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## Development of Flashcard Media Assisted by Augmented Reality in Improving Learning Outcomes in Learning IPAS

## Dwi Putri Diani<sup>1\*</sup>, Desi Wulandari<sup>1</sup>

<sup>1</sup>Elementary School Teacher Education, Faculty of Education and Psychology, Universitas Negeri Semarang, Semarang, Indonesia.

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Corresponding Author: Dwi Putri Diani dwiputridianii@gmail.com

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Abstract: The low learning outcomes of science material on the Human Respiratory System and the lack of application of learning media in the learning process are certainly a complex problem in science learning in elementary schools. The purpose of this study was to determine the development design, feasibility, and effectiveness of media Flashcard assisted by Augmented Reality for grade V students of SDN 01 Kajen. This research is a Development and Research (R&D) with the ADDIE development model, which consists of five stages namely analysis, design, development, implementation, and evaluation. The results of this study indicate that media Flashcard assisted by Augmented Reality is suitable for use in elementary schools. The results of material validation showed an average value of 90% with the category "Very Feasible", while the results of media validation obtained an average value of 96% with the same category. The use of media Flashcard assisted by Augmented Reality proved effective in improving IPAS learning outcomes on Human Respiratory System material with the percentage of posttest reaching 85.68%, while the pretest only reached 50.00%.

**Keywords:** Augmented reality; Flashcard; Human respiratory system; Learning media; Learning outcomes; Media

### Introduction

Learning is an action taken by the teacher to help students acquire knowledge and build attitudes and beliefs. Learning plays a very crucial role in improving the quality of education (Dharmayanti, 2019). In the independent curriculum, the learning approach focuses on students (*Students Cantered Learning*), where students are invited to solve problems, answer questions, and formulate their own questions. In this context, the role of teachers as facilitators is very important to arouse students' enthusiasm and attract their interest in the material being studied.

The curriculum is the core of education that cannot be separated from each other. Curriculum according to (Kamiludin & Suryaman, 2017), is a collection of educational programs designed and implemented to achieve specific learning goals. Each program consists of interrelated and cooperative sections. The curriculum has a very important role in various educational efforts, according to Hidayani (2018). The curriculum must have the ability to improve quality standards so that it can be used as a basis for setting educational goals.

According to the Regulation of the Minister of National Education No. 20 of 2006, Natural Sciences (IPA) is one of the main subjects in the educational curriculum in Indonesia, including at the elementary school (SD) level. The success of science learning in elementary school can be measured by achieving all the learning goals that have been set. In the independent curriculum, the subject of Natural Sciences (IPA) has been replaced by the subject of Natural and Social Sciences (IPAS). It is hoped that through learning science sciences, students will gain a better understanding of themselves and their surroundings, and they will also

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have the opportunity to apply this knowledge in their daily lives.

Teachers have an important role in helping students achieve their social science learning goals according to their abilities. Hands on experience or practical examples can help students improve their abilities during the learning process. IPAS learning is a technical activity that can be divided or integrated into separate sessions (Viqri et al., 2024). Thus, students can recognize and understand their surroundings scientifically through concrete experiences.

The importance of social studies learning for students makes teachers need to design interesting teaching methods. A teacher must be able to create innovative learning methods to meet the needs of students so that learning becomes interesting (Mariyana, 2020). The use of learning media is one of the creativity that can be used by teachers. Many things affect the success of the learning process; This includes teachers, students, media, and learning environments (Al-Maroof & Al-Emran, 2018). In addition, teachers must be able to encourage students to build clear and concrete concepts during learning (Juwantara, 2019). Therefore, teachers are required to present learning materials well, teachers must also be able to choose learning methods and media that are not only suitable for use but also consider various aspects. Thus, it is hoped that the learning media used will be effective in the learning process and suitable for use (Ervan et al., 2020).

Learning media is very important for the learning process in schools. With learning media, teachers can more easily convey material and students will feel more comfortable in learning (Ilmi et al., 2020; Maryanti & Kurniawan, 2018). Learning media is a tool, both physical and non-physical, which is deliberately used as an intermediary between educators and students to facilitate students understanding of the subject matter (Hamka & Effendi, 2019). Learning media plays a very important role in increasing creativity for both teachers and students. The use of technology in education not only enriches the learning experience, but also contributes to improving the overall quality of education, as well as helping to meet the demands of continuous technological developments (Antara & Dewantara, 2022).

