Development of Augmented Reality-Based Booklet Learning Media on Photosynthesis Materials for Grade IV Elementary School

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Abstract: The research and development aim to produce an augmented reality-based booklet on photosynthesis materials, test its feasibility, and determine its readability level. This study applies the Research and Development (R&D) method using the Sugiyono model through seven stages: (1) identifying possibilities and obstacles, (2) collecting information, (3) designing the product, (4) validating the design, (5) testing the product, (6) refining the product, and (7) evaluating the product. The validation results from media experts scored 86%, categorized as "very feasible." Subject matter experts scored 81.3%, and linguists scored 90%, both categorized as "very feasible." Teachers' readability assessment of the augmented reality–based booklet reached 92%, while students' readability was 95%. The developed media is an augmented reality–based booklet containing a cover, usage guide, table of contents, learning objectives, material content, evaluation questions, bibliography, and author biography. The findings indicate that the augmented reality–based booklet is highly feasible and effectively improves understanding of photosynthesis materials for fourth-grade students.

INTRODUCTION

Education is one of the most important things in the order of human life. Improving the quality of education is very important to increase students' potential in daily life in the future (Wibowo et al., 2022). Learning in the digital era poses new challenges for the world of education, especially when students are more accustomed to playing with technology. One of the things that is difficult for teachers to do is to make learning interesting and interactive for students, especially in elementary schools.

IPAS subjects are subjects found in the Merdeka Curriculum which merges science and social studies materials into one subject. The content of the IPAS material is to explain natural conditions and human relationships related to the environment around students (Aini, 2023). Technology also makes it easier for teachers to provide explanations of abstract material (Aini, 2023).

The results of the preliminary analysis in three schools, namely UPT SDN Tawangsari 01, UPT SDN Sidodadi 01 and UPT SDN Sidodadi 02 which were shown by the results of interviews and the distribution of student needs questionnaires showed problems about learning social studies of plants that are the source of life on earth. Based on the results of the interviews, there were 2 teachers who stated that photosynthesis material was difficult for students to understand and the lack of learning media so that students felt bored. Based on the results of the questionnaire given to 56 students in Appendix 3, it shows that as many as 65% of students feel bored when teachers explain using print media such as books, as many as 78% of students are happy when teachers teach using learning videos. As many as 69% of students feel that they can operate smartphones well.

Based on the preliminary analysis, there are potentials and problems that are the basis for the need to develop digital-based learning media. One of the things that can be developed is augmented *reality* for IPAS lessons on photosynthetic materials. The technology that can and is suitable for use in this learning media is *augmented reality* technology on *smartphone devices*.

Augmented Reality (AR) is a technology that combines virtual objects into a three-dimensional real sphere and projects these virtual objects in real time. AR has interactive characteristics in *real-time*, and can bring up 3D objects so that the objects seen are more real (Arianto et al., 2023). Booklet is a small print book medium that contains information accompanied by pictures. A booklet is a leaflet book that contains important things that the content in the booklet must be clear, firm, and easy to understand, and will be easy to understand. The structure of the contents of a booklet resembles a book (introduction, contents, cover), only the way the content is presented is much shorter than that of a book. Its small shape makes the Booklet easy to carry around (Fadilah et al., 2024)

Previous research has revealed one way to improve the knowledge of elementary school students, namely by using booklet media. For example, research conducted by (Uswatun, 2024) by utilizing booklet media can support and provide students' understanding of learning objectives. However, the study uses booklets as a printed medium and has not incorporated digital media in the booklet.

The novelty of this research lies in the combination of print media in the form of booklets with augmented reality (AR) technology. If previous research only developed digital AR or *booklets* in print form, this study combines the two to produce a hybrid learning medium that combines the practicality of booklets with interactive AR experiences. Thus, students not only obtain information through text and images in the booklet, but also can see a simulation of the photosynthesis process in real life in the form of 3D objects through barcode scanning using smartphones. This innovation is expected to increase interest in learning, overcome boredom, and help students understand abstract photosynthesis materials.

This research is entitled *Development of Augmented* Reality-Based *Booklet Learning Media* on Photosynthesis Materials for Grade IV Elementary School. The developed media can be accessed through computers and smartphones by scanning the barcodes contained in the booklet. Booklets can be carried and studied anywhere, in the booklet there are pictures, photos, and text that make it easier for readers to understand the information presented (Uswatun, 2024). With the combination of booklets with augmented reality as one of the learning media, it is hoped that a subject can be more interesting for students so that they do not feel bored (Wibowo et al., 2022).

This study aims to determine the feasibility of *augmented* reality-based *booklet* learning media and shows that *augmented* reality-based *booklet learning media* can be read by grade IV students.

RESEARCH METHODS

The approach used in this study uses a quantitative descriptive approach. Quantitative descriptive approach to produce numeracy data using descriptions and products (Sugiyono, 2019). This approach involves observation, interviews and the use of questionnaires. The quantitative descriptive approach involves both teachers and students. The type of research used is research and development (R&D) that develops learning media because this type of research is a research methodology to create certain products to be tested for efficacy (Sugiyono, 2019).

The research model and development framework applied in creating learning materials or products involve 10 stages. The RnD model created by Sugiyono follows a research and development process that involves the following 10 stages: 1) Identification of possibilities and barriers; 2) Information collection; 3) Preparation of product design; 4) Design validation; 5) Usage testing; 6) Product refinement; 7) Product evaluation; 8) Design improvement; 9) Further product development; and 10) Large-scale production. However, the researcher decided to simplify it into 7 stages of research.

