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Development of Android Application Media Based on PQ4R Learning Strategy on Cognitive Learning Result of Class X Students on Ecosystem Materials

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Abstract

The purpose of this research is to analyze the feasibility of the android application media based on PQ4R learning strategy according to experts and users and to find out the effectiveness of the media on the cognitive learning result of class X MIPA SMA Negeri 1 Batang on ecosystem material. This type of research is Research and Development (R & D) with research procedures using the ADDIE model, namely Analysis, Design, Development, Implementation, and Evaluation. Data collection techniques using observation, interview, questionnaire, and test. The results showed that the percentage obtained from material experts, media experts, and users, namely teachers and students with very decent criteria. The results of the study showed that there was a significant increase in cognitive learning result after using the android application media based on the PQ4R learning strategy on ecosystem material in class X MIPA SMA Negeri 1 Batang which was proven by the results of hypothesis test with Fcount (16,094) > Ftable (3,93). It is also proven in the results of the average posttest score of 87.81 compared to the average pretest value of 47.20 with an N-Gain of 0.77 in the high criteria. This study concludes that the android application media based on the PQ4R learning strategy on ecosystem material was declared very feasible by material experts, media experts, and users, namely teachers and students to use in learning and effectively improve student cognitive learning result.

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INTRODUCTION

Education is a long-term effort that develops together following the needs of society as a result of advances in science and technology. So that education requires attention, both in terms of development and improving the quality of education in response to the demands of society. Teachers are expected to make learning more innovative to improve achievement and student learning result. Based on the results of unstructured interviews with biology teachers at SMA N 1 Batang, students' comprehension skills in reading ecosystem material is still low and not by the competencies expected in the curriculum. Students are not interested in reading the material because according to students the reading material is monotonous and boring, besides that because it contains many terms related to one another. Another problem is that many students don't concentrate on studying because they are too busy with their cell phones which are used for social media and games. The majority of students already have smartphones with the Android operating system, but they have not been used optimally as a learning tool.

Based on these problems, it is necessary to find a solution that is considered capable of helping students improve their reading skills. One learning strategy that is expected to improve and encourage students to read is the PQ4R learning strategy (Preview, Question, Read, Reflect, Recite, and Review). The PQ4R strategy is a component of the elaboration strategy used to help students understand and remember their reading material. This PQ4R includes Preview, namely starting to read, and previewing titles and subtitles at a glance. The question is asking yourself about the reading material to be read. Read, namely start reading while remembering the questions that have been formulated. Reflect, namely, when reading, students look for answers to questions and understand the information contained in the reading. Recite, namely contemplating the information that has been learned from reading results by recording important information. Review, namely reading short notes (essence) that have been made (Al-Tabany 2017). Reading is one way to understand and understand the subject matter. With the PQ4R learning strategy, even though students still read the material, in reading students will go through the preview and question stages which makes the student reading process more meaningful. Because during the Read stage, students don't just read the writing but when reading students have to look for answers to questions that have been made before so that the material can be absorbed better. In addition, when reading students do not only read writing/text because, with the integration of the Android application, students can also read in video form. Therefore, even by reading, students will not feel bored.

To improve student achievement and learning result, instructional media must be innovative and effective about the subjects being taught. So we need varied and fun media, such as interactive media. Interactive media is defined as a combination of various forms of media that are presented interactively in learning media such as text, graphics, photos, animation, video, and sound. The greater the number of students who own and use smartphones, the greater the opportunity to use technological devices, namely smartphones in education. Adobe Flash CS6 is computer software that can be used to create animations and multimedia content. Adobe Flash CS6 includes various features for creating and processing text and objects to make the results more attractive. The PQ4R learning strategy combined with the android application uses Adobe Flash CS6 so that students become more interested and active in learning. Therefore it is necessary to examine the feasibility of the PQ4R learning strategy combined with the android smartphone application and its effectiveness on student learning result in ecosystem material.

RESEARCH METHOD

The research was conducted at SMA N 1 Batang which was carried out in Class X MIPA SMA N 1 Batang in the Even Semester of the 2021/2022 Academic Year. This study used a purposive sampling technique. The sample used was 3 classes with a total of 108 students including 36 students in class X A MIPA and 36 students in class X B MIPA as the experiment class and 36 students in class X C MIPA as the control class. Data collection techniques used in this study include observation, interviews, questionnaires, and tests. The development of learning media in the form of an android application is research and development or Research and Development (R&D) using the ADDIE development model (Analysis, Design, Development,

Implementation and Evaluation). The stages that must be carried out in research in the ADDIE model include the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage.

