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Feasibility Of Developing An Augmented Reality (Ar) Science Module With Audio Integration Using Assemblr Edu: A Case Study On Matter And Its Changes

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Abstract: The study aims to evaluate the feasibility of Augmented Reality (AR)-based science learning media with audio features, using the 4D development model (Define, Design, Develop, Disseminate). The media was developed to facilitate more interactive and immersive science learning through AR visualizations and audio explanations that assist in understanding complex concepts. The development stages include: (1) Define, to analyze the needs and learning objectives; (2) Design, to design AR and audio-based media; (3) Develop, to create the media prototype and conduct feasibility tests through validation by subject matter and media experts; and (4) Disseminate. Data were collected through questionnaires and observations, then analyzed descriptively. The evaluation results show that the learning media was rated as "highly feasible" by experts, particularly in terms of content accuracy, interactivity, and audio quality. With these positive results, the AR and audio-based media is deemed feasible for use in science learning and has the potential to enhance teaching methods in schools.

Keyword: *Augmented Reality, Science Learning, Learning Media*

1. Introduction

The term science refers to a wide variety of knowledge and is also an objective way of gaining that abstract information based on facts regarding the natural world1 beaming with both tangible and intangible things. Matter and its changes are one of the important topics that introduced in elementary school with a part of the science learning objectives in Phase B based on currently implemented Merdeka Curriculum in Indonesia. It is vital that students understand this topic because it also accounts for a wide variety of natural occurrences in their everyday lives such as the evaporation and freezing of water, and condensation [1]. These topics provide a solid foundation for students that is necessary to grasp more complex scientific concepts when they reach higher levels of education.

The research revealed the urgency of the education due to the implications that matters in state changes have started to be more clear and present in daily life [2]. For example, the transformations of solids to liquid and gas and vice versa, is an important property as they apply to areas such as environmental science while also solving everyday problems that we face at home. But this is only one of the reasons so many students struggle with what matter is and how it changes. Misconception is common in science education, students often have misconceptions of basic science concepts [3].

Misconceptions in this area have a lasting impact on student learning. Such misconceptions can make it more challenging for them to build upon existing understanding, and thus more difficult to grasp advanced concepts later on. Make matters worse, it will stop them from applying what they have learned to the real world and it could show poor reasoning or decision making with bigger consequences. If students have a wrong understanding of the water cycle, which is based entirely on

changes in matter, they may be confused by aspects of weather or environmental issues [4]. Moreover, students who struggle to comprehend science constructs are more likely to lose interest and confidence in themselves leading into decreasing achievement [5].

Learning modules, which are designed to help students learn and understand concepts, are one solution to some of these learning challenges. An excellent learning module is an important link between both types of teachers and students, by offering information in a structured and comprehensive way. This is to ensure that the concept or material taken by learners would be further understood along with high engagement in the learning process [6]. Learning modules that engage students' attentiveness and motivation result in better learning outcomes [7].

21st-century technology is changing the future of education by sharing devices with the whole classroom, as advancements in digital tools can prove to enhance learning significantly. It encourages to interact, promotes and enhance learning experience. An exciting technological tool with a lot of buzz in the past few years is Augmented Reality (AR). Augmented reality (AR) is a technology for interactive learning that combines elements of the real world with a virtual environment, by superimposing real two- or three-dimensional objects into physical space [8].

Integrating AR into the teaching and learning process in educational settings is still relatively novel and unexplored. However, AR has already been implemented in subjects like science, specifically the concepts of matter and its transformations. Students now have the opportunity to interact with difficult subjects in a unique and more operative approach. The use of AR-based elements significantly increases the level of student engagement and overall learning outcomes by enhancing students' ability to understand science even for abstract phenomena [9].

Besides having the ability to interact with the user, AR can also be enhanced further by the inclusion of audio features. The integration of the visual and audio elements improves the overall learning experience for different learners as well as make the process of learning more interesting. Assemblr Edu, an AR platform, allows its users to produce AR content effortlessly with the use of 3D models and audio. Considering its ease of use, it is less complicated than other 3D modeling softwares owing to its minimal programming requirements. Users of Assemblr Edu are not limited to the use of its internal features since it supports external 3D modeling images, thus increasing the potential for content development and remains an efficient tool in the development of educational modules [8].

