

Android Media Development Based on Augmented Reality in Photosynthetic Material for PGSD UN PGRI Kediri Students

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ABSTRACT

This study aims to produce educational media based on Augmented Reality (AR) on the photosynthesis material used in PGSD students at Nusantara PGRI Kediri University who are taking the basic concepts of Science (IPA) 2. The type of development research model used in this study is the Borg & Gall model and Lee & Owen with the stages of research and data collection, planning, product development, design validation, design revision. However this research is only limited to design revision after expert validation, this is due to limited research time. The instrument used in this research activity was a validity questionnaire (media expert, material expert, and linguist). Data analysis used in this research activity is descriptive qualitative data analysis and qualitative descriptive. The results of the research obtained from the media expert validator were 73 or 91%, the score of the results of the validation of the Photosynthesis material expert was 37 or 92%, and the score of the results of the validation of the linguists was 38 or 95%. This means that the development of AR-based educational media on photosynthetic material is valid, so that it can be used for learning media on photosynthetic material

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1. INTRODUCTION

The outbreak of COVID-19 all over the world, especially in Indonesia, has changed the structure of the education system from face-to-face learning to online learning (online). But not all lecturers and students are ready to do online learning so that learning does not run optimally. This was caused by a sudden change of order and without prior preparation. Along with these problems, Indonesia has entered the era of the industrial revolution 4.0. This means all aspects of life cannot be separated from internet technology. Besides, the advancement of information and communication technology in the 21st century is developing rapidly which affects life, one of which is in the aspect of education (Divayana, Suyasa, & Sugihartini, 2016). This condition requires lecture activities to adapt learning models and approaches so that students have thinking and learning skills according to real life. In the lecture process, lecturers are required to develop a critical and creative mindset for students, and lecturers are expected to be able to

conduct lectures innovatively according to the times. One way is to develop educational media in the form of artificial objects. Artificial objects or displays that are similar to the original are needed during the learning process because they will improve the skills of students so that the learning process will run well (Arsyad, 2007). In the last few years, the use of smartphones in education has started to become popular in the community, starting from the levels of primary, secondary, to tertiary education, even though the variations and focus of their use are different in each institution.

One of the efforts to improve the quality of education and learning with the above conditions is through online learning improvements. Online learning is closely related to the interaction between students and lecturers. This interaction cannot be separated from the media used by the lecturer in delivering teaching material. The more attractive the media is, the more interested students will be in participating in learning activities or lectures. Media by utilizing Information and Communication Technology in today's era is important in learning. One of the fastest-growing technologies today is smartphones. The existence of technology, especially smartphones and the internet, is now growing. One of the benefits that can be taken from the existence of this technology is by using it as an educational learning medium. So that educational application media can continue to be developed, one of the many is Augmented Reality (AR) technology.

This research is based on the development of media that previously still used conventional media developed into Augmented Reality which is a form of technological development in the form of a combination of virtual objects with real objects in the form of 3-dimensional animation (Azuma, 1997). Augmented Reality aims to develop technology that allows real-time integration of digital content created by computers with the real world (Haller, Billingham, & Thomas, 2006). Apart from computers, currently, AR technology has been developed on Android smartphones. Smartphones with the Android operating system have many advantages, apart from the fact that there are a lot of users in Indonesia, the Android platform is also open source for developers to create applications. Augmented Reality technology which is used as a learning medium is expected to improve student learning outcomes. Because this technology is applied as a learning medium, students will be invited to think in real terms, without having to bring in practical tools directly (Putri et al., 2020).

Based on the results of observations made in the study program. PGSD UN PGRI Kediri is trying to improve the quality of learning. There are several obstacles to realizing virtual-based online learning activities with real objects. This is due to the absence of supporting media for lecture activities, especially on photosynthesis material. Understanding the concept of photosynthesis is a basic competency that must be mastered by PGSD UN PGRI Kediri students because later students after becoming teachers will instill concepts in students regarding the stages of photosynthesis. Photosynthesis material is taught in the subject of basic science concepts for level 1 for first semester students. Photosynthetic material studies the process of photosynthesis. The actual process of photosynthesis cannot be seen by the eye because it is related to the reactions between molecules. It is expected that by using Android Media based on AR students can know the real process of photosynthesis so that students can understand the photosynthesis material.

