Development of Teaching Materials Based on Augmented Reality (AR) Digestive System Materials to Improve Creativity and Cognitive Learning Outcomes

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ABSTRACT

The problem at SD Negeri Ngijo 01 and SD Negeri Mangunsari 01 concerns the lack of technology-based teaching materials and less than optimal learning outcomes in IPAS learning. The formulation of the problem in this research is how to develop, validate and improve student learning outcomes after using Augmented Reality-based teaching materials. This research aims to develop learning media and determine the feasibility and effectiveness of articulate storyline-based E-module media. This research was conducted using the ADDIE model. The ADDIE model consists of five stages: Analysis, Design, Development, Implementation and Evaluation. The study aims to determine the results of the development and effectiveness of articulate storyline-based modules. This research shows that the experts' assessment obtained a median score of very decent criteria with a percentage of 93%. Material experts obtained very appropriate criteria with a rate of 88.8%. Meanwhile, linguists obtained a rate of 100% with very appropriate criteria. The increase in students' cognitive learning outcomes was measured using the N-gain score. The results of the N-Gain test on the pretest and posttest scores obtained an average difference of 39.8 with an n-gain of 0.76 and medium criteria; in the effectiveness interpretation, it received a score of 76.50 with very high criteria. The data description shows that classes that apply Augmented Reality-based teaching materials to science and science subject content achieve more learning outcomes with very effective criteria.

Keywords: IPAS, Sistem Pencernaan, Augmented Reality.

INTRODUCTION

An effective learning process is supported by using models, strategies, methods, media, and teaching materials to facilitate students' learning. Educators need to combine learning models using engaging learning media. The principles of effectiveness and efficiency in the process of delivering learning material need to be adhered to by every teacher (Agnes, 2022). Moreover, nowadays teachers are required to have the skills to present technology-based learning. Educational research written by Azhariadi, et al. 92019) Technological

changes affect the way teachers manage learning. Teachers are required to provide technology-based learning. The demands of the Industrial Revolution 4.0 era for teachers in the world of teacher education are encouraged to develop abilities in mastering technology so that they can design innovative and technology-based learning. (Nurdyansyah & Fahyuni, 2016). As agents of change, teachers can change students' thinking paradigms about teaching and learning activities. By providing interesting lessons for students and giving them motivation to enjoy the lessons (Aini et al., 2020) One of these is educational innovation in learning, namely technology-based learning, which creates both progress and challenges in education. With technology, it can be used anytime and anywhere. Technology offers advantages because it allows instant feedback and corrects student misunderstandings in understanding the material (Wati, 2020).

One of the teaching materials that teachers can use in learning is digital teaching materials based on Augmented Reality (Putra, et al., 2022). Augmented reality-based teaching materials facilitate students' learning both independently and conventionally. Augmented Reality-based teaching materials are equipped with instructions for independent learning so students can learn according to their abilities. Augmented reality-based teaching materials are tools or facilities that can be used as learning materials. They contain material, methods, limitations, and evaluation methods designed systematically and interestingly to achieve the goals and competencies expected according to the level of complexity. (Suwartaya, et al., 2020)

Augmented Reality is a technology that is good to apply in learning. Augmented Reality (AR) is a potential multimedia-based computer technology that is receiving significant attention in the world of education today, and the potential of Augmented Reality in education is just beginning. Augmented Reality interfaces offer interaction between the real and virtual worlds. Using the Augmented Reality system, students interact with 3D information, objects and events naturally. This means that Augmented Reality can create a learning environment where learning objects are presented virtually in the natural environment around students.

Decree of the Head of BSKAP Kemdikbudristek No. 033/H/KR/2022 in Widodo, et al. (2023) It is said that Natural and Social Sciences (IPAS) is a science that studies living things and inanimate objects in the universe and their interactions and examines human life as individuals as well as social creatures who interact with their environment. IPAS helps students grow their curiosity about phenomena that occur around them. This curiosity can trigger students to understand how the universe works and interacts with human life. The basic principles of scientific methodology in science and science learning will train scientific attitudes (high curiosity, critical, analytical thinking skills and the ability to draw appropriate conclusions), giving students wisdom.

