

Development of Smart Apps Creator Learning Media Using Problem-Solving Learning Models on Global Warming Materials to Improve Critical Thinking and Problem-Solving Ability

Reza Fahlevi*, Tien Aminatun¹

¹ Biology Education, Yogyakarta State University, Yogyakarta, Indonesia.

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Corresponding Author:
Reza Fahlevi
rzfhlv74@gmail.com

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Abstract: This study aims to 1) determine the feasibility of smart apps creator-based learning media used in learning activities, and 2) determine the effectiveness of Smart Apps Creator-based learning media to improve Critical Thinking and Problem Solving skills in Global Warming Materials for Class X Students of SMAN 4 Berau. This research is a Research and Development (R&D) study which refers to the ADDIE model. This research was conducted on 30 students in limited trials and field trials using class X1 and X3 students each of 32 students. The results of the study are that the learning media developed meet the eligibility based on expert judgment and effective learning media in improving critical thinking skills and problem solving abilities. The results of the Manova test show a sig value of 0.000 < 0.05, namely Ha is accepted so that there are differences in critical thinking skills and problem-solving abilities between students who use Smart Apps Creator learning media and PowerPoint learning media. The N-gain test of learning media on critical thinking skills gets a score of 68.82 which means it is quite effective and for problem solving skills it gets a score of 91.64 which means it is effective.

Keywords: Smart APPS Creator; Critical Thinking Ability; Problem Solving.

Introduction

Intelligent human resources can be created through quality education. One of the goals of education is to develop students' abilities, including their potential, and to educate the life of the nation. Currently, in the development of 21st-century technology, students are endeavoring to be able to think critically and be able to solve the problems they face, so that they can improve the quality and welfare of creative individuals (Wijaya, 2016).

Critical thinking are one of the very interesting cognitive field today research (Redifer et al., 2021; Snyder and Snyder, 2008). Critical thinking ability is one of the abilities to be achieved in the 2013 curriculum goals. Students who have a high level of critical thinking

ability will often review a problem until they get results that make sense about what they believe. In addition, critical thinking can not only be used in learning but can also be used in everyday life when dealing with a problem because critical thinking skills can include the ability to express, reason, and evaluate so that they can make the right decisions. Critical thinking skills are indeed difficult to apply, but critical thinking skills can be completed and learned. Critical thinking skills can develop through experiences that have been experienced by someone in solving problems (Rahardian, 2022). Someone who thinks critically, will be able to ask a question, submit an answer or argument, ask something, and find other more specific information (Schafersman, 1991).

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In addition, critical thinking is also important because students can be trained to determine the good and bad sides of information. Critical thinking allows students to take advantage of their potential even deeper because critical thinking increases the ability to solve problems, see problems, create, and realize themselves. Verbal and analytical abilities can also be improved by thinking critically. Based on this, the importance of teachers in developing students' critical thinking skills using various ways. One way that can be done to develop critical thinking skills is through teaching using learning models or methods that can make students active in learning (Permatasari, 2014).

According to (Setyaningrum & Husamah, 2013) critical thinking is a systematic, oriented and clear approach that thought process is a mental activity like the process of observing, analyzing, researching, observing and others as a way to find a solution to a problem. Critical thinking skills need practice and education because they did not inherit from their parents or natural production (Nieto & Saiz, 2011). Critical thinking skills must be possessed by students to support rational thought models problems they face (Karim et al., 2020). Critical thinking is a persistent endeavor to discover and analyze a scientifically relevant and supported fact by different scientific evidence to be able to draw conclusions drawn (Hamdani et al., 2012).

In addition to critical thinking skills, problem-solving is important because students can gain experience in solving a problem they face. Students' ability in problem-solving can also make learning activities active. Problem-solving is a process to resolve and provide solutions to the problems faced to achieve a desired goal (Sumarmo, 2012). Problem-solving is an attempt to find a way out that is done in achieving the goals to be achieved. Solving problems requires readiness, creativity, knowledge, and abilities and their application in everyday life. In solving the problems faced by students, it is possible to be more critical and creative in making decisions in their lives (Hadi & Radiyatul, 2014). Critical thinking skills are the ability to analyze and form hypothesis and alternative problem solving to prove assumptions (Oon Seng, 2009; Patonah et al., 2021; Wahyudiati, 2022).