Then the data analysis technique is carried out by 1) analyzing the feasibility of the media with expert validation and user responses and 2) analyzing the effectiveness of the media on learning result. For the feasibility assessment of android application media based on PQ4R learning strategy, it is analyzed by validator experts with feasibility instruments to measure attitudes, perceptions, opinions, and object problems, product designs created or developed (Sugiyono 2018). Apart from being based on a questionnaire from experts, the feasibility analysis also uses a user response questionnaire, namely teachers and students by distributing a Google Form link for students to fill in after using the product. Furthermore, to assess the effectiveness of the media on cognitive learning result is carried out with the normality test, the N-Gain test, and the hypothesis test. The normality test aims to test students' cognitive learning result. If the sign value. > 0.05, the data can be said to be normally distributed. To find out the increase in students' cognitive learning result (pre-test and post-test) a quantitative analysis was carried out using the Gain Normality formula. Cognitive learning result are said to increase if the N-Gain scores ≥ 0.71 in the high category and 0.30 ≤ g ≥ 0.70 in the medium category. In addition to analyzing the normality of the data (normality test), N-Gain, a hypothesis test was also carried out. Hypothesis testing was used to find out whether there were differences in the cognitive learning result of class X MIPA SMA N 1 Batang who studied using the Android application media based on the PQ4R learning strategy. To calculate the value of the hypothesis with SPSS software version 25.0, the ANOVA test was performed. If the F count is greater than the F table or Sig. smaller than 0.05, then the hypothesis (Ha) is accepted, but if the calculated F is smaller than the F table or the value of Sig. greater than 0.05 then the hypothesis (H0) is rejected.

RESULTS AND DISCUSSION

RESULTS

This study aims to analyze the feasibility of an android application based on PQ4R learning strategy according to experts and users and to determine the effectiveness of the media on cognitive learning result of class X MIPA SMA Negeri 1 Batang on ecosystem material.

1) Results of Media Feasibility Data Analysis

Data from the results of the assessment by experts and users, namely teachers and students, were then analyzed to determine the feasibility of the product being developed.

a) Material Validation Test Data

The material expert test was carried out with the aim of knowing the feasibility of the material presented in the media. Aspects of the material expert test include aspects of material relevance, aspects of quality of content and objectives, and aspects of instructional quality. The following is the recapitulation of the material expert test:

Table 1 Material Feasibility Test Data

No.	Eligibility Aspect	Total of Score	Percentage	Criteria
1	Aspects of material relevance	17	85%	Very Decent
2	Aspects of the quality of content and objectives	34	85%	Very Decent
3	Aspects of the instructional quality	36	90%	Very Decent
A whole of percentage		**87**	**87%**	**Very Decent**

Material feasibility test in the "Ecostudy" application media which was validated by Prof. Dr. Sri Ngabekti, M.S. get an average total score of 87 with a percentage of 87% and get very feasible criteria for testing.

b) Media Validation Test Data

The media expert test aims to determine the feasibility of the media developed by the researcher. Aspects of media expert testing include aspects of ease of use and navigation, aspects of visual appearance, aspects of media integration, and aspects of technical quality. Following are the results of the media expert test recapitulation:

Table 2 Media Feasibility Test Data

No.	Eligibility Aspect	Total Score	Percentage	Criteria
1	Aspects of ease of use and navigation	23	92%	Very Decent
2	Aspects of visual appearance	32	92%	Very Decent
3	Aspects of media integration	18	90%	Very Decent
4	Aspects of technical quality	16	80%	Decent
A whole of percentage		**89**	**89%**	**Very Decent**

The feasibility test of the "Ecostudy" application media which was validated by Kholiq Budiman, S.Pd., M.Kom. get an average total score of 89 with a percentage of 89% and get very feasible criteria for testing.