2. METHODS

This study uses a development research model, it is a modified Borg & Gall and Lee & Owen model, both models are modified to complement the limitations and optimize the advantages of each model. Where the Borg & Gall model focuses on research activities, while the Lee & Owen model focuses on media development activities (Aka, 2004). Here are the steps:

1. The stages of research and information gathering are stages that contain needs analysis and front-end analysis.
2. Planning, which consists of scheduling, teamwork, media specifications, content structure, and configuration control.
3. Product development, which contains the preparation of a framework and making media that have been previously planned.

4. Design validation, performing media validation by three experts, namely media experts, material experts, and linguists.
5. Revision of design, namely from the results of the validation that has been carried out by experts, input, suggestions, or criticism is obtained then revised.
6. Product testing is a limited trial of 6 students.
7. Product revision, namely revising the results of a limited trial based on a questionnaire given to 6 students.
8. The use trial is called a field test is given to 20 students.

However, due to time constraints, this research was limited to the design revision stage from the validation results that had been carried out by experts and approved for testing. This research uses descriptive quantitative data analysis techniques and qualitative descriptive data analysis. Quantitative descriptive analysis is used to process data originating from questionnaires and test sheets while qualitative descriptive analysis is used as data processing in the form of responses in the form of suggestions, responses, or criticism. Then for quantitative descriptive and qualitative descriptive data can be obtained from three types of data, namely data validity. Media is said to be valid if the validation results in the form of validation sheets from the three validators (media experts, material experts, and linguists) state that they are valid so that the media can be used.

3. FINDINGS AND DISCUSSION

There are so many android media that are made based on Augmented Reality, but in this study the focus is on photosynthetic material for students that looks 3D animation. The results obtained from this development research are Android Media Based on Augmented Reality in Photosynthesis Matter which was tested on several subjects, which are media experts, material experts, and linguists. This specific media consists of a front-page that presents the name and class, then after entering with the arrow keys students can choose a menu consisting of menu choices for learning objectives, directions, start and download markers, then students open the learning objectives menu so that students know the learning objectives must be achieved, continued to open the menu of instructions so that students understand the next steps. Then students download markers so they can use the Augmented Reality application. Next students enter the start menu. The start menu consists of the subject matter menu, Augmented Reality, quizzes, and supporting information. To be able to see the Augmented Reality application, students enter the Augmented Reality menu then scan the marker that was downloaded earlier, the Augmented Reality application related to the photosynthetic process material can be observed, and to strengthen knowledge about photosynthesis reactions, it can open a menu of supporting information, in supporting information three videos will increase students' knowledge regarding photosynthesis material. After all the activities have been carried out, the final part of the students is to work on the quiz that has been provided in the quiz menu. The following is a display of educational media based on augmented reality on photosynthetic material.

Educative Media Icon Based on Augmented Reality on Photosynthesis Material



Figure 1. Icon the smartphone

After the android application is installed on the smartphone menu, the icon will appear as shown above. Then for how it works students, by clicking the icon above, students can enter the application and a menu will appear as below

The initial application view of Augmented Reality Based Educational Media on Photosynthetic Material



Figure 2. Initial application view

From the view above, students operate educational media by:

1. Click a name to fill in user identity.
2. Click what class to fill in.
3. Then to proceed to the next menu by clicking the arrow button.
4. And if you want to exit the application then click the cross button.

Application Menu View Media of Augmented Reality Based Educational Media on Photosynthetic Material



Figure 3. Application menu view

The above application menu display appears after pressing the arrow key in the initial image. In the application menu display there are:

1. The learning objectives menu contains the objectives or learning outcomes using the application, for more details, see Figure 4. (a).
2. Instructions for using the application contain instructions for using the application, for more details, see Figure 4. (b).
3. The start menu includes a menu of subject matter, augmented reality, quizzes, and supporting information.
4. Marker download menu as shown in Figure 10. (a) which functions to download markers.
5. In addition, there are arrow keys to return to the home screen menu or the previous menu.
6. And the gear button that contains the application developer profile.

