



The Teaching Media for Mangrove Photosynthesis E-Booklets With a Socioscientific Issue Approach Through PBL Improve Students' Critical Thinking

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ABSTRAK

Rendahnya kemampuan berpikir kritis siswa disebabkan karena kurangnya penggunaan media yang dapat menunjang pengembangan kemampuan berpikir siswa. Adapun tujuan dari penelitian ini yakni untuk menghasilkan media ajar e-booklet SSI dan menguji keefektifan PBL dalam meningkatkan berpikir kritis siswa. Penelitian ini tergolong kedalam jenis penelitian pengembangan, yang dikembangkan menggunakan model ADDIE, dengan tahap analisis, perancangan, pengembangan, implementasi, dan evaluasi. Subjek yang terlibat dalam penelitian ini yakni 29 orang siswa SMP. Pengumpulan data dalam penelitian dilakukan dengan menggunakan metode observasi, wawancara, dan tes. Adapun instrument yang digunakan yakni berupa tes dalam bentuk soal uraian bebas. Analisis data menggunakan uji t sampel bebas dan nilai gain score. Hasil analisis penelitian menunjukkan bahwa tingkat validitas e-booklet SSI materi fotosintesis mangrove dengan kategori sangat baik. Efektifitas pembelajaran PBL menggunakan e-booklet SSI berada pada kategori sangat efektif. Ada perbedaan berpikir kritis siswa antara kelas control dan kelas eksperimen. Berdasarkan hasil tersebut maka dapat disimpulkan bahwa penerapan media e-booklet SSI melalui PBL terbukti efektif untuk meningkatkan kemampuan berpikir kritis siswa.

ABSTRACT

The low ability of students' critical thinking is due to the need for more use of media to support the development of students' thinking skills. This study aims to produce SSI e-booklet teaching media and test the effectiveness of PBL in increasing students' critical thinking. This research belongs to the development research type developed using the ADDIE model, with analysis, design, development, implementation, and evaluation stages. The subjects involved in this study were 29 junior high school students. Data collection in the study was carried out using observation, interview, and test methods. The instrument used is in the form of a test in the form of free essay questions. Data analysis used the free sample t-test and the gain score. The research analysis results showed that the validity level of the SSI e-booklet on mangrove photosynthesis was in a very good category. The effectiveness of PBL learning using the SSI e-booklet is very effective. There are differences in students' critical thinking between the control and experimental classes. Based on these results, applying the SSI e-booklet media through PBL has proven effective in improving students' critical thinking skills.

1. INTRODUCTION

IPA is a branch of science that studies nature and everything in it, its objects, and the various events that occur in nature (Jannah & Atmojo, 2022; Nadzif et al., 2022). In its application, science becomes an important scientific discipline to be mastered so that students and the community can understand various natural phenomena in the surrounding environment (Nurwidiyanti & Sari, 2022; Wardani & Syofyan, 2018). Science learning is carried out to improve students' thinking skills and processing skills, especially so that students can get to know the natural surroundings and solve the problems that are in them (Endang et al., 2020; Ningsih & Fitria, 2021; Wijayanto & Istianah, 2017). One of the thinking skills developed in science learning is critical thinking skills. Critical thinking is a thinking ability shown by someone in analyzing problems, ideas, and ideas to solve a problem (Ferdyan & Arsih, 2021; Khofiyah et al., 2019). Critical thinking is one of the basic components that must be developed in the 21st-century learning era. Critical thinking skills can help students to solve problems through logical thinking processes and deal with problems with a higher level of difficulty (Andini & Qomariyah, 2022; Wijayanti & Siswanto, 2020).

It's just that the reality on the ground shows that students' critical thinking skills are still

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relatively low (Endang et al., 2020; Khairiyah & Faizah, 2020). It aligns with the observations and interviews conducted at SMPN 2 Kalianget. The results of observations and interviews show that students are still unable to master critical thinking skills well. The lack of learning media that suits students' needs is one factor that influences students' low thinking skills. The existence of science package books in grade eight is used as a complement to learning. The teaching media students use only contains long description material, and the presented supporting images must be contextual. Hence, the teacher must often remind students to read the subject matter. Students' cognitive learning outcomes are still oriented towards remembering (C1) and understanding (C2). In addition, teachers do not provide opportunities for students to think divergently and convergently in solving a problem related to the science material being studied, such as photosynthesis. If left continuously, these problems will certainly impact decreasing student learning outcomes.