The Digestive System is one of the science material for class V elementary school contained in the science and science learning book for class V Chapter 5 How we live and grow on topic B Why do we need to eat and drink. The learning objectives to be achieved in this lesson are that students can identify the role of the digestive organs and students can describe how humans grow.

Science learning is closely related to student creativity. Through developing creativity, students are able to receive information more quickly and systematically (Purba et al., 2023). The application of science and science learning to increase creativity combined with digestive system material triggers students to express their creations and understanding, in line with research conducted (Safitri et al., 2023) That creativity is a necessity in improving the quality of education and developing students' creative thinking abilities is very important for the educational revolution

Based on the results of observations and analysis of problems carried out at Gugus Dewi Kunthi, especially SD Negeri Mangunsari 01 and SD Negeri Ngijo 01, which was carried out in class V, it showed that teachers did not develop enough teaching materials for learning activities in these schools and still used teaching materials that provided by the government and have not developed learning materials to the maximum, teachers are still guided by teaching materials, namely teacher books and student books. Developing learning materials is a critical component that needs to be done when preparing for learning. Developing learning materials can help teachers coordinate students in the learning process. The learning implemented at SD Negeri Mangunsari 01 out of 14 students in class V, judging from the daily test scores, 11 students (79%) scored below the KKM, while the other 3 (21%) scored above the KKM. Meanwhile, at SD Ngijo 01, with 28 students, judging from daily test scores, 19 (68%) students scored below the KKM, while the remaining 9 (32%) met the KKM.

A solution needs to be found for the low student learning outcomes. Apart from creativity learning outcomes as one of the P5 characteristics in science and science learning, the independent curriculum is necessary because science and science learning is included in lessons that require attention and is included in the lessons that will be tested in class VI later. Apart from that, science is a subject that can help students develop creative skills. The development of Augmented Reality-based media can solve the problems encountered; augmented Reality presents learning components based on the Internet of Things accessed with digital media and displays interactive material that can attract students' attention and stimulate creativity.

MATERIALS & METHODS

This research uses a Research and Development (R&D) research design. According to Sugiyono (2105: 407) development research is a research method used to produce certain products and test the effectiveness of these products.

This research was conducted using a deep development model (Sugiyono, 2014) Development research is a method to produce specific products and test their effectiveness. It uses the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation.

In this development research, researchers used the ADDIE development model to produce Augmented Reality-based teaching materials designed in stages. This media development research was carried out following steps in the ADDIE development model. The material in the media that the researcher will create is the science material on food digestion systems for class V of the independent curriculum in elementary schools.

Research data collection regarding developing Augmented Reality-based teaching materials was done through direct

interviews with class V teachers at SDN Ngijo 01 and SD Negeri Mangunsari 01 Semarang. Based on data obtained from needs interviews given to teachers and students. The results of the interview stated that teaching materials on the digestive system only used pictures from students' books, so, according to students, the learning was less attractive. Students stated that using videos or animated images made them happier and more interested in learning. Thus, teachers want the learning teaching materials developed to be attractive so that students can focus on learning and the quality of education is better with students' higher understanding of the material. Teaching materials are better if they are colourful and have colours that attract students' daily attention. The researcher also collected image and video material related to digestive system material used in developing Augmented Reality-based teaching materials and research instruments such as assessment sheets and teacher and student response questionnaires.

RESULT AND DISCUSSION
Data analysis
The development research that has been carried out has resulted in a product in the form of Augmented Reality-based teaching materials for science and science lesson content. Learning media was developed by focusing on digestive system material in class V of SD Negeri Ngidjo 01 Semarang City. The results of the research examine (1) the development of learning media, (2) the feasibility of learning media, and (3) the effectiveness of media use. Next, it is explained according to the research problem formulation.

