DEVELOPMENT OF METAPLORE "META THE EXPLORER" LEARNING MEDIA BASED ON AUGMENTED REALITY ON INSECT METAMORPHOSIS

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Article Info	Abstract
Article History: Accepted March 2024 Revised February 2024 Approved January 2024	This research aims to produce a product in the form of augmented reality-based learning media on insect metamorphosis that is suitable for use as a supporting tool in learning activities for 4th grade students. Research and Development is the type of research used, adapted using the ADDIE model. The subjects of this research were the 20 4th grade students at SDN Serang 7. Data collection in this research used questionnaires as responses from students to the Metaplore AR-based learning media. The learning media was declared valid based on the assessment of two media experts, two content experts, and two language experts, with validity percentages of 83.1% (very good), 77.8% (good), and 78.9% (good), respectively. The media was rated by students with a percentage of 89.2% as very good. The results indicate that the Metaplore Augmented Reality-based learning media suits 4th grade students at SDN Serang 7. **Keywords:** Metaplore Learning Media; Augmented Reality; Metamorphosis

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A. Introduction

Since the COVID-19 outbreak, learning activities from kindergarten to university have been conducted online. According to Anugrahana (2020), one way to address problems and facilitate students' access to learning materials using technology is through online learning systems. As time goes by, the use of technology in education is based on laws or regulations to facilitate learning (Nugraha, 2022:135).

It can be seen from the observations and interviews conducted at SDN Serang 7 in February 2021. This school has utilized technology such as smartphones for distance learning processes. However, the implementation of learning media is still very limited, with only visual aids available. In this learning process, students are only given tasks to observe and read the provided books without concrete examples of the insect metamorphosis process. Despite advanced technology, learning media should be more diverse, especially regarding insect metamorphosis in 4th grade. According to Suparmi (2013), visual aids such as images of the subject of metamorphosis in living organisms can be used to improve students' learning outcomes. However, the drawback of visual aids is their limited size and passive nature because the displayed objects cannot move. Therefore, besides visual aids, teachers usually use video media to illustrate objects in metamorphosis.

However, instructional video media remain one-way, meaning they do not directly involve students interacting and tend only to observe running animation videos. Nevertheless, if learning media can accommodate students in learning to participate in interactions actively, then the learning process will be more meaningful. According to Ausubel (Rahmah, 2013:44), learning becomes meaningful when individuals connect new phenomena to their existing knowledge structure. In other words, individuals who gather new information can relate it to the knowledge they have acquired previously. According to (Ismail et al., 2018), using technology such as AR devices in learning activities can help solve students' problems, such as visualization, cognitive load, and teaching styles of teachers.

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At present, learning media are also evolving. One of the technologies that can support the development of learning media in the real and digital world is Augmented Reality technology. According to Andriyadi (2018), Augmented Reality is a combination of virtual objects with real-life objects. In the realm of learning activities, AR technology itself has been used during learning activities. As conducted by Arifin (2020) in his research, he developed STEM learning media on geometry topics, which proved to be suitable for learning. Mustama (2017) also utilized AR in his research, developing a 3D Animation Application based on Augmented Reality as learning media for Insect Metamorphosis, making it highly suitable for learning activities. According to Marín-Díaz (2017), in his research titled "The Relationships Between Augmented Reality and Inclusive Education in Higher Education," Augmented Reality has created a new way of communication in learning, as AR can combine text, images, videos, 3D models, and more, which cannot be obtained from books.