Products that have been developed and validated by material experts and media experts are then implemented or tested on students. The implementation phase is carried out in two stages, namely, the first stage is a small-scale trial and the second is a large-scale trial.

c) Questionnaire of Student Responses on Small-Scale Tests

In a small-scale trial, the product will be tested on 20 students from Class X SMA N 1 Batang. At this stage, questionnaires were also distributed to measure and find out the opinions or responses of users, namely teachers, and students regarding learning media in the form of android applications for ecosystem learning. The student response questionnaire consisted of 10 statements using Google Forms with the option to agree on a scale of 5 and disagree on a scale of 0. The following is the recapitulation of the responses of 20 students in class X D MIPA SMA N 1 Batang:

Table 3 Recapitulation of Student Responses

No.	Statement	Total of Score	Percentage
1	How to use this application is simple	100	100%
2	I can understand quickly how to use this application	80	80%
3	The buttons in the application are in accordance with the intended page	100	100%
4	The language used is easy for me to understand	100	100%
5	The material presented is easy to learn	100	100%
6	Video presentation can make it easier for me to understand the material	90	90%
7	Giving practice questions can help me in practicing	80	80%
8	This application makes it easier for me to study independently or in class	100	100%
9	I am motivated to study harder with this application	100	100%
10	This application can add to my enthusiasm for learning	100	100%
TOTAL		**95**	**95%**

Recapitulation of statements from student responses shows that the 10 statements have an average total score and percentage of 95% which indicates that the media is very suitable for use in learning and all students give very good responses and positive responses to the use of android

application media based on PQ4R learning strategy material ecosystem "Ecostudy".

d) Teacher Response Questionnaire on Small-Scale Test

The teacher's response questionnaire used consisted of 10 statements using agree and disagree answer choices. The following is the recapitulation of the response of the biology teacher for class X MIPA SMA N 1 Batang:

Table 4 Recapitulation of Teacher Responses

No.	Statement	Total of score	Percentage
1	Ease of using the application	100	100%
2	The attractiveness of the appearance of the application design	100	100%
3	The neatness of the text, images, and content presented	80	80%
4	Appropriate color balance of text, images and backgrounds	100	100%
5	Appropriate size of text and images in the application	80	80%
6	Relevance of material with KD and learning objectives	100	100%
7	Presenting videos as a means to increase student understanding and as a learning distraction	80	80%
8	Learning media can foster student learning motivation	80	80%
9	Learning media can help students learn ecosystem material	100	100%
10	Learning media can increase students' knowledge	100	100%
	TOTAL	**92**	**92%**

Recapitulation of teacher response statements shows an average total score and percentage of 92% which indicates that the media is very suitable for use in learning and the teacher strongly supports the use of android application media based on PQ4R learning strategy for the "Ecostudy" ecosystem material.

e) Questionnaire of Student Responses on Large-Scale Tests

The student response questionnaire used consisted of 20 statements using Google Form assistance with the choices strongly agree on a scale of 5, agree on a scale of 4, undecided on a scale of 3, disagree on a scale of 2, and strongly disagree on a scale of 1. The following are the recapitulation result Responses of class X A MIPA and X B MIPA SMA N 1 Batang:

Table 5 Recapitulation of Student Responses

No.	Statement	Total of Score	Percentage
1	How to use the "Ecostudy" application is simple and easy to install	80	80%
2	I can quickly understand how to use the "Ecostudy" application	80	80%
3	The buttons in the application are in accordance with the intended page	83	83%
4	The layout of the navigation buttons is clear and not confusing	78	78%
5	The "Ecostudy" application can run smoothly when used	81	81%
6	The language used is easy for me to understand	85	85%
7	The ecosystem material presented in the "Ecostudy" application is easy to learn	77	77%
8	Ecosystem material is presented clearly	83	83%
9	The video presentation in the "Ecostudy" application is clear and interesting	79	79%
10	Video presentation can make it easier for me to understand the material	83	83%
11	Giving practice questions can help me in practicing	81	81%
12	I like the appearance of the application "Ecostudy"	74	74%
13	The appearance of the "Ecostudy" application is nice and attractive	78	78%
14	The menu layout, text, images and other content are neatly presented	81	81%
15	The use of colors, backgrounds, and images is not boring	78	78%
16	The text presented is clear and easy to read	83	83%
17	The "Ecostudy" application can help me in learning	81	81%
18	The "Ecostudy" application makes it easier for me to study independently or in class	79	79%
19	I am motivated to study more actively and creatively with the "Ecostudy" application	74	74%
20	The "Ecostudy" application can add to my enthusiasm for learning	76	76%
	TOTAL	**80**	**80%**