Critical thinking skills are abilities related to analytical and rigid. This ability exists in all students, but underdeveloped and not properly managed. According to in Ariyati (2010), based on academic observations activities, students must memorize and accumulate information, little incentive to develop their thinking skill. So students can theoretically but lack of enforcement. This leads to criticism thinking skills difficult to observe progress (Septiana et al., 2023).

The learning model that can be used by educators that can be used to improve critical thinking skills and problem-solving is the Problem-Solving learning model. Problem-Solving is a learning model that is intended to focus on an aspect of the problem. In Problem Solving students are assigned to solve a problem that has been prepared by the teacher. Santyasa (2007) states that problem-solving begins with confrontation and ends when an answer has been obtained by students according to the conditions of the problem. According to some experts, problem-solving can also affect students' critical thinking skills. This is by the results of research conducted by Utami (2013) which states that the Problem-Solving learning model can significantly influence students' ability to solve a problem. Problem solving is a learning model designed to focus on certain aspects of a problem. In problem solving, students are given the task of solving a problem that has been prepared by the teacher. Lestari (2017) states that problem solving begins with confrontation and ends when students have received answers that match the conditions of the problem. According to some experts, problem solving can also affect students' critical thinking. This is in accordance with the research findings of Sardin & Sunendar (2018) that the problem solving learning model can significantly affect students' ability to solve problems.

Learning activities require learning media so that the learning atmosphere is fun and increases the effectiveness of learning activities (Kartini, 2022). One of the learning media that can be developed using software that can fulfill this is using the Smart Apps Creator or SAC application. Smart Apps Creator is a multimedia-based application that can be used to design and create learning media that can be used on Android and iOS devices without prior coding. SAC can be used as an alternative means when learning online or offline. The use of learning media in learning activities is highly recommended. This is intended so that learning activities do not seem monotonous, so an educator needs to use various learning media so that students do not get bored with learning activities (Azizah, 2020).

The advantages of using the Smart Apps Creator are that it is easy to use media for beginners such as students, making Android-based learning media only needs to include material and images without having to go through the coding process, the media that is displayed is quite interactive so students don't get bored easily, making media can be created according to the creativity of the maker, the size of the application that does not take up too much storage, making animations that are quite easy, the display in the application is easy to understand and access, and the results of creation can be stored on android, ios, exe and HTML devices. The

disadvantages of using Smart Apps Creator are that it is a trial that can only be used for 30 days or can be paid to get a license, limited features if using a trial, the language used in the application is still in English, and can only make learning media that is quite simple (Yallah, 2022).

One of the materials that according to the teacher has more challenges in conveying it is the material on global warming which is taught in class X. This material is about environmental balance, which can be changed by human actions. The challenge faced by the teacher in conveying this material is that this material contains a lot of material and phenomena that students need to understand so that if they convey it in lecture form it is still lacking. This material is also very relevant to train students' critical thinking skills and problem solving. Through the use of problem solving-based Smart Apps Creator media, it is hoped that it can provide understanding to students through interesting experiences and help students understand material by showing environmental conditions, factors that cause global warming, causal relationships and ideal environmental conditions simultaneously. Students not only see changes in the environment, but also know what is happening without knowing the consequences. Global warming can have very bad impacts on life on Earth, such as climate instability, sea level rise, and ecological disturbances. Therefore, to prevent the worse effects of global warming, it is important to have awareness in students about caring for the environment. Based on research by Elviana & Julianto (2022), Smart Apps Creator can be used to create interactive media that helps students understand material and supports student activities. The use of media is intended to help students increase awareness of the importance of protecting the environment, train their ability to think critically and solve problems.

Based on the results of observations at school, according to the teacher, students critical thinking skills and problem-solving abilities are still lacking. It is necessary to be aware a scientific learning process can provide opportunities so that students are more active, more interactive and able to develop critical thinking skills to improve (Permata et al., 2022). Problem-solving skills Students are less active in learning activities if the material presented is boring so learning activities are not effective. Schools have provided good facilities and infrastructure to support learning activities in the form of projectors, wifi networks, and laptops so that teachers can use them in learning activities. However, teachers rarely use learning media because it takes up a lot of time in preparation, only for certain materials the teacher uses learning media, namely in the form of PowerPoint which is already available on the internet. Students are more

interested in learning activities when using interesting media so that it is easier to understand the material presented by the teacher. Based on interviews with several students, they were given the freedom to use smartphones to add references to learning, namely in the form of articles and videos via YouTube.