The use of media in learning makes it very easy for teachers to convey material, because media can concretize various abstract concepts (Arnandi et al., 2022). This certainly helps students to better understand the material presented. Therefore, learning media is an important aspect of the entire learning process and is a field that must be mastered by every teacher in carrying out their professional duties. In learning IPAS, there are a number of problems that often arise. One of them is that students do not concentrate when listening to the teacher's instructions. They also have difficulty finding examples that are relevant to the material being taught. On the contrary, teachers and students face difficulties in visualizing according to the material. Students lack understanding of the learning material because of these challenges. One of the causes of this problem is the lack of use of learning media.

Based on the results of observations and interviews with homeroom teachers of class V at SDN 01 Kajen, it was shown that of the 28 students who took part in social science learning, 21 students (75%) showed low learning outcomes, and 7 students (25%) managed to achieve the Minimum Completeness Criteria (KKTP) on human respiratory system material. This condition is influenced by two factors, namely students do not understand the material taught by the teacher and the lack of use of learning media. The media used today is still limited to the concrete media that are around us, such as torso when learning about the organs of the human respiratory system. As a result, students may easily forget and feel bored while studying. Therefore, a more interesting and innovative learning media is needed, which can increase students' interest in learning. Thus, the learning process is expected to be more active and effective.

One solution to overcome these problems is to develop innovative, creative, and interesting technology-based learning media. The use of this learning media is expected to increase students' interest and motivation, so that in the end it can improve their learning outcomes.

Based on the above solution, it can be done by developing learning media in the form of media *Flashcard* on the material of the human respiratory system. The development of this media aims to create a more engaging learning environment, which in turn can help the learning process effectively. *Flashcard* is a tool for learning which consists of an 18 x 12 cm card equipped with a (Wati & Oka, 2021). *Flashcard* can also be adjusted to smaller or larger sizes (Stefani & Samsiyah, 2021). Media *Flashcard* has an advantage in improving the right brain's memory of the images and words contained in it (Wahyuni, 2020). From this opinion, it can be concluded that *Flashcard* is a small card that contains images, text, or symbols related to a subject.

Researchers using media *Flashcard* assisted by *Augmented Reality* because SDN 01 Kajen provides *Chromebooks* to students during the learning process. But *Chromebooks* is still rarely used in schools. Therefore, to maximize the use of *Chromebooks*, the researcher uses

Augmented Reality. Augmented Reality is a technology that depicts digital objects in the real world so that they appear to be real (Permana et al., 2023). Text, video, audio, and other types of images can be displayed in Augmented Reality (Adrian et al., 2020). Augmented Reality be able to display 3D objects using flashcards or markers that can be created dynamically, so that the object can change according to the situation or the development of time and markers that facilitate the use of man-made or natural objects, such as images as identifiers Augmented Reality (Nirwanto et al., 2021).

Technology *Augmented Reality* can enrich the student learning experience (Kamiana et al., 2019). *Augmented Reality* technology is increasingly popular in the world of education, especially in the teaching of abstract concepts (Sirakaya & Cakmak, 2018). With the use of this media, it is hoped that students will be interested and can experience new and meaningful learning experiences. The research that supports the solution of this problem is the research carried out by (Abdilah & Wulandari, 2024; I. M. Dewi & Setyasto, 2024; P. S. Dewi & Kuswanto, 2023; Frasnyaigu et al., 2023; Rahayu & Wulandari, 2024; Rahmawati & Kamaludin, 2024; Safitri et al., 2018; Sari et al., 2023; Syawaludin et al., 2019).

Based on the results of this study, it can be concluded that the use of *Flashcards* assisted by *Augmented Reality* has a positive impact on improving student learning outcomes. However, previous studies have not specifically developed media *Flashcard* assisted by *Augmented Reality* s for human respiratory system materials with the aim of improving the learning outcomes of grade V students in elementary school. Therefore, this research was conducted with the title "Development of *Flashcard* Media Assisted *by Augmented Reality* in Improving Learning Outcomes in Class V Science Subjects at SDN 01 Kajen Pekalongan".

## Method

The type of research used is research and development. Research and Development Methods is a way to create a specific product and test how effective it is (Sugiyono, 2020). This research concentrates on making *Flashcard* assisted by *Augmented Reality* technology. The process of making a Flashcard requires steps that are tested or validated by media experts and learning materials

In this research, a development research design based on the ADDIE model was used. This model was introduced by Professor Robert Maribe Branch, an expert in the fields of learning, design, and technology, in his book published in 2009 entitled "Instructional Design: The ADDIE Approach". The ADDIE model consists of five stages, namely analysis, design, development, implementation, and evaluation.