One of the efforts that can be made to overcome this problem is to develop a media that can help the student learning process, such as e-booklet media with a socioscientific issues (SSI) approach. E-booklets are learning media that are small in size but can contain various teaching materials accompanied by pictures to explain the material briefly (Hendrianti et al., 2021; Yulianti & Kumala, 2019). Media e-booklets are generally designed to contain various material summaries arranged systematically and illustrative images (Lestari, 2021; Lingga & Silitonga, 2022). An interesting presentation of the e-booklet will increase curiosity about the learning material presented (Eliana et al., 2022). The e-booklet media will be more effective if its application is accompanied by a problem-based learning approach to socioscientific issues (SSI). The SSI approach is a learning approach that aims to stimulate the development of relations between science and society in people's lives (Imaduddin & Khafidin, 2018; Tsai, 2018). SSI learning consistently provides a learning process that involves students. Most students experience the science process at school, but to successfully understand science concepts, these students must be able to learn science in the community (Rohmaya, 2022; Siska et al., 2020). The innovative nature of the SSI learning process in the classroom can trigger critical thinking (HOTS) skills, analysis, argumentation, and reasoning, as well as action for change in society (Alviaturrohman et al., 2021; Azizah et al., 2021).

This indicates that teaching media needs to be integrated into Socio Scientific Issue (SSI) learning to train students' critical thinking. One of the learning models that facilitates practicing critical thinking is the PBL learning model. PBL is a learning model that presents authentic problems as a context for learning critical thinking and problem-solving skills (Aini et al., 2019; Duda et al., 2019). Real and meaningful problem situations can make it easy for students to conduct investigations (Andini & Qomariyah, 2022; Lubis et al., 2019). PBL is crucial to help students learn to ask questions, solve problems, and think critically and independently (Ningsih & Fitriana, 2021; Nofziarni et al., 2019). Many thinking skills are taught directly in the PBL process, including 21st-century skills. PBL is perfect for developing thinking skills because it presents authentic stories to students that require the application of scientific concepts to construct and evaluate possible actions (Margarita, 2018; Rohman et al., 2021).

Previous studies have revealed that socioscientific issue-based e-modules can significantly improve students' critical thinking skills (Sulistiani et al., 2022). Other studies reveal that e-booklet media can significantly improve student learning outcomes (Haque & Zafri, 2021; Paramita et al., 2019). Further research revealed that implementing problem-based learning significantly affected junior high school student's critical thinking skills (Utomo et al., 2020). Based on some of the results of these studies, it can be said that the e-booklet media, the SSI approach, and the PBL learning model positively influence the learning process and student learning outcomes. In previous studies, no studies specifically discussed the development of mangrove photosynthesis e-booklet teaching media with a socioscientific issue approach through PBL on the critical thinking of junior high school students. So this research is focused on this study to produce SSI e-booklet teaching media and test the effectiveness of PBL in increasing students' critical thinking.

2. METHOD

This research belongs to the type of research and development (Research and Development) developed using the ADDIE model. The ADDIE development model consists of five development stages consisting of the stages of analyzing (Analysis), designing (Design), developing (Development), implementing (Implementation), and evaluating (Evaluation). The analysis phase of the research was carried out to identify possible causes of the gap in the abilities of the students of SMPN 2 Kalianget. Furthermore, the design stage was conducted to verify the mangrove photosynthesis e-booklet and the appropriate testing methods. The design phase is carried out by making an inventory of free essay questions (cognitive tasks, motor tasks, procedural tasks) and free essay questions grids, making learning objectives for e-booklets teaching media, as well as compiling the contents of the e-booklet including the

structure of photosynthesis material, the duration of learning time, and the sequence of supporting images, outlining article information, and assessing learning outcomes.

The third stage is the development stage, which is to develop products by producing teaching media e-booklets in PDF form, which can be accessed through the website fkip@wiraraja.ac.id to attract students' motivation to learn science and product revisions. The data collection process can be used to revise the product before implementation. Data source formative evaluation data includes: product analysis from the validator, product tests in the form of description questions, pre-test, post-test, and questionnaires from respondents, and conducting Trials on Small Group Trials (8-20 students). The fourth stage is the implementation stage which aims to prepare human resources and a supportive learning environment. At this research stage, ensure that all the resources needed are available, starting from preparing teachers. The selected teacher must have knowledge and skills in scientific expertise and prepare eighth-grade students by preparing students to participate and interact effectively with the developed learning resources actively. The final stage is the evaluation stage which is carried out to assess product quality both before and after the implementation of SSI-approached science learning by identifying perceptions, learning, and performance; selecting evaluation tools/instruments, tools in the form of questionnaires, interviews, assignments; and Conduct an evaluation, namely using 5W1H questions on the aspects of perception, learning, and performance.