Menu Display Learning Objectives and Instructions for Use of Educational Media Based on Augmented Reality on Photosynthesis Material

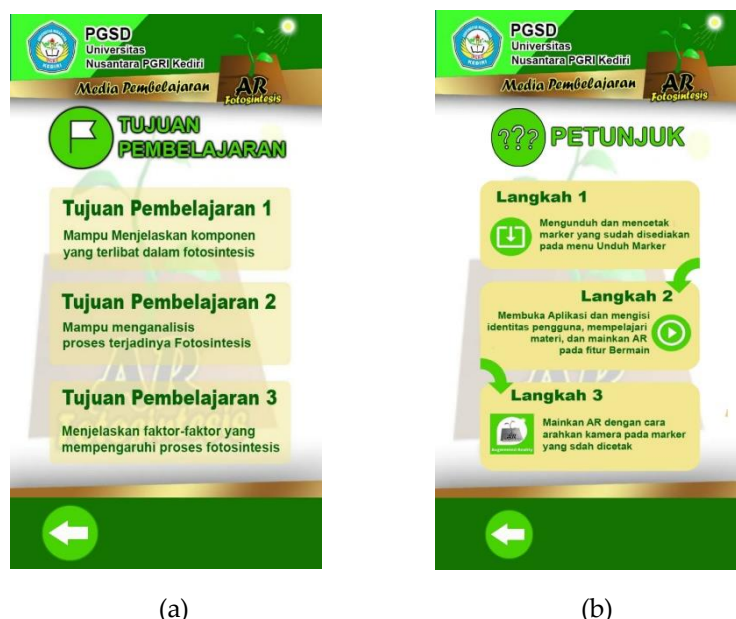


Figure 4. (a) Learning Objectives, and (b) Instructions

Display Menu Application Start (Mulai) Educational Media Based on Augmented Reality on Photosynthetic Material



Figure 5. Display menu application start

The start application menu display appears after pressing the start button on the application menu display. The application start menu consists of:

1. There is a menu of subject matter which when clicked will display the subject matter of photosynthesis reactions when clicked a display will appear like Figure 6.
2. If you click the augmented reality menu, the application icon will appear as shown in Figure 8.
3. The Quiz menu is useful for measuring whether the learning objectives have been achieved or not if the display shown is shown in Figure 9 (a).
4. When clicked, the supporting information menu will appear as shown in Figure 9 (b).
5. Then there is an arrow button to return to the previous menu.

Main Material Menu View of Media Based on Augmented Reality on Photosynthesis



Figure 6. Main material menu view

The following is a description of the material from the main menu of educational media based on augmented reality on photosynthesis. The description of the material consists of the meaning of photosynthesis, the factors that influence photosynthesis and the photosynthetic process. The material is also presented in the form of instructional videos in the supporting information menu.



Figure 7. (a) Photosynthesis material, (b) Photosynthesis factors, and (c) The process of photosynthesis Menu view of Augmented Reality on Photosynthetic Material

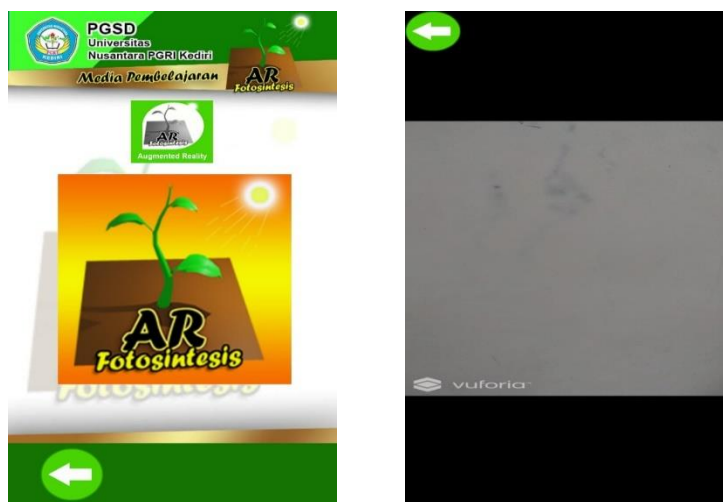


Figure 8. (a) Augmented reality menu, and (b) Scan camera view

Menu Figure 8. (b) The scan camera view will appear after clicking the application icon in Figure 4. (a) The augmented reality menu. Its function is to scan markers and then the application of photosynthesis will appear simply as shown.

Quiz Menu View and Supporting Information for Educational Media Based on Augmented Reality in Photosynthesis Material



(a)

(b)

Figure 9. (a) Quiz menu (example view of one of the questions), and (b) Support menu (video link from YouTube on photosynthesis process and material)

When the Quiz menu is clicked, 10 multiple-choice questions will appear which when worked on there is a certain duration of time and after the questions are finished, the scores of each student will appear according to the account used to enter. When clicked on the supporting information menu, three learning video links will appear related to the process of photosynthesis from Youtube.

