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Validity of Multimedia Peat Swamp Forest Concept Based on Problem Solving to Practice Critical Thinking Skills of Chemistry Students

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Abstract

The wetland learning system is still conventional and lecturer-centered so that students are not accustomed to doing problem solving activities that have an impact on the lack of students' critical thinking skills. This study aims to develop multimedia learning of problem solving based peat swamp forest concepts to determine the validity of multimedia to train students' critical thinking skills. The stages carried out following the ADDIE instructional design flow include analysis, design, development, implementation and evaluation. Data collection techniques used a validation sheet instrument for two material experts from Lambung Mangkurat University and one multimedia expert from Politeknik Hasnur. Readability test was conducted on three active students who had taken a course to introduce the wetland environment in FMIPA ULM. The results showed that the multimedia learning concept of problem solving peat swamp forest to train critical thinking skills of chemistry students of FMIPA ULM Banjarbaru is very valid.

Abstrak

Sistem pembelajaran lahan basah masih bersifat konvensional dan berpusat pada dosen sehingga mahasiswa tidak terbiasa melakukan kegiatan pemecahan masalah yang berdampak pada kurangnya keterampilan berpikir kritis mahasiswa. Penelitian ini bertujuan untuk mengembangkan multimedia pembelajaran konsep hutan rawa gambut berbasis *problem solving* untuk mengetahui bagaimana validitas multimedia untuk melatihkan keterampilan berpikir kritis mahasiswa. Tahapan yang dilakukan mengikuti alur desain instruksional *ADDIE* meliputi analisis, desain, pengembangan, implementasi dan evaluasi. Teknik pengumpulan data menggunakan instrumen lembar validasi terhadap dua ahli materi dari Universitas Lambung Mangkurat dan satu ahli multimedia dari Politeknik Hasnur. Uji keterbacaan dilakukan terhadap tiga mahasiswa aktif yang pernah mengambil mata kuliah pengenalan lingkungan lahan basah di FMIPA ULM. Hasil penelitian menunjukkan bahwa multimedia pembelajaran konsep hutan rawa gambut berbasis *problem solving* untuk melatihkan keterampilan berpikir kritis mahasiswa kimia FMIPA ULM Banjarbaru sangat valid.

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A. Introduction

This research is motivated by the wetland learning system which is still conventional and centered on lecturers so that students are not used to doing problem-solving activities which have an impact on the lack of critical thinking skills. This can be seen from the lecture program unit which puts forward the lecture method in the learning system. Starting from the principles of constructivism in the learning process and the development of science and technology in the 21st century, which make a major contribution to the quality of education today, giving researchers the opportunity to develop interactive learning media in the form of multimedia learning the concept of problem solving based peat swamp forest to practice students' critical thinking skills. Science process skills are an approach that must be used as a reference to carry a learning process that is able to lead students to find facts, build concepts, and have a scientific attitude. Problem solving skills in this case are part of science process skills (Putra, 2019). Problem solving is the basic process for identifying problems, considering problem-solving options and determining problem-solving options. The problem solving process is chosen if the strategy used at that time does not succeed in achieving the desired goals (Ruhena, et.al., 2019).

Learning media that utilize multimedia are able to provide advantages that are not owned by other types of learning media. Multimedia-based learning media requires users to be able to use and practice skills in their use. The use of several senses, especially visual and sound, makes multimedia able to present phenomena that cannot be presented in direct learning (Sutopo, 2012). The use of multimedia is expected to improve student understanding of the subjects being taught (Fajriah & Churiah, 2016). The effect of using multimedia in learning can be quite significant. This is in line with the research results of Husein et al. (2015) who used multimedia in the experimental class obtained higher results compared to the control class with the classical method. Similar research was conducted by Rahayu (2016) who succeeded in developing interactive learning media based on Adobe Flash CS6, Fajriah & Churiyah (2016) succeeded in developing learning media based on Corel Video Studio Pro X7. In addition, Husein & Ariani (2016) have used video as a material for developing learning media. Creative products as a result of technological innovation in the world of education expected to be able to increase effectiveness and efficiency in overcoming educational problems.