This study used the Pretest-Posttest Control Group Design. Selection of the sample using a random sampling technique. The research population was eighth-grade junior high school students for the 2021/2022 academic year, with 29 students. The research location is SMPN 2 Kalianget at Jalan Gersik Putih Number 69 Kalianget. Data was collected using validation sheet instruments, questionnaires, and essay test questions. Data were analyzed using the percentage formula to determine the validity of teaching media products, learning effectiveness, and student responses. The critical thinking test items were analyzed using the free sample T-test and calculating the N-gain score. In this study, there were differences in critical thinking between the control and experimental groups. Group differences The normality test in this study used the Kolmogorov-Smirnov test and was supported by the SPSS v.22-assisted Shapiro-Wilk test results. The normality test is used as a prerequisite for hypothesis testing, which is carried out on the results of the N-gain scores of the control and experimental classes. The homogeneity test in this study used Levene's test assisted by SPSS v.22. Test the hypothesis using the free sample T-test. The experimental group also saw an increase in critical thinking which was tested using the results of the N-gain score calculation. The research analysis results were then qualified into the qualification table for teaching media instruments and the qualifications for learning effectiveness, as shown in [Table 1](#) and [Table 2](#).

Table 1. Teaching Media Instruments

Achievement level	Qualification	Description
>80%	Very good	No revision needed
70%-79%	Good	No revision needed
60%-69%	Enough	Revised
50%-59%	Not enough	Revised
<50%	Less	Revised

Tabel 2. Learning Effectiveness

Value Description	Category
81%-100%	Very effective
61%-80%	Effective
41%-60%	Effective enough
21%-40%	Less effective
<20%	Ineffective

3. RESULT AND DISCUSSION

Result

This development research produced a product in the form of an e-booklet teaching media on mangrove photosynthesis material based on Socio Scientific Issues (SSI) using Problem-based learning (PBL) to improve the critical thinking of Kalianget 2 Middle School students. The resulting products are used as teaching materials for teachers and students. The process of preparing the e-booklet is carried out through the stages of analyzing (Analysis), designing (Design), developing (Development), implementing

(Implementation), and evaluating (Evaluation). The results of each development stage are as follows: the first stage is the analysis stage. The analysis results show that students must be more proficient in reviewing what is obtained during learning, especially in photosynthesis material. This problem arises because teaching media integrated into Socio Scientific Issue (SSI) learning must provide this capability. Thus, the teacher needs help conveying natural science material, especially those related to using sunlight to make food, which is taught in photosynthesis material. The analysis of students' needs revealed that 58% needed to understand that there were biology-related issues in photosynthesis material.

The second stage is the design stage, which is carried out by selecting media to write the contents of the e-booklet using the design application in Microsoft Word 365 online. The selection of supporting images is adjusted to the potential of mangroves in Kalianget 2 Middle School, focusing on Alor plants and photosynthetic materials; Figure 2 contains issues on photosynthesis material presented in an e.booklet to attract students to study science. The description of the design issues at the beginning of learning can be seen in Figure 1.



Figure 1. Issues at the Beginning of Learning

The third stage is the development stage or the media development stage. At this stage, validation was carried out on the initial product development by the validator in the field of expertise in science education strata-3 in material and design. User validation is taken from the results of student responses on small-scale tests. The results of the validity assessment are presented in Table 3.

Tabel 3. The Results of the Assessment of the Validity of Material Experts and Media Experts

No	Component	Result (%)	Category
1	Content eligibility	94	Very good
2	Presentation	89	Very good
3	language	67	Good
Average		83	Very good

Suggestions from the validator are to complete the theory of photosynthesis, which needs to be better structured, add research results to strengthen environmental issues, design the e-booklet format to be more interactive, and complete the reference list. The next step is a small-scale test assessment on six junior high school students from high, middle, and low academics. The average response result of 90.74 is in the very good category, so the development test can be carried out on a wide scale. The results of the student response assessment can be seen in Table 4.