Download Marker Menu View and the view of Augmented Reality-Based Educational Media Applications on Photosynthetic Material

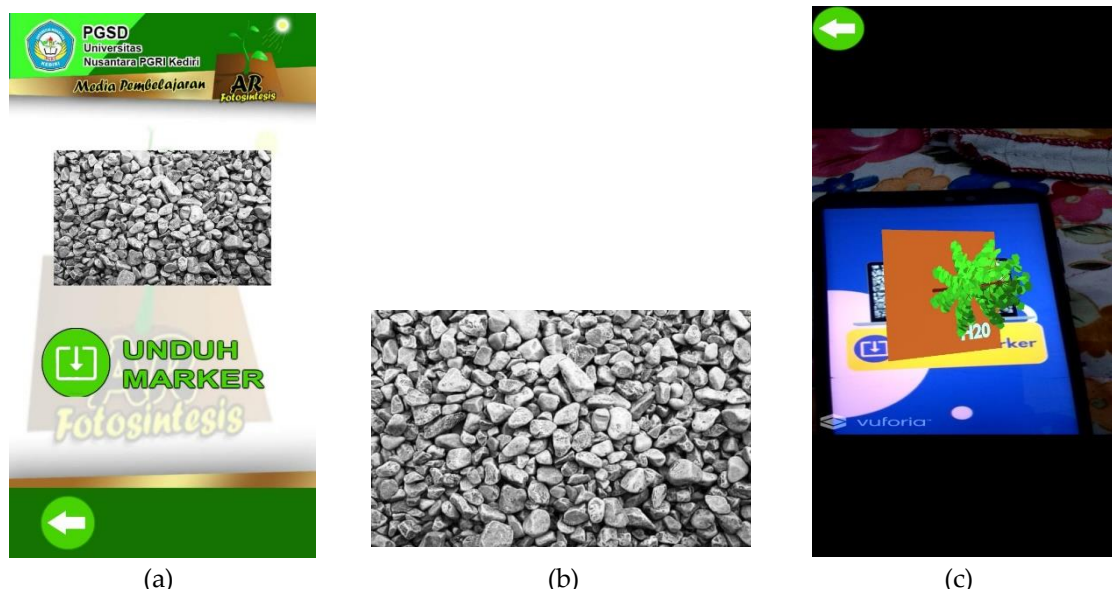




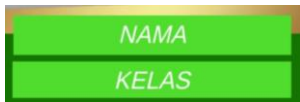

Figure 10. (a) Download marker menu view, (b) The downloaded marker, and (c) The application view of augmented reality




The marker download menu will appear as shown in Figure 10 (a), when you click download marker, the marker can be automatically downloaded to be able to scan the Figure (b). After the markers are scanned using the camera scan augmented reality menu on the application menu starting in Figure 4 then an augmented reality application will appear as shown in Figure 10 (c) above which will display the process of implementing photosynthesis in a simple manner.

Buttons Functions on Education Media Based Augmented Reality on Photosynthetic Material

The following is a table of buttons in educational media based on augmented reality on photosynthetic reaction material:

Table 1. Buttons Functions in the Application

Buttons	Functions
	Icon in smartphone view Button to activate the marker scan camera so that the application appears.
	The button with this symbol is used to go to the next step.
	To fill in the name and class of students who use the application.
	The arrow button is used to return to the previous view.

	The button with this symbol is used to view profiles.
	Continue to the next quiz question.
	The button with this symbol functions to exit the application.

To find out the validation results of an educative media Augmented Reality-based on the developed photosynthetic material, the validation was carried out by 3 validators: media expert validators, material experts, and linguists. The first validation process was carried out by a media expert, Bu Nurita Primasatya, M.Pd. The validation results from media experts can be seen in Table 2.

Table 2. The validation results from a media expert

No	Indikator	X	Y
1	The color theme of educational media based on Augmented Reality in Photosynthetic Material is very interesting	3	4
2	The text size of educational media based on Augmented Reality in Photosynthetic Material is very clear	4	4
3	The text clour of educational media based on Augmented Reality in Photosynthetic Material is appropriate	4	4
4	The picture of educational media based on Augmented Reality in Photosynthetic Material is clear and interesting	3	4
5	The audio in educational media based on Augmented Reality in Photosynthetic Material is clear to listen.	3	4
6	The fitures in educational media based on Augmented Reality in Photosynthetic Material can be used easily and clearly.	3	4
7	The instructions for using Augmented Reality Media on Photosynthetic Material is clear	3	4
8	The menu view presented on Educational Media Based on Augmented Reality on Photosynthesis Material is informativ	4	4
9	Media view based on Augmented Reality on Photosynthetic Material is informative	4	4
10	The audio of Augmented Reality on Photosynthetic Material is clear and easy to understand	3	4
11	The marker of Augmented Reality on Photosynthetic Material is clear and harmonious	4	4
12	The media on Photosynthesis Material increases learning motivation	4	4
13	The Media Based on Augmented Reality on Photosynthesis Material is able to involve students in the learning process	4	4
14	The Media Based on Augmented Reality on Photosynthesis Material is able to guide students in learning activities	4	4