One of the learning media used to support insect metamorphosis learning activities is augmented reality-based Metaplore learning media. Learning media is a way of communicating with others using print and electronic media (Nugraha, 2022). In this Metaplore learning media, there are two insect metamorphosis processes: incomplete and complete metamorphosis. The process of insect metamorphosis is presented in the form of 3D objects based on Augmented Reality using puzzles as the base marker and smartphones as the scanning device. In this research, learning media can be operated on Android smartphones. As an open-source platform, Android allows developers to create applications with various tools (Kusniyati, 2016).
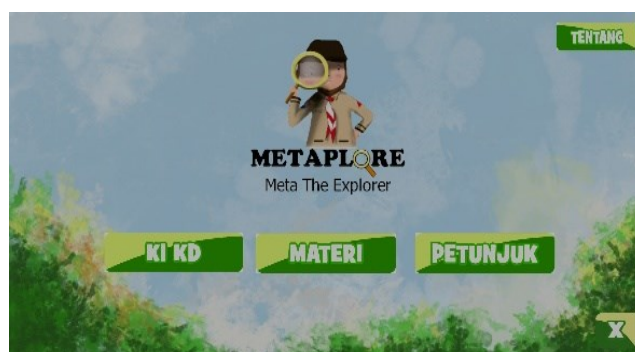

Figure 1: Metaplore Learning Media Based on Augmented Reality

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Based on the background, this research is suitable as a learning media for 4th grade students at SDN Serang 7.

B. Methods

The research was conducted at SDN Serang 7, in the Serang District, Serang City, Banten Province. This type of research is research and development (R&D).

The research method adopted the ADDIE development model, consisting of five stages, which, according to Sugiyono, 2015 are analysis, design, development, implementation, and evaluation. Needs analysis, curriculum, and material analysis are the three stages of analysis. The needs analysis was conducted to ensure that learning media are available and used by schools, as well as the classroom conditions and problems teachers face when delivering the material. Curriculum and material analysis was conducted to determine which materials teachers considered difficult to convey to students. These materials were then selected for use in this research.

The second stage is design. This stage consists of designing research instruments and learning media. The design of research instruments consists of several parts, such as interview guidelines, questionnaires for media expert validity, material expert validity, linguist validity, and student response questionnaires. Creating a storyboard for the developed learning media is the first step in the learning media design process.

The third stage, known as development, produces version 1.1. This learning media is created using Blender software. Blender is open-source software used to create 3D models or animations. According to Zaky (2016), Blender is used to create 3D models and animations but can also be used for 2D objects. 3D models of insects such as butterflies and grasshoppers, which undergo metamorphosis, are created in this process. After creating the 3D insect models, the next step is to create the Main Menu scene in Unity, as shown in the image, with one Canvas containing three Panels, six Buttons, and four Text elements. The Buttons enable scene switching, panel switching, and application closure using the Unity App. Unity software is complex for creating various types of games.

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Additionally, Unity provides an asset store containing assets or tools that can be directly used for game development, such as character shapes, map views, scripts, and more (Winarno, 2015). To enable this learning media to display 3D objects as Augmented Reality, the researcher creates markers to be scanned to display the created 3D objects. Marker creation uses Vuforia software first to create a simple image as the target. According to (Meilani, 2018), Vuforia offers tools for creating targets, managing target databases, and securing applications with licenses. This version 1.1 learning media will then be reviewed by two learning media experts, two content experts, and two language experts who will assess the validity of version 1.1. If the experts deem the learning media valid, version 1.1 will proceed to implementation. However, if version 1.1 is deemed invalid, corrections will be made until all issues are resolved and the learning media is ready for the next stage.

Implementation, the fourth stage, involves testing the learning media deemed valid with trial subjects, namely students in the classroom. Learning takes place in the classroom, and after the session, students are given worksheets to assess their understanding of the material after using the learning media. In addition to providing worksheets, students receive a questionnaire regarding their feedback on the learning media used.

Evaluation, the fifth stage, involves evaluating the developed learning media for the feasibility of trial product testing. Furthermore, evaluation is recommended to develop learning media for future use.

C. Results and Discussion

This developmental research has produced a learning media called "Metaplore," an acronym for Meta the Explorer, built based on field needs analysis. During the analysis stage, interviews with teachers found that the required learning media should be easy to carry to class, duplicable, and usable anywhere. Regarding the characteristics of the students, it is known that they are proficient in technology, and some have Android-based smartphones. The analysis results were then followed by media design, starting with creating a storyboard to develop the application. The application created based on the storyboard cannot function

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independently, so the developed learning media consists of two parts: Metaplore puzzle as a marker and Metaplore application as its application. After the media design development stage, the learning media can be realized.