Table 4. Results of Student Response Assessment

No	Indicator	Result (%)	Category
1	Satisfaction	83.33	Very good
2	Relevance	94.44	Very good
3	Confidence	94.44	Very good
Average		90.74	Very good

The fourth stage is the implementation stage. The effectiveness of PBL learning can be shown from the results of observing the implementation of learning, which contains the syntax for selecting

topics from the analysis of environmental problems through student orientation to problems, work planning through scientific practice carried out in groups, implementation of the use of e.booklets with the SSI approach through individual and group investigative guidance, presentation of final results, and evaluation through analysis and problem-solving process. The implementation of PBL using the SSI approach e.booklet as a whole, can be implemented in the eighth grade of SMPN 2 Kalianget according to the PBL learning plan. Specifically, students can identify scientific problems, explain phenomena scientifically, use scientific evidence, and demonstrate an attitude of sustainability so that scientific literacy is formed. The results of the analysis of learning effectiveness can be seen in [Table 5](#).

Table 5. The Effectiveness of Learning

No	Aspect	Result (%)	Category
1	Teacher	91	Very effective
2	Student	83	Very effective
Average		87	Very effective

Data on critical thinking skills were obtained from pre-test and post-test scores of experimental class students using critical thinking indicators consisting of providing basic explanations, building basic skills, strategies, and tactics, explaining further, and concluding. The percentage results for each indicator can be shown in [Table 6](#).

Table 6. Assessment of Critical Thinking on Each Indicator

No	Indicator	Result (%)	Category
1	It gives a basic explanation	92.86	Very good
2	Build basic skills	76.79	Good
3	Strategy and tactics	85.00	Very good
4	Explain further	62.50	Enough
5	Conclude	70.95	Good

Furthermore, the significance value analysis results in the normality test using the Kolmogorov Smirnov control and experimental classes showed results of 0.200 (control class) and 0.200 (experimental class). The significance value of the normality test using Shapiro Wilk was 0.933 (experimental class) and 0.068 (control class). This value indicates a number above 0.05 (sig. value > 0.05), so the data in the control and experimental classes are normally distributed. More detailed results of the data normality test can be seen in [Table 7](#).

Table 7. Normality Test Results

Class	Sig.Kolmogorov-Smirnov	Sig.Shapiro-Wilk
Experiment	0.200	0.933
Control	0.200	0.068

The homogeneity test in this study used Levene's test assisted by SPSS v.22. The significance value in the homogeneity test using Levene's test is 0.329. It can be stated to be greater than 0.05 (sign value > 0.05). Based on the specified criteria, if the value of the sign. > 0.05, the data of the two groups (experimental class and control class) have a homogeneous variant or homogeneous distribution of data, so it can be stated that it meets the requirements for hypothesis testing (free sample T-test). The free sample T-test results in the experimental and control classes show that the significance value is 0.000. It can be stated that the value of the sign. Smaller than 0.05 (0.000 <0.05), meaning there is a significant difference between classes that do not use the SSI e.booklet approach and classes that use the SSI e.booklet approach. The next step is the n-gain test which aims to determine the increase in students' critical thinking skills. Based on the results of calculating the N-gain score, it was found that the average value of the N-gain score for the control class was 0.35 (35%), including the low category. It can be stated that learning in the control class is less effective for increasing critical thinking. In the experimental class, the average N-Gain value of 0.73 (73%) is included in the high category.

The fifth development stage is the evaluation stage. This stage was carried out by distributing a questionnaire to the eighth graders of Kalianget 2 Public Middle School in the form of a product in the form of an e.booklet in PDF format, which can be accessed on the Wiraraja University website. The response results showed a positive response from eighth graders; as many as 14 students, after learning

science using the SSI e-booklet, showed a positive response. The ongoing learning activities encourage students' interest in repeating the learning process, giving a positive response of 85.71%. The learning process can foster a link between learning activities with the benefits obtained, showing a positive response of 90.48%. Students who have confidence that the activities learned are easy and enthusiastic to practice have a positive response of 78.57%. The results of the student response assessment can be seen in [Table 8](#).