Various types of research related to multimedia with various forms and methods, provide opportunities for researchers to develop learning media that can provide space for students to think critically in solving problems. Through multimedia learning of the concept of peat swamp forest based on Adobe Animate CC 2018 as the main application and Corel Video Studio Pro X7 as a supporting application, it is hoped that it can train students' critical thinking skills in solving problems. The purpose of this study was to develop a problem solving based multimedia learning on peat swamp forest concepts to determine the validity of multimedia to train students' critical thinking skills. Content validity is also known as relevant, namely the contents of the prototype design are in accordance with knowledge principles (Ploomp & Nieveen, 2007). The validity of multimedia learning the concept of peat swamp forest as a learning medium was obtained from the validation sheet score provided by the validator. Indicators of critical thinking skills used in this multimedia research according to Ennis (1985) in Kuswana (2011) include: 1) providing simple explanations, formulating problems 2) identifying or formulating criteria to determine possible answers, 3) analyzing arguments, 4) compiling strategy and tactics, and 5) concluding. Meanwhile, the problem solving steps used according to Greenstein (2012) include: 1) understand the problem, 2) think of all possible solutions (brainstorm all possible solutions, 3) compile a plan (devise a plan), 4) carry out the plan, and 5) evaluate the results).

B. Materials and Method

This research includes development research with ADDIE instructional design which consists of 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation (Branch & Kopcha, 2014). Multimedia validation was carried out by 2 material experts from Lambung Mangkurat University and 1 multimedia expert from Hasnur Polytechnic using several instruments that have been validated before, such as multimedia validation sheets and multimedia materials, RPS validation sheets, LKM, evaluation questions and teaching materials. The research procedure is described as follows:

1. Analysis

The stages in the analysis carried out include three things, namely needs analysis, student characteristics and material characteristics. Multimedia-based interactive learning media that can train students' critical thinking skills in solving problems is still minimal so that its existence is still very much needed. The target users are students of the ULM Chemistry Study Program who have take the Introduction to Wetland Environment courses

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with low, medium and high levels of knowledge. While the material characteristics were chosen for the concept of peat swamp forest because according to the lecture program unit owned by the Chemistry Study Program in general, students were only required to be able to name and explain flora and fauna whose lives depend on wetlands only, and in particular students were only required to be able to describe the characteristics peat swamp forest ecology and ecological processes in the peat swamp forest ecosystem. In fact, students will learn well if they start with understanding problems, formulating problems, analyzing arguments to finding solutions to problems. This is supported by previous studies (Andini, 2015; Munawarah, 2017; Putra, *et al.*, 2019) that the problem-solving process requires students to be more active in building critical and creative ideas to solve problems that occur.

2. Design

At this stage, the researcher begins to design what will be included in multimedia such as instructions for use, learning objectives, learning systems, material presentation to the form of evaluation. In addition, researchers also designed several instruments in the form of validation sheets which are required for validation purposes.

3. Development

The designs that have been made are then realized in the form of tools in the form of RPS, LKM, Evaluation Questions, Teaching Materials to the manufacture of multimedia. In multimedia production, researchers used the Adobe Animate CC 2018 application for a media framework which includes the home menu, instructions, introduction, evaluation, LKM, materials, Critical Thinking Skills Rubric, and the About menu as shown in Figure 1.

Figure 1
Initial Draft Multimedia Main Home Display
(Before Validation)

4. Implementation

At this stage the researcher applies a learning system developed through multimedia. This means that everything that has been developed is installed or configured in such a way as to its role or function so that it can be implemented. The implementation stage in this study was carried out by testing multimedia directly to students which was carried out in stages, namely:

1) All devices were validated by 3 validators using valid instruments.
2) The initial draft multimedia device was tested on three students individually to determine the readability of the students. The suggestions and input given by the validator lecturers and students are then analyzed for improvement until the validation process produces a very valid multimedia device as shown in Figure 2 (main homepage), Figure 3 (instructions for use), Figure 4 (introduction), Figure 5 (material), Figure 6 (evaluation), Figure 7 (LKM), Figure 8 (Critical Thinking Skills / KBK rubric), Figure 9 (about developer profile) Figure 10 (support system), Figure 11 (Advisor 1) and Figure 12 (Advisor 2).