The goal of this research is to create a science module based AR using Assemblr Edu that focus on topic matter and its changes. Some audio integration features are also included in the module to improve students' interest and understanding. The objective is to evaluate if AR and audio can be effectively integrated into educational modules, so as to make the learning of science concepts more engaging to learners. Such a module design is anticipated to alleviate the misconceptions and the challenges that students encounter when learning about matter and its change making the learning of the subject more efficient and enjoyable. The combination of Augmented Reality and audio-visual aids in particular science modules is a promising approach in enhancing the quality of the science curriculum. Through the use of the technology which is interactive and interesting, teachers are able to assist the learners understand complex scientific ideas, encourage them and in the end, improve their understanding and performance. This research intends to expand the existing literature regarding the use of AR in primary science education.

2. **Researh Methods**

This study employs a Research and Development (R&D) methodology aimed at developing a product, specifically an Augmented Reality (AR) science module integrated with audio, using Assemblr Edu for the topic of matter and its changes. The development process follows the 4-D model, which includes the stages of Define, Design, Develop, and Disseminate.

The parameters measured in this study include feasibility of media by experts. The Feasibility Level of the AR Science with Audio Module assesses how appropriate and effective the module is for educational purposes. The feasibility test will be carried out by two media experts and two subject matter experts, each of whom assesses the module based on their area of expertise. The assessment will focus on aspects such as the layout of the design and illustration of the images, audio aspects, ease of use, and benefits for users. Material validation by subject matter experts assesses several aspects, including content quality, presentation and communication, as well as aspects of learning strategies.

The percentage of validity can be calculated using the formula:

$$\text{Results} = \quad \times 100\%$$

The feasibility categories are determined according to the following criteria:

Table 1. Media Feasibility Criteria.

Score in percent (%)	Feasibility Criteria
81 – 100 %	Highly feasible
61 – 80 %	Feasible
41 - 60 %	Quite Feasible
21 – 40 %	Not feasible
< 21%	Very not feasible

3. Results and Disscusion

This research aims to develop and assess the feasibility of Augmented Reality (AR)-based science modules with audio integration using the Assemblr EDU platform, with a focus on the material and its changes. The 4D model (Define, Design, Develop, Disseminate) guides the development process.

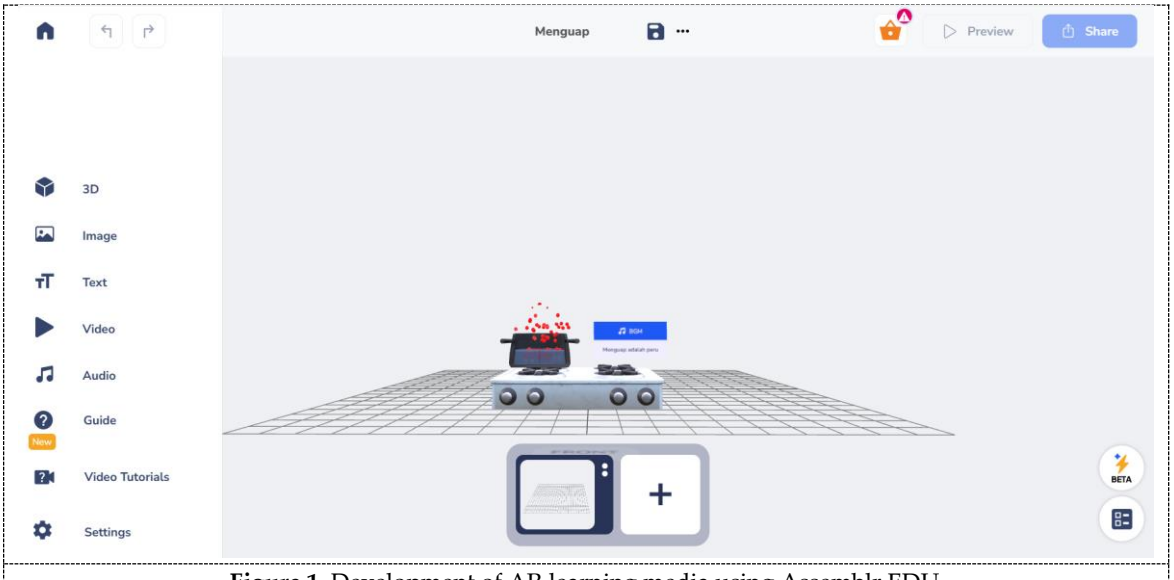

Figure 1. Development of AR learning media using Assemblr EDU.