Recapitulation of statements from student responses shows that the 20 statements show an average total score and percentage of 80% indicating that the media is suitable for use in learning and all students are enthusiastic about using the android application media based on the PQ4R learning strategy ecosystem material "Ecostudy".

f) Teacher Response Questionnaire on the Large-Scale Test

While the teacher's response questionnaire on the large-scale test consisted of 20 statements with very good choices for scale 5, good for scale 4, sufficient for scale 3, poor for scale 2, and very poor for scale 1. The following is the result of the recapitulation of the responses of biology teachers in class X MIPA SMA N 1 Batang:

Table 6 Recapitulation of Teacher Responses

No.	Statement	Total of Score	Percentage
1	Ease of using the application	100	100%
2	Compatibility of navigation with assigned functions	100	100%
3	Smooth application when installed and used	80	80%
4	The attractiveness of the appearance of the application design	100	100%
5	The neatness of the text, images, and content presented	100	100%
6	Appropriate color balance of text, images and backgrounds	80	80%
7	Appropriate size of text and images in the application	80	80%
8	Conformity of material with SK and KD	100	100%
9	Relevance of material with indicators	100	100%
10	Material relevance to learning objectives	100	100%
11	The scope of material presented	100	100%
12	Presentation of examples that support the content of the material	80	80%
13	Video presentation as a means of increasing student understanding and as a learning distraction	80	80%
14	Presentation of material in accordance with the PQ4R strategy used	100	100%
15	The suitability of the practice questions with the content of the material	80	80%
16	Learning media can foster student learning motivation	100	100%
17	Learning media supports students to think creatively	100	100%
18	Learning media can help students learn ecosystem material	100	100%
19	Learning media can provide independent learning opportunities for students	100	100%
20	Learning media can increase students' knowledge	100	100%
	TOTAL	**94**	**94%**

Recapitulation of teacher response statements shows an average total score and percentage of 94% which indicates that the media is very suitable for use in learning and the teacher strongly supports the use of android application media based on PQ4R learning strategy for the "Ecostudy" ecosystem material.

2) Results of Media Effectiveness Data Analysis

Assessment of the effectiveness of the android application media based on the PQ4R learning strategy was analyzed by normality test, N-Gain test and hypothesis test. The large-scale trial was conducted on 36 students in class X A MIPA & 36 students in class X B MIPA as the experiment class and 36 students in class X C MIPA as the control class. In the large-scale trials studied were student learning result with a pretest carried out before using the android application media based on the PQ4R learning strategy on the ecosystem material "Ecostudy" and the posttest carried out after using the android application media based on the PQ4R learning strategy on the ecosystem material "Ecostudy".

Recap the results of the pretest and posttest in the experiment class as follows:

Table 7 Pretest and posttest results of experiment class A

	PRETEST	POSTTEST
Total	1479	3087
Average	41,08	85,75
Deviation	44,67	
The Highest Score	63	100
The Lowest Score	17	60

Table 8 Pretest and posttest results of experiment class B

	PRETEST	POSTTEST
Total	1699	3161
Average	47,20	87,81
Deviation	40,61	
The Highest Score	73	100
The Lowest Score	17	60

Based on table 7 and table 8 with each class of 36 students, it is known that there was a very significant increase in the average between the pretest and posttest of the experiment class using the android application media based on the PQ4R learning strategy of the "Ecostudy" ecosystem material. While the recap of the results of the pretest and posttest in the control class is as follows:

Table 9 Results of pretest and posttest control class C

	PRETEST	POSTTEST
Total	1709	2839
Average	47,47	78,86
Deviation	31,39	
The Highest Score	67	93
The Lowest Score	27	60

Based on table 9 with a total of 36 students, it is known that there was no significant increase in the average number of pretests and posttests without using the android application media based on the PQ4R learning strategy on the "Ecostudy" ecosystem material. The increase is not as big as the increase in the experiment class or those using the android application media based on the PQ4R learning strategy material for the "Ecostudy" ecosystem.