The analysis stage aims to evaluate needs which include an assessment of the needs of teachers, students, facts, concepts, procedures of learning materials, and the learning objectives themselves. In addition, this stage also aims to collect the data needed in the development of learning media *Flashcard* assisted by *Augmented Reality* that focuses on human respiratory system materials.

In this study, the product design will be prepared with the help of the Canva application. This design stage is the process of creating a visualization of learning media that includes various elements of the product to be developed.

The development stage is an important phase that involves making products according to the initial design and carrying out the validation process. Once the product has been developed, it will be evaluated by a material expert and a media expert to obtain constructive input and suggestions.

Furthermore, in the implementation stage, at this stage the product trial was carried out on class V teachers, small groups, and large groups. Once the limited and extensive trial is complete, the results must be evaluated to be used as a reference for revision.

The final stage in product development is evaluation. At the trial stage, the media is expected to affect the material of the human respiratory system. However, if the results do not meet expectations, then it is necessary to make notes to improve the media to meet the expected conditions.

The main goal of the research is to create a specific product, aligned with the chosen approach and development. For initial data collection in the field, the method used is more qualitative. However, for the product feasibility testing stage, we use a quantitative experimental method. The data collected will be analyzed through a qualitative-narrative approach and quantitative calculations.

The subject of the research is the subject that is the focus of the research by the researcher (Arikunto, 2020). The subject of this study involves teachers and 28 grade V students at SDN 01 Kajen, Pekalongan Regency, in the 2024/2025 school year. Of these, there are 12 female students and 16 male students.

In this study, data collection techniques are carried out using test and non-test methods to obtain accurate information about the effectiveness of *Flashcard* assisted by *Augmented Reality* in learning IPAS. The test method includes the implementation of pre-test with the aim of finding out how well students understand the material to be taught and post-test to find out if student learning outcomes are improving and how well they master the material. Meanwhile, non test nethods involve observation, interviews, questionnaires, and documentation to collect additional information related to the learning process. To ensure the validity of the media being developed, the research instrument also involves validation by media experts, material experts and related practitioners.

In this study, product trials are carried out by measuring what will be measured, both validity and reliability, the research must be designed very carefully and thoroughly, especially when preparing the right and quality measuring instruments. Data analysis is carried out through three main stages. The first stage is the initial data analysis, which is carried out descriptively to identify the needs of teachers and students for Flashcard assisted by Augmented Reality. Furthermore, at the stage of product data analysis, media feasibility testing and feedback collection from teachers and students were carried out, by calculating percentages and classifying assessment results. Finally, the final data analysis includes a normality test to determine the distribution of data, a t-test to compare the results of the pretest and posttest, and an N-gain test which aims to measure the effectiveness of learning media in improving student learning outcomes.

## **Result and Discussion**

Development of Media Flashcard Assisted by Augmented Reality

Researchers used ADDIE's research and development procedures to develop *of media Flashcard assisted by Augmented Reality* in class V science and technology content, according to Robert Maribe Branch, professor of learning, design, and technology, in his book entitled "Instructional Design: The ADDIE Approach". The ADDIE model has 5 stages, namely analysis, design, development, implementation, and evaluation.

In the analysis stage, the researcher identified the problems at SDN 01 Kajen by conducting observations, interviews with teachers, and analyzing student learning outcomes. The results show that the lack of concrete understanding of students is caused by the limitations of learning media. In addition, teachers face difficulties in delivering science and technology material which is quite complicated. Therefore, the development of new media that can increase students understanding and motivation is needed. Therefore, the development of innovative media that can increase student motivation and understanding is needed.

The design stage includes the creation of of media *Flashcard* assisted by *Augmented Reality* technology, using the Canva and Assemblr Edu platforms. *This*  *Flashcard* is equipped with images, explanations, and QR Codes that facilitate digital access through *Augmented Reality*. With a total of 26 pages and two main subthemes, this medium is designed to improve student interaction in the learning process.

At the development stage, media *Flashcard* assisted by *Augmented Reality* are designed using Canva and Assemblr Edu. They are also equipped with QR Codes for easy digital access. The following is the development of media *Flashcard* assisted by *Augmented Reality*.



**Figure 1.** Overall view of media *flashcard* assisted by *augmented reality* 



Figure 2. Media *flashcard* assisted by *augmented reality* front view



Figure 3. Rear view of media *flashcard* assisted by *augmented reality* 



Figure 4. Augmented reality display



Figure 5. Augmented reality QR code display

Media Flashcard assisted by Augmented Reality Eligibility Assessment

The feasibility assessment of media *Flashcard* assisted by *Augmented Reality* is carried out through validation by media experts, material experts, and through questionnaires from teachers and students. In this case, validators of media and material experts play an important role in providing assessments on technical aspects and the use of media in learning (Zulfa et al., 2019). This media has been validated by two experts and assessed using the Likert scale. Furthermore, the products that have been developed are tested by media and material experts.