Using the Likert scale questionnaire instrument, media experts, material experts, and linguists validate the learning media before its use in learning activities. According to Sugiyono (2012), the quality is scored as follows: very good= 5, good= 4, fair= 3, poor= 2, and very poor= 1 using the Likert scale.

The validation by experts consists of two experts in each field. The validity results from the material, media, and linguist experts can be seen sequentially in Tables 1, 2, and 3.

Table 1
Material Expert Assessment Results

No	Assessment Aspects	Scores	
		Expert 1	Expert 2
1.	Suitability of Material Description with Basic Competencies	7	7
2.	Accuracy of Material	26	29
3.	Supporting Learning Materials	6	6
Total		39	42
Score Percentage		75%	80,7%
Average		77,8%	
Criteria		**Good**	

The assessment results from the material validator indicate an average score of 77.8% with the category "good" because the Metaplore learning media is already following the basic competencies in the 2013 curriculum. The validation results from Experts 1 and 2 obtained a score of 7 for suitability of material description with basic competencies, and the supporting learning materials obtained a score of 6 from both Experts. Meanwhile, the validation results from Expert 1 obtained 26 and Expert 2 obtained 29 for material accuracy. Thus, the Metaplore learning media has covered material that aligns with the educational goals and basic competencies. The material presented in the Metaplore learning media only focuses on science subjects, specifically insect metamorphosis in 4th grade elementary school. In this Metaplore learning media, students can understand the environment by observing

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and communicating the acquired material by formulating their concepts, as mentioned by Andriana (2020:410).

Table 2
Media Expert Assessment Results

No	Assessment Aspects	Scores	
		Expert 1	Expert 2
1.	Media Design	46	49
2.	Software	18	20
Total		64	69
Score Percentage		80%	86,2%
Average		83,1%	
Criteria		**Very Good**	

From the feasibility test results conducted by the media validator, it can be outlined that the assessment by the media validator obtained an average score of 83.1% in the "very good" category. It is because the produced media has an attractive design, is easy to use, and makes learning more engaging, thus rendering the learning activities more interactive. In the validation test by Expert 1, the results obtained for the media design feasibility indicator were 46, while the software feasibility was 18. Expert 2 obtained a score of 49 for the media design feasibility indicator, and the software indicator scored 20. Therefore, the learning media can be used in teaching, as it provides students with the opportunity to convey messages or information during the learning process, thereby increasing student interest and attention during the learning process (Arsyad, 2017:4).

Table 3
Linguists Assessment Results

No	Assessment Aspects	Scores	
		Expert 1	Expert 2
1.	Suitability to the level of development of students	7	7
2.	Communicativeness	16	15
3.	Coherence and Cohesion	6	6
Total		29	28
Score Percentage		80,8%	77%
Average		78,9%	
Criteria		**Good**	

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Based on the assessment results from the linguist, an average score of 78.9% was obtained with the "good" category. The assessment results from Expert 1 for suitability to the student's development level received a score of 7, the communicativeness indicator scored 16, and the coherence and cohesion aspect scored 6. In the validation test results from Expert 2, the scores obtained for the suitability to the student's development level were 7, the communicativeness indicator scored 15, and the coherence and cohesion aspect scored 6. Based on the assessment by the two linguists on the Metaplore learning media, it can be concluded that the language used in the Metaplore learning media is appropriate for the student's developmental level. The language used is also communicative and coherent, thus facilitating the students.