Figure 2
Main Home Display of Multimedia Draft Revision Results (After Validation)

Figure 3. Display Instructions for Use

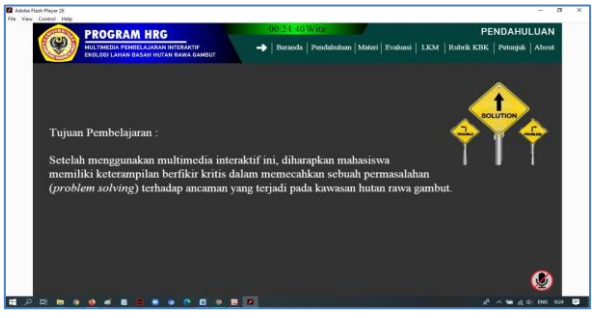

Figure 4. Introductory Views

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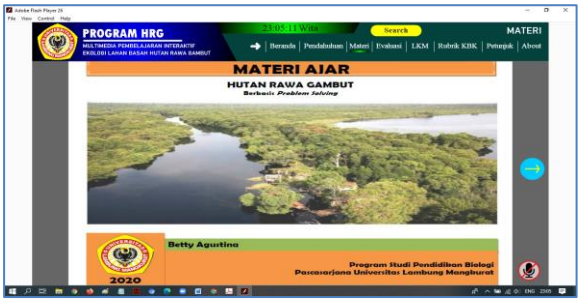

Figure 5 Display of Learning Materials

Figure 6 Display of Evaluation

Figure 7 Display of LKM

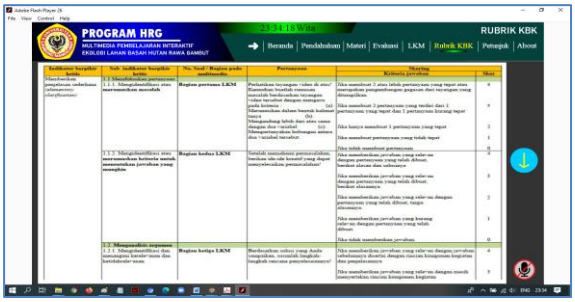

Figure 8 Display of KBK Rubric

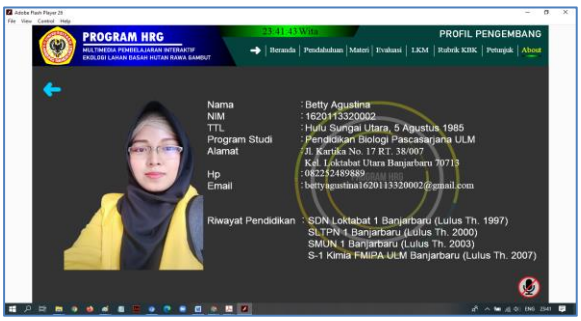

Figure 9 Display of Developer Profile

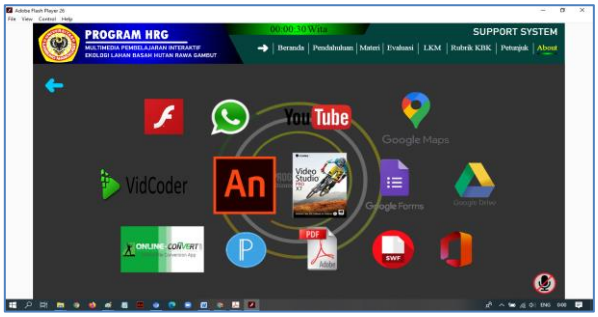

Figure 10 Display of Support System

Figure 11 Display of Acknowledgments (1)

Figure 12 Display of Acknowledgments (2)

5. Evaluation

Each stage of the ADDIE process involves formative evaluation. It is multidimensional and is an important component of the ADDIE process (Branch and Kopcha, 2014). Formative evaluation is carried out at the end of each face to face. After learning is complete, summative evaluation is carried out to improve learning. Summative evaluation aims to measure the final competence of the learning objectives to be achieved. The evaluation results are used to provide feedback to the media users. Revisions are made according to the results of the evaluation or the needs that have not been met by the media. The data that has been obtained from expert validators are then analyzed using a modified formula from Arikunto (2010) as follows:

$$\text{Score} = \frac{\text{Total score obtained}}{\text{Total score}} \times 100$$

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The value obtained is matched with the expert validity criteria as adapted from Akbar (2013) (Table 1).