The learning media design created is a prototype, which contains an initial description or design of the learning media product and is used as a reference for learning media development.
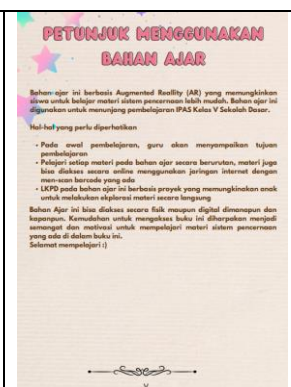

Figure 1. Cover

Figure 2. Instruction

Figure 3. Learning target

Figure 4. Matery

The product design is prepared according to data obtained through interviews with teachers and students. The media results developed are applications that can be accessed online or offline. The media uses bright and cheerful themes to attract students' attention. How to visualize material content can influence cognitive processes in critical thinking and independence in learning and influence learning outcomes (Rusli, M., 2017). This effect can occur due to limited sensory memory capacity (related to how information comes in visually and/or audio, as well as the learner's working memory in processing information into meaningful knowledge (Rahayu et al., 2021).

The results of the feasibility assessment of Teaching Materials

The feasibility of Augmented Reality-based teaching materials for science and science lesson content carried out several tests to assess the suitability of the product. The feasibility of Augmented Reality-based teaching materials for science and science lesson content is tested through the following stages: (1) expert validation on media, language and material aspects (2)

small-scale feasibility test to try out media use and find out opinions on media use.

Table 1 Feasibility Teaching Materials

Expert	Score	Percentage	Information
Media Expert	69/75	92%	Very Worth It
Matery Expert	40/45	88.8%	Very Worth It
Linguist	45/45	100%	Very Worth It

Based on the expert's assessment, the media expert validator the media received very appropriate criteria with a percentage of 93% and the comment "The media is suitable for use for research with improvements to the visual aspect". The material expert validator obtained very appropriate criteria with a percentage of 88.8% with the note, "The material is in line with learning outcomes and needs to be improved in the formulation of learning objective sentences and added examples of a more complex digestive system." Meanwhile, linguists obtained a percentage of 100% with very appropriate criteria. In line with the research they have carried out. Oktaviyanti et al. (2023) developing augmented reality-based teaching materials requires validators.

Table 2 Small Group Test Results

Test	N	Result	Information
T-Test	12	Sig 0.00<0.05 mean 30.83	shows an average difference with an increase of 31%
N-Gain	12	N gain score 0.688 Effectivity 68.87	Obtaining ngain scores with medium criteria and very effective levels of effectiveness

The small-scale test was carried out using Augmented Reality-Based Teaching Materials on the science and science lesson content for 12 class V students using the students' cellphones. The process of installing and using the media went well based on the results of data analysis, which showed that in the small-scale test, the use of media increased learning outcomes by up

to 31%. The level of effectiveness is very effective. So, after conducting small-scale trials, no revisions were made to the content of the Augmented Reality-Based Teaching Materials in the science course. Teaching materials are feasible and can be tested in large-scale trials. To measure the feasibility of using teaching materials.

The effectiveness and use of media is measured by analyzing the gain index. In this research, normalized gain (N-Gain) is used. Gain shows increased student learning outcomes for Digestive System Material after using Augmented Reality-Based Teaching Materials in the science and science lesson content. Results of gain test calculations on pretest scores and posttest scores before and after using Augmented Reality Based Teaching Materials

Table 3 N gain Test

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain	28	.54	.90	.7651	.11092
NgainPersen	28	53.85	90.00	76.5050	11.09177
Valid N (listwise)	28				

The results of the Homogeneity test for the experimental class obtained an n-gain of 0.76 and the criteria were Medium, in the effectiveness interpretation it obtained a score of 76.50 with the criteria being quite effective.

DISCUSSION

The product design is prepared according to data obtained through interviews with teachers and students' needs. The media results developed are applications that can be accessed online or offline. The media uses bright and cheerful themes to attract students' attention. How to visualize material content can influence cognitive processes in critical thinking and independence in learning and influence learning outcomes (Rusli, M., 2017). This effect can occur due to limited sensory memory capacity (related to how information comes in visually and/or audio, as well as the learner's working memory in processing information into meaningful knowledge (Rahayu et al., 2021).