Besides providing assessments, experts also provided suggestions for improving the learning media. One suggestion is adding background music to make the learning media more interactive. It is also recommended that the application interface be more contrasted to see the text material more clearly. Instructions should be structured more clearly, and the language used should be adjusted to the student's age level, specifically for 4th grade elementary school. The 3D objects should be animated to be more attractive and interactive, allowing users to zoom in/out/rotate them. Background music audio should be added to the learning media, and the application interface should be changed to have a contrasting background color to make the text visible. The language used for user instructions should also be changed according to the expert's suggestion. Due to the researcher's limitations, the suggestion regarding transforming 3D objects into scalable moving animations can be improved. Considering the assessments from media, content experts, and linguists, it can be concluded that the developed learning media is feasible to use and has been revised according to expert suggestions.

The augmented reality learning media was then used in teaching activities after being deemed appropriate and after improvements were made. Students used the learning media during classroom instruction in one session with the topic of insect metamorphosis. After the learning activity ended, students filled out the questionnaire provided to assess the suitability of the Metaplore learning media.

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Sugiyono (2015) states that the Guttman scale measures student responses to the questionnaire. This scale consists of words such as "yes-no," "true-false," "ever-never," "positive-negative," and so on. Basmalah (2013) states that this formula is used to calculate the average percentage of each, namely:

$$P = \frac{\Sigma X}{N} \times 100\%$$

Description:

P   = Percentage of student responses

ΣX = Total score for each criterion chosen by students (yes or no)

N   = Ideal total score

Here are the responses from 4th grade students at SDN Serang 7 regarding the Augmented Reality-based Metaplore learning media.

Table 4
Student Response Results

No	Assessment Aspects	Student Response Results
1.	Design	81,6%
2.	Language	90%
3.	Material	96%
Total		89,2%
Criteria		**Good**

Research findings show that AR-based Metaplore learning media strengthens previous research findings. The findings align with Mustama's (2017) and Wahyudi's (2018) research, which states that learning media can be used in the classroom. Theoretically, this learning media has good potential to motivate 4th grade students for several reasons. Firstly, it allows students to manipulate real objects—physical objects—thus creating a learning experience, which aligns with Ausubel's idea (Rahmah, 2013:44) that meaningful learning occurs when someone connects new phenomena to their existing knowledge structure. In learning, teachers must be able to manage learning media well because the accuracy of media selection determines the success of the learning process (Lestari, 2022:146). Secondly, the learning media used in assignments do not directly provide information about the material; instead, they require students to explore the learning media and build their knowledge. It is consistent with constructivism theory, where

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students construct their knowledge rather than the teacher providing it. Through learning media, students can actively participate in learning, complete tasks effectively, demonstrate creativity, generate many ideas or concepts, become more independent, work effectively in group and individual activities, and strengthen their characteristics in learning (Sagita et al., 2023). Although this learning media has been deemed feasible to use in 4th grade student learning, it has some limitations. Despite its small size and ease of use for teachers in the classroom, a very limited range of learning materials is provided, only covering insect metamorphosis. Additionally, the application has not been updated, and teachers cannot create models to display through the application without developer assistance. Therefore, future improvements are needed, including material and model updates, so that the teachers can create and display their models according to their abilities.

D. Conclusion

In this research and development, a learning media called "Metaplore" has been produced, which is considered suitable and valid for use in learning, fulfilling the criteria of media, material experts, and linguists. The developed learning media also fulfills the criteria to be used according to students' responses, with the "very good" category in science learning. Metaplore learning media has advantages such as making learning more enjoyable as students can actively engage in the process, and it enhances innovation by utilizing Augmented Reality-based technology. However, this media also has limitations, including being confined to science topics related to insect metamorphosis only, featuring only butterflies and grasshoppers as examples of insects, lacking practice questions or quizzes in the application, static 3D objects observed without movement, and limited access to 3D objects when scanned into AR, which is only compatible with certain smartphones.

Therefore, teachers are advised to use this learning media in classroom activities on insect metamorphosis, thus aiding students in understanding the process of metamorphosis in insects. For development purposes, the learning media should be expanded using a comparable concept, augmented reality, for different subjects and not limited to science subjects only. Additional 3D objects could

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include other insect examples, such as mosquitoes, frogs, or dragonflies. In subsequent research, 3D models could also be developed into 3D animations.

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