Table 1 Expert Validity Criteria

No	Score	Validity Criteria	Information
1	<20	Very not valid	May not be used
2	21-40	Not valid	May not be used
3	41-60	Less valid	Can be used but needs major revision
4	61-80	Valid	Can be used but needs a minor revision
5	81-100	Very valid	Can be used without revision

The expert validator's assessment of multimedia includes three aspects, namely language, software engineering and visual appearance. The language aspect is divided into two indicators, namely (1) the use of language and (2) writing sentences. Software engineering aspects are divided into ten indicators, namely (1) effectiveness and efficiency of multimedia learning programs, (2) program management, (3) program reusability, (4) program smoothness, (5) program installation, (6) program documentation, (7) navigation, (8) suitability of template layout, (9) quality of interaction, and (10) text readability. While the visual display aspect consists of four indicators, namely (1) screen display quality, (2) image quality, (3) video quality and (4) animation quality (Septiyan, 2018).

The data obtained from students were analyzed using the same formula as the previous formula, the value was then converted according to the readability criteria table adapted from Arikunto (2015) (Table 2).

Table 2 Student Readability Criteria

No	Score	Readability Criteria
1	≤ 50 - 60	Totally disagree
2	> 60 - 70	Disagree
3	> 70 - 85	Agree
4	> 85 - 100	Very agree

C. Results and Discussions

The process of developing multimedia learning carried out using the ADDIE instructional design has produced a prototype in the form of multimedia learning of problem solving-based peat swamp forest concepts to train students' critical thinking skills which are very valid as shown in Figure 13.

Based on the graph in Figure 13, multimedia learning results of development after being revised according to expert input are included in the very valid category both seen from the multimedia component and material components and supported by the results of other devices in multimedia such as RPS, teaching materials, LKM and evaluation questions which all have validation values above 80.

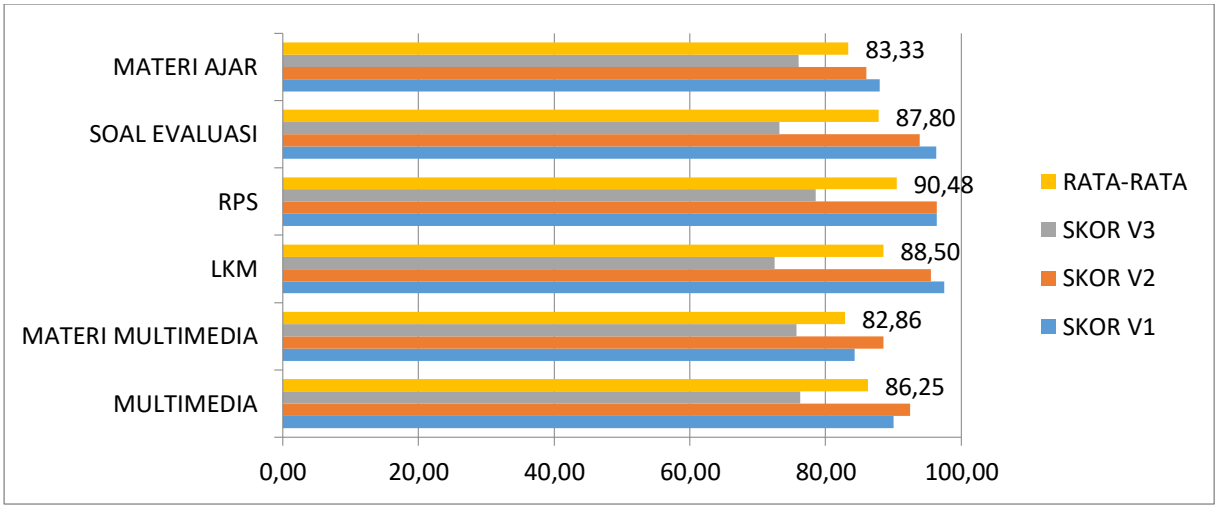

Figure 13. Graph of Expert Validation Results

Based on the results of expert validation, indicators (1) and (2) has classified as very valid. The drawbacks of the previous draft have corrected as suggested. Sentences that exist in multimedia learning that meet linguistic criteria will improve student understanding. That is in line with the research results of Fitriansyah, Arifin, & Biyatmoko (2018) that the popular scientific book of spiny animals on Denawan Island uses language that is easy to understand, an attractive appearance following scientific learning can develop critical thinking skills.