Then the pretest and posttest value data were analyzed using the normality test, N-Gain test, and hypothesis testing with the help of the application program from SPSS version 25.

a) Normality Test

Table 10 Normality Test of Experiment Class

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRE_TEST	.077	72	.200*	.970	72	.078
POST_TEST	.096	72	.098	.942	72	.002

Table 11 Normality Test of Control Class

Tests of Normality		
Kolmogorov-Smirnov[a]	Shapiro-Wilk	

	Statistic	df	Sig.	Statistic	df	Sig.
PRE_TEST	.137	36	.087	.968	36	.367
POST_TEST	.134	36	.104	.930	36	.025

In the results of the calculation of the experiment class normality test, it can be seen that the sig. 0.200 > 0.05, then the pretest values are normally distributed. The posttest value shows the sig. 0.098 > 0.05, it is concluded that the post-test scores are normally distributed. While the results of the calculation of the control class normality test showed that the sig. 0.087 > 0.05, then the pretest values are normally distributed. The posttest value shows the sig. 0.104 > 0.05, it is concluded that the post-test scores are normally distributed. The results of the pretest and posttest values show that the data is normal and homogeneous so that it can be used for further calculation requirements.

b) *N-Gain* Test

Table 12 *N-Gain* Test of Experiment Class

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	72	.26	1.00	.7749	.14990
Ngain_Persen	72	25.93	100.00	77.4872	14.99029
Valid N (listwise)	72				

Table 13 *N-Gain* Test of Control Class

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	36	.33	.83	.6077	.14455
Ngain_Persen	36	33.33	82.50	60.7683	14.45523
Valid N (listwise)	36				

By using the N-Gain formula, the N-Gain score in the experimental class was 0.77. It can be concluded that the results of the calculations are in the high category, which means that students' understanding is high. Whereas in the control class the results of the N-Gain score were 0.61 and it can be concluded that the results of these calculations are in the medium category, which means that students' understanding is moderate.

c) Hypothesis Test

In addition to analyzing N-Gain, student responses, and teacher responses, a hypothesis test was also carried out on the use of android application media based on the PQ4R learning strategy for the "Ecostudy" ecosystem material to find out whether there were differences in cognitive learning result between control and experimental class students on large-scale tests using one way ANOVA test on SPSS software version 25.0. If F count is greater than F table or Sig. smaller than 0.05, then the hypothesis (Ha) is accepted, but if the calculated F is smaller than the F table or the value of Sig. greater than 0.05 then the hypothesis (H0) is rejected.

H_0 : The development of an android application media based on PQ4R learning strategy cannot improve students' cognitive learning result in class X SMA N 1 Batang ecosystem material

Ha : Development of an android application media based on PQ4R learning strategy can improve students' cognitive learning result in class X SMA N 1 Batang ecosystem material

Table 14 Hypothesis Test

ANOVA					
Learning_Result					
	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	1504.167	1	1504.167	16.094	.000
Within Groups	9906.750	106	93.460		
Total	11410.917	107			

Based on the results of the hypothetical calculations, it shows that the dk within the group (comparison) = 1, the dk within the group (the denominator) = 106, at α = 0.05, the value of the F table is 3.93. While F count = 16.094. Fcount > Ftable, 16.094 > 3.93 and a significance value of 0.00 <0.05 then H0 is rejected and Ha is accepted. It can be concluded that the android application media based on the PQ4R learning strategy can improve students' cognitive learning result in class X SMA N 1 Batang ecosystem material.

DISCUSSION

The results of the development of android application media based on the PQ4R learning strategy "Ecostudy" ecosystem material to improve student learning result in ecosystem material are further studied in the discussion. The research discussion includes (1) media feasibility assessment and (2) media effectiveness assessment.

1) Feasibility Assessment of Android Application Media Based on PQ4R Learning Strategy

The feasibility assessment was carried out by analyzing expert validation data and user questionnaires, namely teachers and students. Based on the validation results from media experts and material experts, it shows that the android application media based on the PQ4R learning strategy can be used in learning. The results of material validation by material experts obtained a percentage of 87% and media validation by media experts of 89%, it can be concluded that the android application media based on the PQ4R learning strategy for ecosystem material "Ecostudy" is very suitable for use in learning ecosystem biology material.

The recapitulation of student responses shows that by giving 20 statements, an average total score and percentage of 80% is obtained, which indicates that all students are enthusiastic about using the Android application media "Ecostudy". While the recapitulation of teacher response statements obtained an average total score and percentage of 94%. These results show that the teacher strongly supports the use of android application media based on the PQ4R learning strategy for the "Ecostudy" ecosystem material. Feasibility can be seen from product users such as teachers, students, and other experts who do not experience difficulties in using the product, and the products developed have appropriate implementation.

