The results of the t-test calculation obtained the sig. value (2-tailed) of $0.000 < 0.05$, which can be interpreted as H_0 is rejected and H_a is accepted, which means that there is a significant difference in the average learning outcomes of students before and after using the *Ketep Pass* picture book learning media based on augmented reality in the research.

The N-Gain test was conducted to provide a general overview of the improvement in student learning outcomes before and after treatment or to determine the improvement that occurred in the average student learning outcomes before and after the *Ketep Pass* picture book

learning media based on augmented reality was used in learning to identify information texts. The results of the N-Gain test in this research showed that the calculation results obtained an N-Gain score of 0.738219835 with high criteria, which means that there is a significant difference in the average between before using and after using the *Ketep Pass* picture book learning media based on augmented reality. Several variables influence different student learning outcomes. According to Bhatti and Rasli (2017), students' internal and external conditions include physical conditions, such as physical health; psychological conditions, such as intellectual and emotional abilities; and social conditions, such as the ability to socialize with the environment. Teachers must see students' abilities within themselves and external stimulus situations to learn well.

Augmented reality-based *Ketep Pass* picture book learning media has proven effective in improving students' understanding of informational texts. These results align with Novitasari and Qurrotaini (2024), whose the similarity lies in developing augmented reality-based learning media in picture books. Both utilize augmented reality technology as an interactive tool to enhance students' learning experiences. However, the difference lies in the focus of the subjects studied; where this research focuses on the Indonesian language subject to improve students' understanding of the contents of the messages in the informational text,

In addition, Dewi and Fransyaigu (2024) also showed similarities with this research. Both research aims to produce learning aids that can improve the reading comprehension of the fourth-grade elementary school students through augmented reality technology. This research indicates that the development of augmented reality-based learning media is efficient and effective in helping students understand a reading. However, there are differences in the types of media used. The research used story media in the form of comics, while this research uses information text in picture books. In addition, this research was developed using the research and development (R&D) method with the ADDIE (Analyze, Design, Development, Implementation, Evaluation) model. It was tested on a limited basis on fourth-grade students as part of the learning media's evaluation and refinement stage.

Conclusion

The *Ketep Pass* picture book media design based on augmented reality was developed based on the needs of teachers and students in learning. The development of the *Ketep Pass* picture book media based on augmented reality is in the integration of local wisdom content in information texts. The development of the *Ketep Pass* picture book media based on augmented reality aims to improve students' reading comprehension skills in the material and help them understand the contents of messages and information in information texts.

The results of the assessment of the *Ketep Pass* picture book media based on augmented reality received a score of 93.3 from media experts (highly feasible) and 90 from the original material (highly feasible). These results state that this media is highly feasible for learning the learning outcomes (CP) of reading and viewing. Students can understand information about everyday life in printed or electronic form.

The effectiveness of the *Ketep Pass* picture book media based on augmented reality is known from the increase in pre-test and post-test scores. In the small group, the average pre-test score of 22% increased to 100% in the post-test, while in the large group, the average pre-

test score of 4.5% increased to 86.8%. The normality test showed the data was normally distributed (sig. pre-test and post-test, > 0.05). The results of the paired sample T-test and Wilcoxon tests confirmed significant differences before and after using the *Ketep Pass* picture book media based on augmented reality. Then, the N-Gain test in the small group showed a score of 0.71977619 (high category), and in the large group showed a score of 0.738219835 (high category), proving that the *Ketep Pass* picture book media based on augmented reality is efficacious in improving students' reading comprehension.

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