In the Define stage, the needs analysis reveals students' difficulties in understanding physical and chemical changes. The Design stage involves identifying key concepts, creating a content framework with the teacher, and ensuring coverage of important topics such as the properties of the material and changes. In the Develop stage, 3D objects representing solid, liquid, and gaseous states, along with examples of changes, are created. Audio explanations are synced with AR visuals for a holistic learning experience. Prototypes are tested to ensure functionality, by engaging media and subject matter experts to get feedback. Revisions are carried out before the classroom trial, to ensure the module is informative and effective in improving students' understanding of science concepts.

After completing the module's prototype, the internal testing is done by the team who checks, for example, how objects are being interacted with, the quality of audio, or the responsibility of the platform. Then, the feasibility of the modules is tested, which includes sending them to media and material experts. The feedback from the expert make it possible to suggest appropriate revisions and improvements. This process of hastening towards vetting the modules is to make sure that its quality for student-teacher testing has already been achieved. Hence the idea is to ensure that the module will be educative while at the same time promoting students' understanding of elaborate scientific ideas. It is also possible, and it is the case here, that plain-text comments had to be provided by the project experts in order to assure the conceptual coherence of the module. This aspect of development is key in making the module suitable for broader classroom application by enhancing its functionalities and suitability in actual learning situations. The validation results from the experts are summarized in the following table.

Table 2 Media expert validation

Statement	Percentage (%)
Media Design	87.5%
Layout and Image Illustration	95.8%
Presentation and Language Aspect	93.8%
Ease of Use	87.5%
User Benefits	96.4%
Average	**92.2%**

The Validation results of the Augmented Reality (AR) science module with sound affirm that the module has been highly feasible in almost all the scored parameters. A 92% score was recorded for the media design which has corroborated with earlier research findings emphasizing the relevance of efficiently designed digital learning tools in captivating the students [6]. In this aspect, several parameters were assessed by media experts such as the appearance of the AR science module cover, the suitability of the AR media size with android standards, the attractiveness of the AR science module cover, the suitability of the letters used, the selection of the right typeface, the clarity of the letters, spacing and spacing in normal text, whether the module displays a supportive color contrast, color attractiveness, the suitability of the color of the writing, display an attractive background. The layout and illustrations aspect which assesses the arrangement of layout elements on the cover gives a good impression, displays the center of view, the placement of layout elements is consistent based on the writing pattern, the use of illustrations of problems related to daily life received 87.5%, and text

inconsistency still remained a target area for future improvement. Most respondents 95.8% mentioned, the highest score that the audio part obtained, emphasized the importance of clear and synchronized audio in achieving the desired learning outcomes [10]. Audio-visual synchronization in learning media can attract children's attention to the word they are currently hearing. In addition, it also helps improve children's reading skills so that children's understanding of texts also increases [11]

Figure 2. Cover of the AR science learning module.

The language and presentations of the module also performed well at 93.8%, which lends credence to the fact that the use of precise and simple language helps in improving understanding [7]. Efficacy of application smartphones rated at 87.5% suggests that the module does not require much technical knowledge to handle, although some improvements must be made on application speed. In general, an overwhelming 92.2% was the total validity score of the developed AR-based module and therefore it is readily applicable in science education as it employs creative and captivating techniques to support students learning experiences.

Table 2 Subject matter expert validation

Statement	Percentage (%)
Content of the Media	96.8%
Presentation and Communication	97.5%
Aspect for Learning Strategy	96.9%
Average	**97%**

Based on the results of validation by two material experts on Augmented Reality (AR)-based science modules and Assemblr Edu-based audio, it can be concluded that this media has a very high feasibility. The assessment shows an overall average score of 97%, which indicates that the module meets the standards for use in science learning. This score is obtained by assessing the following statements: learning in the media is in line with the basic competencies (KD) and core competencies, the material presented in the media is in accordance with the basic competencies (KD) and core competencies, the presentation of the material is carried out in order, the material in the media is presented in complete,

the material presented can help understanding other topics, the material in the media is delivered clearly without complication, Dialogue or story text in the media is right on target with the material, the learning topic is presented clearly, the concept of the material is conveyed in accordance with scientific standards, the formulas and symbols are written in accordance with scientific standards, the audio explains the material appropriately, the problems in the media are related to daily life, the illustrations are in accordance with the content of the material in the media, the evaluation questions are presented clearly in the media, Evaluation questions include all the material that has been presented and the image objects displayed in accordance with the material taught.