Based on the results of this study, researchers want to develop learning media that are suitable for use in learning activities and are effective for improving critical thinking skills and problem-solving abilities. So the researchers raised the research title "Development of Learning Media Based on Smart Apps Creator using the Problem-Solving Learning Model on Global Warming Material to Improve Critical Thinking and Problem-Solving Skills of Class X Students of SMAN 4 Berau".

Method

Research Design

This study uses the Research and Development (R&D) type of research. The development process refers to the ADDIE model which consists of 5 stages, namely analysis, design, development, implementation, and evaluation.

Research Subject and Locations

Limited trials in this study were 30 students of class XI IPA 3 SMAN 4 Berau who were selected using a random sample using a lottery. Large group trials or field trials involve students in class X1 and X3 of SMAN 4 Berau which are different from limited trials. Two classes were used in this study, namely the control class and the experimental class. Selection of classes using random sampling by lottery. The experimental class was given treatment using smart apps creator learning media while the control class did not use interactive learning media, but used Powerpoint learning media and both classes used the same learning model, namely using the problem-solving learning model.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O1	X1	O2
Control	O3	X2	O4

Source: Modified from Johnson & Christensen (2014)

Description:

- O1: Pretest students critical thinking skills and problem-solving before using learning media
- X1: Learning using learning media based on Smart apps creator with the Problem-solving model.
- O2: Post students critical thinking skills and problem-solving after using learning media
- O3: Pretest critical thinking skills and problem-solving before conventional learning using PowerPoint

- X2: Learning to use student books with the Problem-Solving model
- O4: Posttest critical thinking skills and problem-solving after conventional learning using PowerPoint

Learning media feasibility data were analyzed quantitatively and qualitatively. Quantitative data results in the form of scores obtained from assessment questionnaires from expert lecturers, biology teachers, and students. The data is then converted into qualitative data using descriptive analysis.

Data Analysis

The data obtained is calculated on average and then converted into a qualitative value on a scale of 4 with a Likert scale. The conversion of scores into scores on a scale of 4 is as table 2:

Table 2. Score Conversion

Score Range	Category
$X > X_i + 1.8 S_{bi}$	Very Worth it
$X_i + 0.6 S_{bi} < X \leq X_i + 1.8 S_{bi}$	Worthy
$X_i - 0.6 S_{bi} < X \leq X_i + 0.6 S_{bi}$	Decent Enough
$X_i - 1.8 S_{bi} < X \leq X_i - 0.6 S_{bi}$	Less Eligible
$X \leq X_i - 1.8 S_{bi}$	Very Inadequate

Source: Widyoko (2011)

Information:

- X_i : Mean ideal score (1/2 (maximum score + ideal minimum score))
- S_{bi} : ideal standard deviation (1/6(maximum score - ideal minimum score))
- X: Score obtained

The minimum product feasibility value is good enough, so the product is feasible to be tested on students as a medium in learning activities. The effectiveness of using smart app creator-based learning media in improving students' critical thinking skills and problem-solving can be measured through hypothesis testing.

The Manova test was conducted to see the effectiveness of smart apps creator learning media to improve analytical thinking skills and problem-solving skills. Before the Manova test is carried out, the data must go through a multivariate normality test by determining the Mahalanobis distance then go through a covariance variant matrix homogeneity test with the Box's M test.

Result and Discussion

The development of learning media products produces appropriate and effective smart apps and creator-based learning media to improve critical

thinking skills and problem-solving abilities. Product development stages are:

Stage of Analysis

The first stage in this research is the analysis stage. In the analysis phase, needs analysis, curriculum analysis, and student characteristic analysis were carried out. In the needs analysis stage, the researcher interviewed biology teachers at SMAN 4 Berau.

Based on the results of the interviews obtained from the teacher said that the teacher faced some difficulties in delivering the material due to the limited learning media available. Learning activities in class usually use YouTube videos and student textbooks, but students sometimes feel bored and are not interested in learning activities seen during the question and answer session there is no interaction between students and teachers, so learning objectives are difficult to achieve. The teacher said that global warming material is material that is quite boring for students so in its delivery media and learning models are needed that can attract students' interest in understanding the material. Critical thinking skills and problem-solving are considered suitable for global warming material so researchers develop learning media based on Smart Apps Creator to hone critical thinking skills and problem-solving in students.

Analysis of the characteristics of students is used to determine the characteristics of students who are the subject of research which is the basis for researchers in compiling and developing the developed modules. The modules developed are by the characteristics of the students, namely class X high school students who are generally 15 to 16 years old. In learning activities, students participate in learning activities quite well, but learning activities feel boring because they rarely use media and too much material is presented so students feel tired and sleepy quickly. For this reason, learning media is needed that students can use offline wherever they study.