This media is very feasible to use because it was developed based on KD analysis for ecosystem material and when developing, several aspects are used to assess or evaluate learning media. The results of research by (Setiyowati, Maharani, and Astuti 2018) also show that based on the assessment of material experts from all aspects of the criteria, the feasibility of the Android-based "Chemical Lab Work Guide" application as a media guide for high school chemistry practicum class XI gets an average total of 99.3 so that it is included in the very good criteria and the criteria are very feasible to be used as a guide for chemistry practicum in Class XI High School.

2) The Effectiveness of the Use of Android Application Media Based on PQ4R Learning Strategy

The effectiveness of the use of the android application media based on the PQ4R learning strategy for the "Ecostudy" ecosystem material can be seen through increasing students' cognitive learning result based on the results of the N-Gain test from pre and post-test scores. Effectiveness is also based on whether there is a significant difference between the cognitive learning result of the control class and the experimental class. The learning strategy is said to be efficient in improving students' cognitive learning result if statistically, the student's cognitive learning result show a significant difference between initial understanding and understanding after learning is shown with a significant gain.

By using the N-Gain formula, the N-Gain score in the experimental class was 0.77. It can be concluded that the results of the calculations are in the high category, which means that students' understanding is high. Whereas in the control class, the results of the N-Gain score were 0.61 and it

can be concluded that the results of these calculations are in the medium category, which means that students' understanding is moderate.

Hypothesis test calculations were also carried out on the cognitive learning result of the experimental class, it was found that Fcount (16.094) > F Table (3.93) and the value of Sig. smaller than 0.05. From the results of calculating the N-Gain and testing the hypothesis, it can be said that the android application media based on the PQ4R learning strategy ecosystem material "Ecostudy" effectively improves students' cognitive learning result, this indicates that students can absorb lessons and increase knowledge by using the developed learning media.

Strengthened by (Fatmawati, Yusrizal, and Hasibuan 2021) conducted research that showed that the development of android application-based learning media was very effective and feasible for improving students' cognitive learning result in social studies subjects. This was reinforced by the results of the study which showed an increase in the pretest and posttest results, which initially averaged 65, after using the media it became 75 with 85% of the students who scored. Almost the same research was carried out by (Rohmana and Suwahyo 2020) conducting research which concluded that there was a significant increase in cognitive learning result in classes using android applications for learning the construction of wheels and tires at SMK Negeri 1 Tengaran. The increase in cognitive learning result of 0.44 (gain value) with moderate criteria which indicates an increase in students' cognitive learning result in the experimental class is included in the medium category. The use of the latest Android-based application media evidence can motivate in improving students' cognitive learning result.

Based on the results of the study, learning using the android application media based on the PQ4R learning strategy "Ecostudy" ecosystem material which was developed effectively can improve students' cognitive learning result. This can be seen from the number of students who got a complete score in ecosystem material. One of the factors that determine the success of student learning is the learning media used. The use of learning media in the learning process can arouse students' interest in learning, provide stimulation to want to learn, and even bring a psychological influence on students. The results of the study (Ahmad et al. 2022) also concluded that the learning media for the Android application being developed can be said to be of high quality by fulfilling 3 criteria, namely very feasible, practical, and effective.

RESEARCH LIMITATIONS

Android application media products based on the PQ4R learning strategy "Ecostudy" ecosystem material still have limitations, namely that they can only be used or accessed with smartphones or cellphones with the Android operating system, Android application media products are only in the form of biology lessons, especially ecosystem material and there is no facility for interaction between users. learning media that can be used as a means of discussion.

CONCLUSION

Based on the results of research and discussion, the following conclusions can be drawn:

1. The android application media based on the PQ4R learning strategy "Ecostudy" ecosystem material that has been developed is declared very feasible by material experts, media experts, and users, namely students, and teachers for use in learning.
2. Based on the results of hypothesis testing and N-Gain, it shows that the android application media based on the PQ4R learning strategy material ecosystem "Ecostudy" is effective in increasing students' cognitive learning result

SUGGESTION

Based on the development research conducted, there are several suggestions, among others

1. For further media development so that applications can be easily accessed by smartphones with Android and iOS operating systems.

2. The material menu in the application contains more biology material for one school year, not only ecosystem material.
3. Availability of means of interaction between learning media users that can be used as a means of discussion, for example by having a chat menu.
4. On the media that is made, it is better to state in writing the stages in the PQ4R and give clear instructions to the user for each stage.

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