**Table 1.** Results of the Validation Test of Media Experts

Aspects	Total score
Learning	16
Serving	12
Interoperability	11
Display	23
Language	7
Media	8
Scores obtained	96

Table 1 the results of validation by media experts show a final score of 77, with a percentage of 96%. This indicates that the media is very worthy of being tested in the field, of course after making several improvements based on suggestions from media expert validators.

**Table 2.** Results of the Validation Test of MaterialExperts

Aspects	Total score
Learning	21
Language	12
Material	21
Scores obtained	54

Table 2 the results of material validation conducted by expert lecturers show a final score of 54 with a 90% percentage. This indicates that the media is very feasible to be tested in the field, after improvements are made based on input from material expert validators.

Based on the results of validation by media and material experts, it shows that this media is classified as "very feasible". The percentage of eligibility given by media experts reached 96%, while material experts gave an assessment of 90%.



Figure 6. Augmented reality display after revision



Figure 7. Front view of human respiratory system organ blind map *Flashcard* 



Figure 8. Back view *Flashcard* blind map of human respiratory system organs



Figure 9. Front view of efforts to maintain respiratory system health *Flashcard* 

After evaluating the feasibility of the researcher developed product, the media and material validators made notes aimed at improving media *Flashcard* assisted by *Augmented Reality*. The suggestion given by the media validator is the addition of a *Flashcard* that displays a blind map of the human respiratory organs, as well as the inclusion of a voice over feature and an *Augmented Reality* play button. Meanwhile, the suggestion from the material validator is to add *Flashcard* related to efforts to maintain the health of the respiratory organs and adjust to the learning scenario.

The implementation stage is carried out through trials in two groups, namely small groups and large groups. The small group trial involved six students of varying skill levels, while the large group trial involved 22 students. The purpose of this implementation stage is to assess the feasibility of media *Flashcard* assisted by *Augmented Reality* based on students' responses through a questionnaire that has been prepared. In addition, this

stage also aims to evaluate the extent to which students understand the use of the media. Thus, the implementation stage is an important step in testing this product to class V teachers, as well as to the two groups of students.

**Table 3.** Questionnaire of Responses of Small-ScaleTeachers and Students

Responses	Score (%)	Information
Teacher	100	Very Feasible
Student	100	Very Feasible

The results of the questionnaire conducted on the responses of teachers and students on a small scale showed a score of 17, with a percentage of 100%, which shows very good criteria.

**Table 4.** Large-Scale Teacher and Student ResponseQuestionnaire

Responses	Score (%)	Information
Teacher	100	Very Feasible
Student	96	Very Feasible

The results of the large-scale response questionnaire showed an outstanding achievement, with a total score of 17 for teachers and students. The percentage of teacher responses reached 100%, and the percentage of students reached 96%, both of which met the criteria very well.

Based on the results of the questionnaire listed in Table 3 and Table 4, it can be concluded that the responses from teachers show that this media has a feasibility percentage of 100%. Meanwhile, student responses showed a suitability rate of 100% for small scales and 96% for large scales, both of which fall into the "very feasible" category. As a result, media Flashcard assisted by Augmented Reality was rated very positive and practical based on responses to 17 Likert scale questions, of which almost all questions received a score of 1. Therefore, product revisions on product trials are not required. This is in line with previous research which showed that the response questionnaire of teachers and students with a score above 75% showed very positive results. This shows that media Flashcard assisted by Augmented Reality is very suitable for use in education (Avipa et al., 2023; S. A. Maharani & Ramadan, 2023; Ningrum et al., 2021; Putri Wangi & Gede Angung, 2021; Wijayanto & Sutriyono, 2018).

# The Effectiveness of Media Flashcard Assisted by Augmented Reality

The final stage in this process is evaluation, which aims to assess the effectiveness of the media that has been developed. Based on the results of the trial, media *Flashcard* assisted by *Augmented Reality* has proven to be feasible to use without the need for additional revisions. It is hoped that this final product can increase the effectiveness of IPAS learning and make students more active and motivated in understanding the material about the human respiratory system.

The effectiveness of development media *Flashcard* assisted by *Augmented Reality* can be assessed through student pretest and posttest score data in a large group trial. This trial was carried out by involving 22 students in class V of SDN 01 Kajen. After testing media *Flashcard* assisted by *Augmented Reality* in a large group, *pretest* and *posttest* scores were obtained which were then analyzed to measure the effectiveness of the media.