The Design Stage

At this stage, the researcher designed the media storyboard starting from the design of the image layout to the design of the instruments to be used in the learning assessment. The learning media that will be developed is adjusted to the results of the analysis of the needs of teachers and students, namely using the Smart Apps Creator application on global warming material in class X at SMAN 4 Berau.

Based on the results of the analysis, the design of Smart Apps Creator-based learning media has several components such as a cover page, main menu, learning objectives, instructions for using the application, materials, learning activities, and about the developer.

The design of learning media uses the Canva application and is made attractive so that students are motivated in learning activities. The results of the design of learning media are:

Cover

The cover of the Smart Apps Creator learning media contains the title of the material, namely global warming. The illustrations on the cover page images are designed in full color according to the theme. On the cover page, there is a start button that is used to go to the next page or start learning media. An attractive cover design is expected to attract students' interest and students' motivation to study. The following is a cover design for learning media.



Figure 1. Display Cover on Learning Media

Main Menu

On the main menu page, there are several menus to go to the desired pages, namely the user manual menu, learning objectives, learning materials, activity 1, activity 2, and about the developer. The following shows the main menu for learning media.



Figure 2. Main Menu Display on Learning Media

Instructions for Use

The user manual page contains instructions for use and navigation in using the media. The following displays instructions for use in learning media.

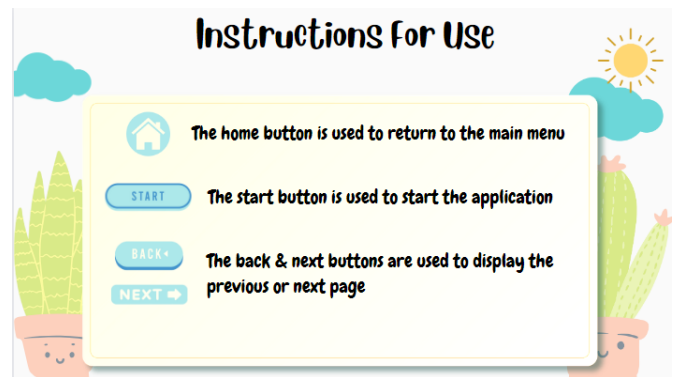


Figure 3. Display Instructions for Use in Learning Media

Learning Objectives

The learning objectives page contains the learning objectives to be achieved by students. The following shows the learning objectives in the media.

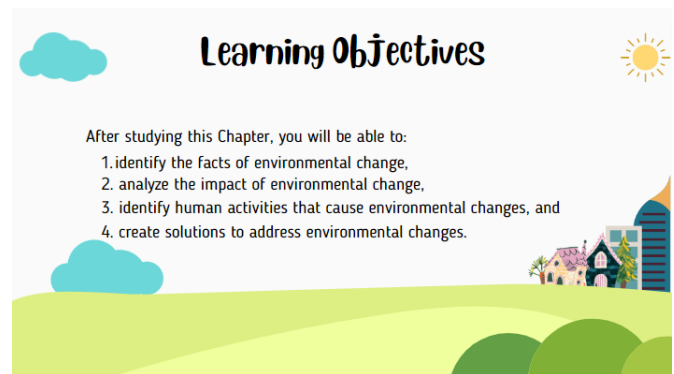


Figure 4. Display of Learning Objectives on Learning Media

Learning Materials

The learning material page has several sub-menus that contain material that will be taught to students. The following shows the learning material on the media.

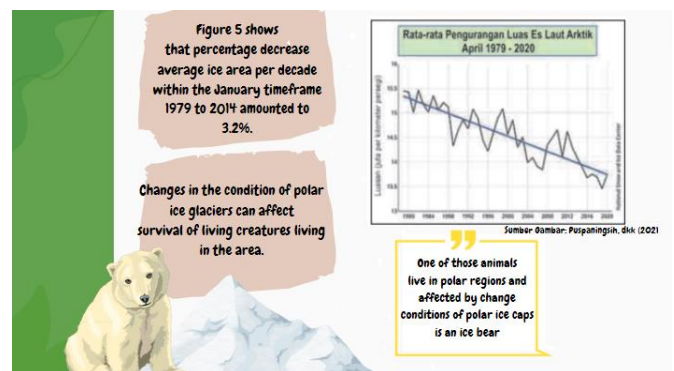


Figure 5. Display of Learning Materials on Learning Media

Learning Activities

The learning activity page is divided into 2, namely Activity 1 and Activity 2. Activity 1 contains articles that will be worked on by students and activity 2 contains links to go to YouTube which will be worked on by

students. Students are divided into 2 groups to work on activities 1 and 2. The following shows the appearance of activities 1 and 2 learning on the media.