In addition, the data processing method in this study includes quantitative descriptive analysis. Descriptive data was obtained through the evaluation of an open questionnaire that asked for teachers' opinions, suggestions, or perspectives after the learning process using learning media. In addition, quantitative data is obtained through the calculation of the results of a questionnaire with predetermined answer options. These results are used to evaluate the final outcome of each question or statement posed to the teacher.

Table 1. Validation Questionnaire Assessment Indicators

Scale	Criterion
1	Bad
2	Not Good
3	Pretty Good
4	Good
5	Excellent

The achievement rate scale parameter can use this average percentage qualification to assess the feasibility of a product that has been developed.

Table 2. Product Eligibility Level Criteria Based on Expert Validation Test

Achievement Rate	Kualifikasi	Information
$80 \leq x \leq 100\%$	Highly feasible	No revision required
$60 \leq x \leq 80\%$	Proper	No revision required
$40 \leq x \leq 60\%$	Quite feasible	Needs revision
$20 \leq x \leq 40\%$	Less worthy	Need for revision

RESULTS AND DISCUSSION

The results of this research, which included observational findings, interviews, and filling out questionnaires to identify student needs, were identified in 3 schools located in UPT SD Negeri Sidodadi 01, UPT SD Negeri Sidodadi 02,

and UPT SD Negeri Tawangsari 01 have identified several problems that may occur in the 3 schools, such as limited learning media and students feeling bored when learning.
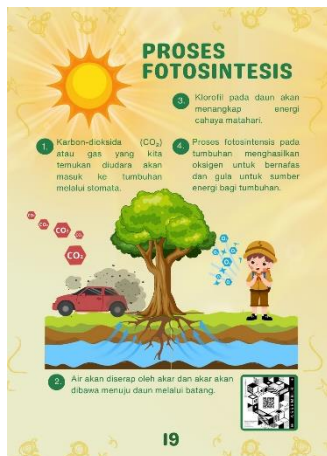

Figure 1. Contents of the *booklet*

Figure 2. *Barcode Augmented reality*

The booklet that has been compiled was evaluated by 9 assessors who were divided into 3 experts, namely material experts, language experts, and media experts. All of these assessments have sufficient expertise in assessing learning media. This evaluation process involves filling out a validation questionnaire to explore aspects of the material, language, and media.

Table 3. Media Feasibility Validation Results

Validator	Percentage Effectiveness	Media Eligibility
Material Expert	81, 3 %	Highly feasible
Linguist	90%	Highly feasible
Media members	86%	Highly feasible

The *Booklet* Learning Media Based on *Augmented Reality* Class IV Photosynthesis Materials received 81.3% results from material experts which showed that this medium was very suitable for use. The results of the material validation show that the content of the material on the training media is in accordance with the Learning Outcomes (CP) and Learning Objectives (TP) that have been prepared, the content of the material presented is in order, contains an

invitation to protect plants, and the images presented are in line with the content of the material.

Meanwhile, the results of language validation showed a 90% assessment percentage which showed a very feasible category. The *Booklet* Learning Media Based on *Augmented Reality* Photosynthesis Material Class IV, has linguistic rules that show straightforwardness, communicative and language suitability.

In addition, the results of media validation showed that 86% were in the very feasible category. *Augmented* Reality-Based *Booklet Learning Media* Class IV Photosynthesis Materials have instructions for use that are clearly arranged and easy to understand, the material presented is in accordance with the learning outcomes (CP).

The results of the readability test, in which teachers fill out questionnaires, show that the learning media is rated "Very Feasible" with 92% included in the "Very Feasible" category. On the other hand, the results of filling out the student questionnaire showed that the learning media was rated "Very Feasible" with an average percentage score of 95%. The learning media developed by the researcher is based on product evaluation after receiving input and assessments from various sources during the trial phase. The initial evaluation of this product is validated by experts in materials, languages, and media. Furthermore, the trial was carried out on three teachers and ten students at Blitar Regency Elementary School for the second evaluation. This trial includes assessment through a questionnaire filled out by teachers and students after they use the medium. After evaluating the developed product, the researcher made improvements to overcome the shortcomings in the learning media that was being developed, including for student evaluation, adding a variety of exercises, such as matchmaking, observation, and filling questions.

CONCLUSIONS AND RECOMMENDATIONS

Based on the acquisition of 9 validators, namely 3 material validators, 3 media validators, and 3 language validators. Augmented *reality-based* booklet *media* is suitable for use by students. From the results of the material validators, a percentage of 81.3% was obtained which was included in the very feasible category,

the media experts obtained 86% which were included in the very feasible category. Linguists get 90% who fall into the category of very feasible. Based on the results of the readability test for 3 teachers and grade IV students. In the readability questionnaire, teachers obtained a percentage of 92%, this score is included in the assessment range of 80%-100% and is included in the very feasible category. In the readability questionnaire, students obtained a percentage of 95%, this score is included in the assessment range of 80%-100% and is included in the very feasible category. *This augmented* reality-based *booklet* learning media can help students' understanding needs during learning. *This booklet* can be used by educators as an additional medium. For researchers, they can develop a more realistic *augmented reality* without the addition of 3-dimensional icons.

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