The validation result of the software engineering aspects obtained a very valid category

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score for indicators of program effectiveness and efficiency. Means of this result are the multimedia learning program can be used whenever and wherever students are even though they do not have to meet face to face, especially during the Covid-19 pandemic requires students to study more active and independent at home. The use of effective and efficient multimedia learning can increase students' desire and interest in learn (Hening et al., 2015; Hayati et al., 2017).

The multimedia produced in this study has designed using Adobe Animate CC 2018 as the main application. Corel Video Studio Pro X7 as a supporting application in the video editing process. Also, other applications such as YouTube for learning materials in LKM, Google Form for making evaluation questions and LKM, Google Drive for storing files about evaluation and LKM questions, Microsoft Office for storing files in the form of a word or excel such as making planning tables, Adobe Acrobat for storing teaching material files and KBK rubrics, and WhatsApp for storing sound files before inputting them into multimedia and some supporters others such as (Figure 10) to smooth the multimedia creation process. The existence of interactive animation effects is the advantage of these applications, make it easier for researchers to be more creative in the manufacturing process so that interactive multimedia quality can be producing, can build student learning motivation. That is because Adobe Animate CC 2018 is software that has complete tools that can help create animated works (Nugraha & Muhtadi, 2015).

Multimedia programs have managed well. Ease of installation, clear instructions for use because it is made audio-visual, and the navigation buttons are make blinking and blocking, as suggested by multimedia experts, making it easier for students to use. The absence of interference in the learning multimedia program developed can provide comfort for lecturers and students to use multimedia so that the learning process runs smoothly. The ease of using multimedia learning will increase student learning activities. That has supported by Mardiah, et al. (2018) than the use of media to increasing learning activities.

The program documentation scores very well. That is because multimedia learning uses the Google Form feature found on the LKM and Evaluation menu. That makes it easier for researchers to check the results because the answers sent by students will automatically be recording via the admin email that has been making. Besides, students can see the score from the evaluation carried out both pre-test and post-test via the student's email sent by the system except for the MFI results because the assessment has based on a separates formula according to the Critical Thinking Skills assessment rubric developed by the researcher. That is why multimedia has still made online's as suggested by students in individual tests. That seems contradictory to the advice of expert validators who ask for multimedia to making offline. However, for the sake of the smoothness of the learning system, for purposes that involve student responses such as activities in LKM and evaluations, they must still operate online. If all multimedia menus are made offline, this product becomes non-interactive because it is only for students, its function is only limited to presenting content, while researchers need direct feedback from the learning process for data analysis purposes.

Templates or screens in learning multimedia are a display of the various menus available. The arrangement of the menus in the multimedia learning template is considered neat, attractive and the color composition is appropriate because it has followed colors.co recommendations as suggested by multimedia experts. Multimedia learning interaction is in a good category. Media is a tool that must have high interaction because it will attract student interest (Sambodo, 2014).

The next aspect of the developed learning multimedia assessment is the visual display. Good multimedia is multimedia that has a quality visual audio display accompanied by good animation so that it can foster higher learning motivation in students. The visual aspect gets a very good score because the quality screen display is supported by HD (high definition) quality images so that it looks very clear. Quality videos because the editing process uses Corel Video Studio Pro X7 which has been converted to Youtube using the Online Converter. In this case, not all of the original content is displayed in the Student Worksheet, because the length is quite long, which is approximately 8 minutes which makes students saturated. Therefore, before being used as learning material, the video is edited first by cutting the parts that do not need to be displayed but not reducing the content to be conveyed through the video so that the duration is shorter, about 3 minutes and this is more effective and efficient to use as learning material.

Besides, the audio included in each menu of interactive learning multimedia displays further enhances learning motivation and student absorption of messages conveyed through multimedia. This is in line with the research of Purwono, et al. (2014), that audio-visual / sound-image media enrich the learning environment, nurture exploration, experiment, and discovery, and

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encourage students to develop speech and express their thoughts.