Figure 6. Display Activity 1 on Learning Media



Figure 7. Display Activity 2 on Learning Media

About the Developer

The page about the developer contains a profile of the learning media developer. The following is a view of the developer on learning media.



Figure 8. Views About Developers in Learning Media

Development Stage

The next stage is the development or develops stage. The development stage aims to see the feasibility of the learning media that has been designed. The validator consists of 2 expert lecturers, namely material

expert lecturers and media experts. The data obtained are as follows:

Feasibility of Learning Media Based on Material Expert Assessment

The recapitulation of the assessment results can be seen in the table.

Table 3. Recapitulation of Validation Results by Material Experts

Material Content Validation Results		
Assessment Aspects	Score	Category
Material eligibility	11	Very good
Material accuracy	11	Very good
Didactic	13	Good
Construction	31	Good
Technical	12	Good
RPP Validation Results		
Assessment Aspects	Score	Category
Formulation of Learning Objectives	15	Good
Contents presented	14	Very good
Language	8	Pretty good
Time	5	Pretty good

Based on the data in Table 3, it can be seen that the quality of learning media based on assessments by material expert lecturers shows that learning media is suitable for use in learning activities with revisions according to suggestions.

Feasibility of Learning Media Based on Media Expert Assessment

The recapitulation of the assessment results can be seen in the table.

Table 4. Recapitulation of Validation Results by Media Experts

Assessment Aspects	Score	Category
Software engineering	18	Very good
Visual Communication	26	Very good

Based on Table 4, the validation results can be seen that the quality of learning media based on assessments by media expert lecturers shows very good criteria. So that learning media is suitable for use in learning activities with revisions according to suggestions.

Implementation Stage

The fourth stage of the ADDIE development model is the implementation stage. After the learning media was declared feasible by the validator, the learning media was tested on a limited basis. In the limited trial, the sample is X students.

Limited Trial Results

Learning media that have been revised based on suggestions and input from reviewers are then carried out a feasibility test on students. The trial is in the form of a test of questions to obtain questions that are valid for use in learning activities.

Feasibility of Learning Media Based on Practitioner Assessment, Student Responses

Learning media is then given to teachers and students to be asked for their responses to the learning media developed. The validation was carried out by a biology teacher at SMAN 4 Berau. Recapitulation of the results of the assessment by the teacher can be seen in the following table.

Table 5. Recapitulation of Teacher Assessment Results

Assessment Aspects	Score	Category
Software engineering	12	Very good
Visual Communication	12	Very good
Material Eligibility	8	Very good
Material Accuracy	10	Good
Didactic	21	Very good
Construction	33	Good
Technical	16	Very good

Based on the results of the validation it can be seen that the quality of learning media based on the assessment by the teacher shows very good criteria. So that learning media is suitable for use in learning activities with revisions according to suggestions.

The results of student assessments include aspects of presentation, language, visual communication, and usefulness. Data from the responses of 32 students were calculated on average and then looked at the categories. The assessment instrument uses a Likert scale. Recapitulation of assessment results by students can be seen in the following table.

Table 6. Recapitulation of Student Assessment Results

Assessment Aspects	Score	Category
Presentation	10.90	Very good
language	11.20	Very good
Visual Communication	11	Very good
Benefits	7.60	Very good

Based on the validation results, it can be seen that the quality of learning media based on the assessment by students shows very good criteria. So that learning media is suitable for use in learning activities with revisions according to suggestions.

Instrument Empirical Validity and Reliability

The validity and reliability of the instrument aim to determine which items are feasible to use to test the effectiveness of learning media that has been developed

on students' critical thinking skills and problem-solving. The questions tested are in the form of analytical thinking skills and problem-solving consisting of 10 multiple choice questions and 5 essay questions. The trial was conducted on 30 students of class XI. The results of the empirical test can be seen in the appendix. From testing the validity of the items filled in by 30 respondents, $r_{count} > r_{table}$ which is declared valid. The results of the reliability test prove that all questions are declared reliable.