Table 8. Results of Student Response Assessment

No	Indicator	Result (%)	Category
1	Satisfaction	85.71	Very good
2	Relevance	90.48	Very good
3	Confidence	78.57	Good
Average		84.92	Good

Discussion

The results of this study prove that learning in the experimental class using the SSI e-booklet through PBL has proven to be effective for increasing critical thinking. In PBL learning for junior high school students, students can find interesting and authentic problems in their environment because students are usually interested in everything at this age. The novelty of this research is to develop teaching media in the form of e-booklets integrated with socio-scientific issues implemented through PBL. The data shows that the highest indicator of the critical thinking skills of the eighth graders of SMPN 2 Kalianget is shown when students can provide basic explanations, strategies, and tactics. In this learning activity, students are asked to clarify and interpret the statements and ideas in the mangrove e-booklet using the SSI approach. After this stage, students are asked to determine suitable alternatives to overcome the problems presented. Such a learning process requires students to be able to think critically, where critical thinking includes elements of skilled and active interpretation and evaluation of observation ([Aufa et al., 2021](#); [Ferdyan & Arsih, 2021](#); [Khofiyah et al., 2019](#)). In this case, in student-centered learning, the teacher is only a facilitator of learning. Learning by utilizing the SSI approach trains students to consider reasoning as a causal explanation, such as the possibilities that exist in a case, find relevant evidence, and generalize the possibilities that are considered most suitable to solve problems in the learning context ([Khoiriyah & Suprpto, 2021](#); [Rohmaya, 2022](#); [Siska et al., 2020](#)). Critical thinkers need to have several indicators that must be met in solving problems, namely being able to determine concepts, being able to argue, being able to make conclusions, being able to answer questions according to the context of problems relevant to science material, being able to explain the interrelationships of concepts, and being able to evaluate ([Ferdyan & Arsih, 2021](#); [Khofiyah et al., 2019](#)). In the solving phase (problem-solving), the SSI model can improve students' critical thinking skills compared to the direct learning model ([Munawaroh & Auliya, 2022](#)).

Further findings indicate that problem-based learning conditions are more active in training students to discuss. Thus, students critical thinking skills are more developed after implementing PBL using the SSI approach e.booklet. Ideally, learning activities are designed to deal with new situations or solve problems related to the knowledge gained by students. The use of PBL is supported by Ausubel's learning theory of meaningful learning which emphasizes the need to connect new information to relevant concepts in one's cognitive structure. ([Serevina et al., 2018](#)). PBL adalah strategi pendidikan dimana pembelajaran didorong oleh masalah ([Margarita, 2018](#); [Rohman et al., 2021](#)). The problem can be a challenge, a picture of difficulties, or unexpected events ([Aini et al., 2019](#); [Duda et al., 2019](#)). It can also be incidents with an interesting element or events requiring a solution or explanation. PBL, as a learning theory, argues that students do not learn only by accumulating knowledge; they need to build their understanding of the concept. Students explore the concept of knowledge in different contexts; relate new information to prior knowledge; experiment with using knowledge in various contexts; determine the concept; and value personally building meaningful knowledge ([Andini & Qomariyah, 2022](#); [Lubis et al., 2019](#)).

These findings contribute to the literature by proposing a PBL model integrated with socio-scientific issues in developing e-booklet media that is applied to 21st-century students. Using e.booklet teaching media with a socioscientific issue approach has proven effective in providing opportunities for eighth-grade students SMPN 2 Kalianget investigates a problem in a group discussion. Media must prevent students from knowing to knowing; difficult becomes easy: complex becomes simple, and the abstract becomes concrete ([Eliana et al., 2022](#); [Lingga & Silitonga, 2022](#)). Such learning situations can improve students' critical thinking skills because the learning process trains students' arguments to discuss socioscientific issues that describe scientific knowledge, ethics, and values ([Hidayat & Riyana, 2021](#);

Lestari, 2021). Classroom activities that use the SSI approach and e.booklet provide new experiences for students. In this case, the development of the mangrove e.booklet presents various problems related to social issues (socio-scientific issues) around students. The results obtained in this study are in line with the results of previous research, which also revealed that socioscientific issue-based e-modules could significantly improve students' critical thinking skills (Sulistiani et al., 2022). Other studies reveal that e-booklet media can significantly improve student learning outcomes (Haque & Zafri, 2021; Paramita et al., 2019). Further research revealed that implementing problem-based learning significantly affected junior high school students critical thinking skills (Utomo et al., 2020). Based on the results of this study, the e-booklet media, the SSI approach, and the PBL learning model positively influence the learning process and student learning outcomes.

4. CONCLUSION

Based on the data analysis and discussion results, it can be concluded that using the mangrove photosynthetic e-booklet media using the SSI approach through PBL has proven effective in increasing the critical thinking of Kalianget 2 Public Middle School students. These findings provide evidence of the positive effect of using SSI-based teaching media on improving critical thinking skills.

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