The media presented has innovative development characteristics displayed in certain sections with the following details: (1) Augmented Reality-based teaching materials are developed in book form with the Project Based Learning model as the application. (2) The augmented reality-based teaching materials contain science and science subjects and digestive material for class V at SD Negeri Mangunsari 01. (3) The augmented reality-based teaching materials contain learning tool plans with the Project-based Learning model, project worksheets, materials, songs, and practice questions. (4) Augmented Reality-based teaching materials are accessed using digital devices by displaying material components in interactive Augmented Reality. (5) Augmented Reality-based teaching materials are designed to stimulate student creativity. (6) Images and illustrations presented are designed via Canva. There is a guide to using teaching materials as a guide for teachers using augmented reality-based teaching materials.

The expert assessment shows that the media expert validator, Mr. Dr. Deni Setiawan, S.Sn., M.Hum. The media received very appropriate criteria with a percentage of 93% and the comment "The media is suitable for use for research with improvements to the visual aspect". The material expert validator obtained very appropriate criteria with a percentage of 88.8% with the note, "The material is in line with learning outcomes and needs to be improved in the formulation of learning objective sentences and added examples of a more complex digestive system."

Meanwhile, linguists obtained a percentage of 100% with very appropriate criteria. This is in line with the research they have carried out. Oktaviyanti et al. (2023) Developing augmented reality-based teaching materials requires validators.

The small-scale test results were carried out using Augmented Reality-based teaching materials for science and science lesson content for 12 class V students using the students' cellphones. The process of installing and using the media went well based on the results of data analysis, which showed that in the small-scale test, the use of media increased learning outcomes by up to 31%, with an efficient level of effectiveness. So, after conducting small-scale trials, no revisions were made to the content of the Augmented Reality-Based Teaching Materials in the science course. Teaching materials are feasible and can be tested in large-scale trials. To measure the feasibility of using teaching materials.

A large-scale trial was conducted by providing lessons to 28 class V students at SD Negeri Ngijo 01 Semarang. Augmented Reality-based teaching materials in science and science lesson content are used as learning resources in learning activities. Students conduct a pretest before using augmented reality-based teaching materials in science course content. Teachers and researchers provide learning using Augmented Reality-based teaching materials in food science and science lesson content to support the delivery of the material.(Prabandari et al., 2022). Media is broadcast using projectors and individual devices to make it easier for students to watch and use learning media, students can pay attention to the teacher's explanation using the media that has been provided. Students in groups discuss and work on LKPD (Widiyanti & Fitrotun Nisa, 2021).

After completing the learning activities, students worked on posttest questions distributed to all class V students at SD Negeri Ngijo 01 Semarang City. The results of students' pretest and posttest answers were then carried out with statistical tests to measure the increase in students' mastery of concepts.

The results of the N-Gain test on the pretest and posttest scores obtained an average difference of 39.8 with an n-gain of 0.76 and medium criteria. In the effectiveness interpretation, it obtained a score of 76.50 with very effective criteria. The data description shows that classes that apply Augmented Reality-based teaching materials to science and science subject content achieve more learning outcomes with very effective criteria.

CONCLUSION

The media presented has innovative development characteristics displayed in certain sections with the following details: (1) Augmented Reality-based teaching materials are developed in book form with the Project Based Learning model as the application. (2) The augmented reality-based teaching materials contain science and science subjects and digestive material for class V at SD Negeri Mangunsari 01. (3) The augmented reality-based teaching materials contain learning tool plans with the Project-based Learning model, project worksheets, materials, songs, and practice questions. (4) Augmented Reality-based teaching materials are accessed using digital devices by displaying material components in interactive Augmented Reality. The expert assessment shows that the media expert validator, Mr Dr Deni Setiawan, S.Sn., M.Hum. The media obtained adequate criteria with a percentage of 93%. The material expert validator obtained very

feasible criteria with a rate of 88.8%. Meanwhile, linguists obtained a rate of 100% with very appropriate criteria. The increase in students' cognitive learning outcomes was measured using the N-gain score. The results of the N-Gain test on the pretest and posttest scores obtained an average difference of 39.8 with an n-gain of 0.76 and medium criteria; in the effectiveness interpretation, it obtained a score of 76.50 with very high criteria. Effective. The description of the data shows that classes that apply Augmented Reality-based teaching materials to science and science subject content achieve an increase in learning outcomes with very effective criteria. Similar research is expected to pay more attention to the limitations of technical development and planning.

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