Evaluation Stage

Field Trial Results

The final product from the results of the second phase of revision after being tested was limited to students of class XI and then field tested extensively to determine its effectiveness in improving students' critical thinking skills and problem-solving abilities. At this stage, 2 classes were used, namely the experimental class and the control class, which consisted of 32 students from class X. Students in each class will be given a pretest before learning activities and a posttest after learning activities. The experimental class used smart apps creator learning media which had been declared feasible and the control class was a class whose learning activities used PowerPoint, both classes used the same learning model, namely the problem-solving learning model.

Pretest Multivariate Normality Test

The multivariate normality test is a prerequisite hypothesis test to test the effectiveness of learning media. Multivariate normality test using Mahalanobis Distance. The test results can be seen in the following table.

Table 7. Multivariate Normality Test Results

Pearson Correlation	0.964
Sig. (2-tailed)	0.000

Based on the results obtained, the correlation coefficient shows 0.964 which indicates a very high correlation coefficient. Increase the correlation coefficient between -1 to +1.

Pretest Multivariate Homogeneity Test

The multivariate homogeneity test aims to determine whether the data used comes from a homogeneous population or not. This test can be carried out using the Box's M test. The results of the analysis can be seen in the following table.

Table 8. Box's M Test Results

Box's M	0.684
F	0.220
df1	3
df2	691920.000
Sig.	0.882

Table 7 shows that the Box's M test value is 0.684 and the F value is 0.220 with a significance level of 0.882. The significance value obtained is greater than 0.05 so that the covariance matrix is the same or homogeneous.

Manova test

The Manova test is used to analyze differences in critical thinking skills and problem-solving abilities between students who take part in learning with the Smart Apps Creator learning media and PowerPoint learning media. The test statistic in the Manova analysis used in this study is Hotelling's Trace because there are only two independent variables. The results of the Manova test are presented in the following table.

Table 9. Manova Test Results

Test Analysis	F	Sig.	Decision
Hotelling's Trace	11.82	0.000	H _a accepted

Based on Table 9, get the sig. $0.000 < 0.05$ so that H_a is accepted so that there are differences in critical thinking skills and problem-solving abilities between students who take part in learning with the Smart Apps Creator learning media and PowerPoint learning media.

One learning model that can improve students' problem-solving abilities is the problem-solving learning model. Problem-solving is learning to solve problems based on several principles or events that have occurred. In this learning model, students learn to formulate and solve problems (Mufarokah, 2009). The problem-solving learning model is a way of presenting lessons that can encourage students to find and solve problems or problems in achieving learning goals. These learning activities can train students in dealing with various individual and group problems. This learning model is also able to stimulate students' thinking skills critically because, in the learning process, students carry out many problem activities from various aspects to finding problems (Salahudin, 2015). This means that critical thinking skills will make Students can understand concepts and state reasons to support their argument based on indirect sources of information have a relationship with problem solving and reasoning skills, so increase good critical thinking skills will be followed by mastering other skills (Subagiyo et al., 2023). Students must also have critical thinking skills because these skills

help them make decisions and understand scientific concepts and processes (Razak, 2021).

Learning media based on smart apps creator can be accessed by students using Android so that it can be used easily and is available offline and online. The use of android makes students motivated rather than material only presented by the lecture method. The use of smartphones in learning activities can also add to and support existing knowledge and new knowledge from various sources so that students are more interested in learning to use smartphones (Ruziana, 2016).

Learning using learning media based on smart apps creator using problem-solving learning models is considered effective in improving students' critical thinking skills and problem-solving abilities. So that combining problem-solving learning models with smart app creator media can help students hone their thinking skills in solving a problem presented.

Conclusion

Media learning based on the Smart Apps Creator that has been developed meets eligibility based on assessments from media experts, material experts, biology teachers, and students, namely the assessment of media experts. The application of Smart Apps Creator-based learning media in improving students' critical thinking skills and problem-solving abilities of students is seen from the results of the Manova test getting a sig. $0.000 < 0.05$ with the conclusion that there are differences in critical thinking skills and problem-solving abilities between students who take part in learning with Smart Apps Creator learning media and PowerPoint learning media.

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Author Contributions

This research article was conducted by two authors. Research, validation, data analysis, wrote, Reza Fahlevi; review- writing and editing, Tien Aminatun. The authors have checked drafts and countries for publish to any platform

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Conflicts of Interest

Define stage each variable and check the pointers a tool for sustainable development with development research. When focusing media development, design media that has based on real life training ever applied before. Use it method and approach of both groups are experimental and control monitor media influence. This interest avoids influencing the results.

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