**Table 5.** Cognitive Learning Outcomes Pretest andPosttest

Action	Pretest	Posttest
Average	50.00	85.68
Highest Scores	65	100
Lowest Rate	35	70
Number of Completed Students	0	22
Learning Completeness	0%	100%

The cognitive learning outcomes of grade V students at SDN 1 Kajen showed a significant comparison between pretest and posttest scores, as shown in table 5. The average pretest score was 50.00, and the average posttest score increased to 85.68. Therefore, there is an average difference of 35.68 between the two values. In the pretest stage, no student achieved learning completion, with a percentage of zero. However, at the posttest stage, 22 out of 22 students managed to achieve learning completion, showing a hundred percent improvement for students. The data showed that there was a significant difference between the learning outcomes of students about the Human Respiratory System material in grade V of SDN 1 Kajen before and after the application of media Flashcard assisted by Augmented Reality.

To ensure the validity of the data, a normality test was carried out using Shapiro Wilk. The following are the results of *the pretest* and *posttest normality tests*:

Table	6.	Norma	lity	Test
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Parameters	Shapiro-Wil	
	N	Sig.
MoCA-Ina pre test	28	0.071
MoCA-Ina post test	28	0.135

Based on table 6, the normality test of the pretest value with the Shapiro-Wilk test assisted by the SPSS version 21 application showed sig = 0.071, while the normality test of the posttest value showed sig = 0.135. If the significance value > 0.050, the normality test

criteria is considered normal. The data is considered abnormal if the significance value < than 0.050.

The paired sample t-test was also carried out to determine the difference in the average score of the pretest and posttest. The purpose of this test is to find out how significant the difference in the average student score in the pretest and posttest is.

Table 7. Laneu 1-163	Table	7.	Paired	<b>T-Tes</b>
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Result		Paired T-Test
	Ν	Sig. (2-tailed)
MoCA-Ina pretest post test	28	<,001 reviews

According to table 7. The results showed a Sig. (2tailed) value of 0.000 (less than 0.005), which showed that there was a significant difference between the pretest and posttest results. This shows that the use of media *Flashcard* assisted by *Augmented Reality* increases students' interest in learning IPAS.

After the data is normally distributed, the N-gain test can be carried out to find out whether the *pretest* and *posttest* scores of the students' learning outcome interest questionnaire have increased on average. According to Lestari et al. (2018), the data shows an average increase. This happens if the N-Gain value > 0.3 for the medium criterion and more than 0.7 for the high criterion.

Table 8. N-Gain Test

Result	Ν	Mean
N-gain Score	28	70.0893

Based on the average (mean) percent of 70.0893 obtained for the category is quite effective, according to the results of the N-Gain Score test on the results of the *pretest* and *posttest* of SDN 1 Kajen students. Therefore, media *Flashcard* assisted by *Augmented Reality* have been shown to increase students' interest in learning. It can also be used as an alternative to learning media in science subjects. This research is supported by several relevant researches, namely research by Maharani et al. (2022), Putri et al. (2024), Sukasih et al. (2022), Vari et al. (2023), Voliani (2021) and Wahyuni (2020).

The results of the study found that students obtained better learning outcomes after using media *Flashcard* assisted by *Augmented Reality*, which was categorized as "high". These results show that media *Flashcard* assisted by *Augmented Reality* are very effective to be used in learning because they can improve the learning outcomes of human respiratory system materials.

#### Conclusion

This study shows that the learning outcomes of grade V students on the respiratory system science 40

material at SDN 1 Kajen can be improved through the use of media *Flashcard* assisted by *Augmented Reality*. The results of the feasibility assessment showed a percentage of 96.25% feasibility of the media component and 90% feasibility of the material component, so that it can be categorized as "Very Feasible". The results of the analysis of pretest and posttest scores showed an average increase of 35.68 with an N-Gain of 0.70 for the medium category. This shows that grade V elementary school students are better at learning science and technology material about the respiratory system with the help of *Flashcard* media.

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#### **Author Contributions**

Main author and researcher of the article, D.P.D; collecting information, D.P.D.; creating tools to measure needs and responses, D.P.D; creating material and media expert validation assessments, D.P.D; creating evaluations, D.P.D;. creating and testing research products, D.P.D; data processing and writing the initial article, D.P.D. research and writing the second article, D.W; validating instruments and initial product design before submitting to media and material expert validators, D.W; supervisor who directed and guided the first author, D.W.

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### **Conflict of Interest**

The authors declare no conflict of interest.

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