15	The Media Based on Augmented Reality on Photosynthesis Material is able to encourage students to take an active role in the learning process	3	4
16	The Media Based on Augmented Reality on Photosynthesis Material is equipped with informative and it is easy to understand	4	4
17	The Media Based on Augmented Reality on Photosynthesis Material is completed with clear explanation	4	4
18	The Media Based on Augmented Reality on Photosynthesis Material has a clear plot of usage	4	4
19	The evaluation questions on Augmented Reality-Based Media on Photosynthetic Material are easy to understand	4	4
20	The program of Augmented Reality-Based on Photosynthetic Material is easy to operate	4	4
TOTAL		73	80

Noted: X = Obtained score, Y = Maximum score

Based on Table 2, it shows that the number of scores from the validation results of media experts is 73 or 91%. This means that the material on the development of educational media based on Augmented Reality on photosynthesis material has met the valid criteria for further use in learning activities in the basic concepts of science subject (IPA) for PGSD Nusantara University PGRI Kediri students with revisions in accordance with the criticism and suggestions given by the validator. The following are criticisms and suggestions from media expert validators:

Table 3. Revisions and suggestions

No.	Critics dan Suggestions	Perbaikan
1.	In the section "Factors Affecting the Process of Photosynthesis" the text at the bottom (bottom three lines) is illegible.	In the section "Factors Affecting the Process of Photosynthesis" the text at the bottom (bottom three lines) is readable.
2.	The video "photosynthesis process 1" could not be accessed.	The video "photosynthesis process 1" can be accessed.
3.	There is no indication yet about the function of each button used.	It has been added the instructions for the quiet function of each button used.

Meanwhile, the material expert validation on Photosynthesis was carried out by Bagus Amirul Mukmin, M.Pd. The results of the validation from material expert can be seen in Table 4.

Table 4. The validation results from a material expert

No	Indicator	X	Y
1	The appropriateness with learning objectives	4	4
2	The existing materials in educational media based on augmented reality on photosynthetic materials coherently and systematically	4	4
3	The material in the Educational Media Based on Augmented Reality on Photosynthetic Material is in accordance with the needs	4	4
4	The view of existing material on Augmented Reality-Based on Photosynthetic Material is completed	4	4
5	The view of existing material on Augmented Reality-Based on Photosynthetic Material is related to one and another	4	4

6	The view of existing material on Augmented Reality-Based on Photosynthetic Material is balanced	4	4
7	The Quiz in on Augmented Reality Media on Photosynthesis Material is in accordance with the basic concepts of science subject matter (IPA).	3	4
8	The Quiz in Educational Media Based on Augmented Reality on Photosynthesis Material is coherence (easy-difficult)	3	4
9	The difficulty level of quiz items on Augmented Reality Media on Photosynthetic Material is in accordance with the level of student ability	4	4
10	Kuis dalam Media Edukatif Berbasis Augmented Reality pada Materi Fotosintesis meningkatkan pemahaman mahasiswa terhadap materi The quiz in Augmented Reality Media on Photosynthesis Material improves students' understanding of the material	3	4
TOTAL		37	40

Noted: X = Obtained score, Y = Maximum score

Table 4 shows that the total score of the results of the validation of the Photosynthesis from a material expert was 37 or 92%. This means that the material on the development of educational media based on Augmented Reality on photosynthesis material has met the valid criteria for further use in learning activities in the basic concepts of science subject for PGSD Nusantara University PGRI Kediri students without the need for revision.

Meanwhile, linguist validation for the development of educational media based on Augmented Reality on photosynthesis material was carried out by Rian Damariswara M.Pd. The results of the linguist validation are as shown in Table 5.