The material presented in the multimedia learning result of this development contains learning problem solving to practice critical thinking skills, understanding of peat swamp forest, the area and distribution of peat in Indonesia, peat swamp forest vegetation, physical, chemical, and biological characteristics, utilization of peat swamp forest, problems peat swamp forest and management of damaged peatlands, as well as strategies for preventing peat swamp forest fires. The link feature provided in the last section of the teaching material menu, which comes from books, articles, and journals, really helps students enrich their knowledge about wetlands, especially the concept of peat swamp forest. A learning media that has the right material content will be able to make students understand the material so that this will affect student motivation in learning (Triyanti, 2015).

Clarity of problem-solving indicators and critical thinking skills in interactive multimedia learning get good scores. This is illustrated by the LKM menu which is made in such a way as to follow the steps that should be carried out. Starting from understanding the problems that exist in the learning video, making problem formulations based on visually visible variables by following the provisions of the problem formulation as suggested by the material expert validator, thinking about possible answers according to students' creative ideas, analyzing arguments, making designs in the form of problem-solving steps, making a planning table with additional information labels to make conclusions.

Interactive communication scores well. This is following the purpose of this multimedia learning to teach students to be able to solve problems so that they can practice critical thinking skills. Arsyad (2017) states that the teaching and learning process will run effectively and efficiently if it is supported by the availability of media that support the interaction process that is being carried out. In line with the expert validation stage, a legibility test was also carried out on three active students who had taken the subject of introducing the wetland environment to the concept of peat swamp forest. The implementation of the readability test can be seen in Figure 14. The legibility test needs to be done in development research because it aims to obtain information about clear errors and deficiencies, where these errors will be experienced by students when using multimedia learning in the learning process. According to Pratiwi, et al., (2014), a readability test was carried out to analyze the extent of the readability and difficulty of the developed learning multimedia

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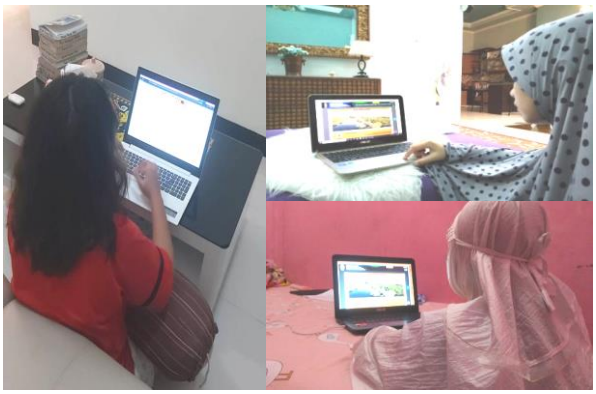

Figure 14 Student Readability Test

Based on the readability test results, the learning multimedia design received a better assessment than the initial draft. The initial appearance of good multimedia learning is important's because it can affect the first assessment of multimedia learning users. In the developed learning multimedia, there is the use of buttons, text, video images, sounds, and has a rating background design overall gets very good from students. Based on the results of the student readability test as a whole, it states that the presentation of the material in the developed learning multimedia includes the animation that is easy to understand and very interesting, in addition to the language used is clear, the composition of the material used is continuous.

Based on the results of the student readability test, all of them feel interested and motivated when learning to use this interactive learning multimedia. The use of learning-media aims to provide student learning motivation (Susilo, 2015). Motivation in learning can lead to feelings of pleasure in carrying out the learning processes will increasing the activities and learning outcomes of students who use this learning multimedia. That is following the research of Lesman, Dharmono, & Putra (2018) that increased student learning motivation makes students more active and also eager to follow the stages of the learning process so that it will cause positive things and can improve learning outcomes.

All validation and legibility test results that have finished. That result has shown the multimedia learning of the peat swamp forest concepts of problem solving-based to train the critical thinking skills of chemistry students of FMIPA ULM is very valid.

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D. Conclusion

This development research has resulted in multimedia learning of the peat swamp forest concepts of problem solving-based to practice critical thinking skills of chemistry students of FMIPA ULM with quality very valid. This score is base on the results of expert validation tests and student legibility tests. Even though it is considered very valid, the researcher suggests further research to improve the design to make it more interactive. That design in question mainly adds direct discussion activities between lecturers and students as well as between students so that the learning process is not only independent but more cooperative and supported by materials related to local wisdom.

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