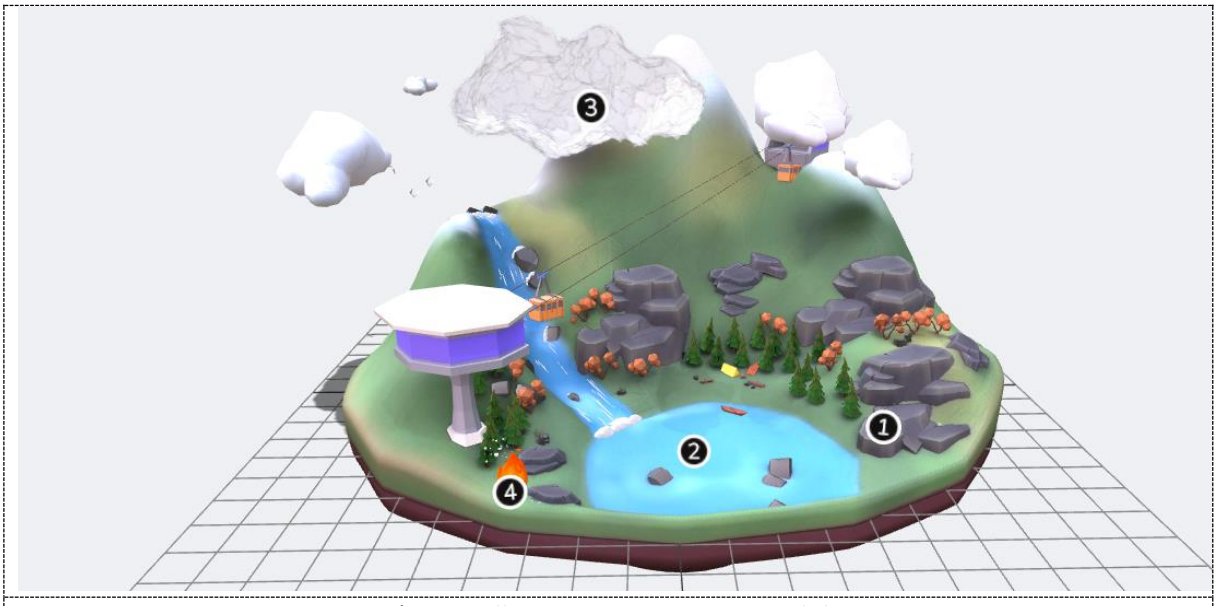

Figure 3. Illustration in AR science modul.

In terms of media content, the validity reached 96.8%, emphasizing that the learning objectives and materials presented were in accordance with the basic competencies and core competencies. The material is delivered in order, complete, and relevant to daily life, helping students in understanding important concepts. The suitability of illustrations and evaluation questions with the material also received high scores, showing that this media supports students' understanding comprehensively.

In terms of presentation and communication, this module is rated very good with a validity score of 97.5%. The language used is easy for learners to understand, while the use of audio helps clarify the material. The use of the right language flow allows students to understand the material effectively.

The aspect of learning strategies also received a validity score of 96.9%. This module is considered to be able to increase student motivation, support the learning process, and can be used in various other learning models. Based on these results, the AR science module based on Assemblr Edu is declared very feasible to be used as an innovative learning media. Learning media that has been deemed suitable based on the assessment of media experts and material experts, needs to be further tested, namely practicality and effectiveness tests [12, 13]. Science learning using AR improves students' analytical skills and provides a better understanding of science learning [14, 15]

4. Conclusion

Based on the research results, the development of the Augmented Reality (AR)-based science module, enhanced with audio via the Assemblr Edu platform, has been deemed highly feasible as a teaching medium. Media validation testing by experts achieved a score of 92.2%, categorized as highly

feasible, while content validation by subject matter experts received a score of 97%, also in the highly feasible category.

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