Table 5. The validation results for a linguistic expert

No	Indikator	X	Y
1	Using good and correct language rules.	3	4
2	Using general or local terms that match the subject discussion.	4	4
3	The language is straightforward and in accordance with the language level collage students	4	4
4	Using communicative and informative language.	4	4
5	The accuracy of using local terms or languages is described clearly.	3	4
6	The sentences can convey the content of the material or information well.	4	4
7	The sentences are simple and accurate.	4	4
8	Spelling accuracy	4	4
9	Consistent use of terms.	4	4
10	Consistent use of punctuation and symbols.	4	4
TOTAL		38	40

From Table 5, it can be seen that the total score of the linguist validation results is 38 or 95%. This means that the development of Augmented Reality-based educational media on photosynthesis material is valid for further use in learning activities in the basic science concepts course for PGSD Nusantara

University PGRI Kediri students with revisions under the criticism and suggestions given by the validator. The following are criticisms and suggestions from the linguist validator:

Table 6. Revisions, critics and suggestions

No.	Critics and Suggestions	Perbaikan
1.	The foreign writing, such as Augmented Reality, should be italicized. The word "quiz" should be written in Indonesian, "kuis".	The foreign writing, such as Augmented Reality, is italicized. The word "quiz" should be written in Indonesian and has been revised, "kuis".
2.	An interrogative sentence on the subject matter use lowercase except the beginning of the sentence. The reason is that capitalization is only used in the title or subtitle.	The question sentence on the subject matter has been using lowercase except.
3.	The writing of the word "dibawah ini" on the material of photosynthetic factors is written separately as "di bawah ini".	The writing of the word "dibawah ini" on the material of photosynthetic factors has been written separately as "di bawah ini".
4.	There should be a gear symbol (symbol gerigi) replaced with the word "profile", because in general the gear symbol is used for settings	There is a gear symbol that has been replaced with the word "profile".

Augmented Reality (AR) learning media is a technology-based learning media. AR combines virtual and real objects in the form of 3D animations with supporting text according to the actual environment so that users can feel the object more real (Klopfer, 2008). AR has a rich capacity which can be seen through supporting devices such as smartphones or tablets which are equipped with information according to real objects (Bower, Howe, McCredie, Robinson, & Grover, 2014). AR can be defined as a variation of virtual reality, which means directing the user into a synthetic environment. When it gets dark, the user is limited in seeing the real world around him. However, AR can provide a 3D image for users to see the real world, through virtual objects that are superimposed or combined with the real world (Kaufmann, 2003). Based on this opinion, it can be concluded that AR is a combination of virtual and real objects in the form of 2D or 3D animation which is equipped with supporting information to make it easier for users to recognize objects in real-time. It can be concluded that AR is a combination of virtual and real objects in the form of 2D or 3D animation which is equipped with supporting information to make it easier for users to recognize objects in real-time. This can be used in the learning process, namely AR as a learning medium because AR can visualize objects well, as evidenced by the results of research on educational media based on augmented reality on photosynthetic material that has been described previously, it can be seen that products or educational media based on Augmented Reality on photosynthetic material developed from the results of expert validation, namely from media experts by 91%, from material experts by 92% and from linguists by 95%, from each of these results these values indicate that augmented reality-based educational media on photosynthetic material is included in the eligible criteria and is not must re-validate (Arikunto, 2010). It can be concluded that the overall results are valid and feasible, this is in accordance with previous research conducted (Burhanudin, 2017) which provides the final conclusion that the results of the feasibility assessment by material experts get a value with a category feasible, the media expert's assessment gets a decent category and the user expert's assessment gets a decent category. Similar results have also been found by (Mustaqim, Pd, & Kurniawan, 2017) which states that Augmented Reality can be used in entertainment, medicine, mechanics, and learning media. The research conducted (Fenty, Pradono, & Nurochmah, 2014) is also not much different based on the research conducted, augmented reality can be implemented in

interactive learning applications on photosynthetic material, and respondents stated that the 3D animation design on Plant AR learning media is easy to use and attracts learning interest. which is compared to other studies that still use power point media or others.

4. CONCLUSION

This research and development produce android software products or media based on Augmented Reality on photosynthetic material. The results of the research obtained from the media expert validator were 73 or 91%, the score of the results of the validation of the Photosynthesis material expert was 37 or 92%, and the score of the results of the validation of the linguists was 38 or 95%. This means that the development of AR-based educational media on photosynthetic material is valid. Furthermore, it can be used in learning activities in the subject of basic science concepts for study program students. PGSD Nusantara University PGRI Kediri with revisions under the criticism and suggestions given by the validator.

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