Enhancing Critical Thinking Skills through The Development of Educational Kit Based on Problem Based Learning on Conservation Material

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Abstract. Critical thinking skills (CTS) are essential preparations for addressing challenges in the 21st century era. The use of traditional lecture learning models and less innovative media leads to student passivity and negatively impacts critical thinking levels. This study aims to develop a valid, practical, and effective educational Kit based on problem based learning (PBL) on conservation to enhance CTS. The research model employed is analyze, design, develop, implement, and evaluate. Data collection techniques included literature surveys, interviews, questionnaires, and tests. Qualitative data were acquired from interviews, comments from validators, as well as practical comments and suggestions from teachers and students. These were analyzed using qualitative descriptive analysis techniques. Additionally, quantitative data from content and media expert testing results, practicality assessments by teachers and students, as well as pretest and posttest scores, were analyzed using SPSS and percentage analysis techniques. The media validation yielded a result of 93.54%, and material validation achieved 94.78%, both falling within the “very valid” category. In the practical aspect involving teachers and students, the results reached 93.76%, demonstrating a high level of practicality in the applied learning criteria. The pretest and posttest results of the students revealed a discernible difference. The N-gain test, gauging the difference between the two, indicated a moderate improvement. The highest increase was observed in the inference indicator with a score of 0.67, while the self-regulation indicator showed the lowest improvement at 0.34.

In conclusion, the educational Kit based on PBL was found to be valid, practical, and effective in enhancing CTS.

Keywords: Conservation, critical thinking, educational Kit, problem based learning

Introduction

In the rapidly evolving landscape of the 21st century, science and technology are advancing at an unprecedented pace, requiring adjustments for human survival (Septikasari & Frasandy, 2020). Adaptation to these changes demands a set of skills to confront various challenges (Anggraini & Hudaidah, 2021). A key skill required in navigating the challenges of the 21st century is critical thinking (Mardhiyah et al., 2021), an advanced cognitive skill encompassing systematic and logical abilities crucial for effective decision making.
Possessing critical thinking skills (CTS) becomes particularly important as it facilitates students in training and focusing on resolving encountered problems with greater ease (Wahyuni, 2015).

In Indonesia, the level of students' CTS is low (Agnafia, 2019). The results of the program for international student assessment (PISA) in 2018 Indonesia obtained a ranking position of 64 out of a total of 65 countries. This achievement shows a decrease compared to 2015 with a ranking position of 62 out of 72 countries. The test questions from PISA present real problems that require higher-level thinking, so students must be able and have CTS to be able to solve them (Suprayitno, 2019). Meanwhile, of the six levels presented, Indonesian students can only answer level 1 and level 2 questions (Marudut et al., 2020). The low level of critical thinking is also evidenced by data from the trend in international mathematics and science study (TIMSS) which shows that Indonesia always scores below the average international score (Hadi & Novaliyosi, 2019). From the TIMSS data, it indicated that Indonesian students were weak in solving problems in the problem solving section that required critical thinking, problems that required proof or generalization (Fristadi & Bharata, 2015). This is also in line with studies that show that the level of critical thinking of students in Indonesia is still low (Hidayati et al., 2021; Nuryanti et al., 2018; Solikhin & Fauziah, 2021). The problem of low levels of CTS, if left unchecked, will have an adverse impact on educational aspects or on the quality of human resources (HR) that will be produced (Kartika et al., 2020). One of the reasons of this low skill is that the learning still implements conventional lecture methods (Jamaluddin et al., 2020), so students are not accustomed to being presented with active learning that can increase thinking potential (Nuryanti et al., 2018). Science learning activities that involve active student participation require innovative learning media to provide more experience for students (Moto, 2019).

Learning media is a tool that is part of the teaching and learning process to convey messages from ongoing learning (Nurrita, 2018). One of the media that involves an active process for students during learning is educational Kit (Kusdiyanti et al., 2022). Educational Kit is a set of tools packaged in a simple instrument box (Yulianti et al., 2021). The components in educational Kit can be used as practicum activities, simulations, models, or other learning activities (Prasrihamni et al., 2022). The advantages of educational Kit media can be used by students and teachers anywhere and anytime (Yulianti et al., 2021). This media is still rarely used in the learning process because its use will require a longer time, this happens because there is an active process of students in operating educational Kit components and there will also be a teacher process to direct students to build concepts from the activities they do (Juwita, 2015). However, if learning activities using educational Kit are operated properly, it can involve active students who support practicing student skills, one of which is critical thinking (Aripriharta et al., 2019). This is supported by several learning studies using Educational Kit is able to improve students' CTS (Paramita & Widodo, 2017; Setiawan et al., 2018). Learning media is essentially a tool used in learning, meaning that the media will be meaningful if it is in accordance with the series of learning processes that take place (Falahuin, 2014). So it takes a learning model that can maximize student participation in building their thinking skills using existing media.

Problem based learning (PBL) is a students-centered model to build learning experiences from contextual problem solving activities. This model also emphasizes the critical thinking process for solving the problems presented (Haryanti & Febriyanto, 2017). The advantages of the PBL learning model include students being trained to solve real problems, students can build their own knowledge from their learning activities, students are accustomed to using various sources in finding information, and scientific activities occur in it (Rerung et al., 2017). This model is in accordance with science learning because it is
identical to the formation of a concept with scientific activity (Matta, 2014). The stages of learning activities in this learning model start from orienting the problem, followed by organizing students by the teacher, conducting the investigation process by students, then students present and develop the results of their reasoning, and end with reflection during the problem solving process (Shofiyah & Wulandari, 2018). This learning model is considered capable of practicing CTS because learning with contextual discussions will make students realize if what is being learned can be used in life and make the learning process more meaningful (Ramlani, 2018). This is in line with several studies that concluded that this model is effective in improving CTS (Al-fikry & Syukri, 2018; Ariani, 2020; Kurniahtunnisa et al., 2016).

Science learning focuses on the formation of concepts and theories that are related and associated with the environment of everyday life (Hidayati et al., 2021). One of the science learning materials related to natural life problems is conservation (Sukaesih & Kartijono, 2014). Conservation material is related to the current phenomenon where many human activities are found that have a negative impact on nature and human survival (Fardhani, 2021). Moving from this problem requires solving it using the concept of conservation. However, the application of learning in conservation material still uses the lecture and question and answer method (Leksono et al., 2013). Learning is much more meaningful when students are actively involved in building an understanding of conservation concepts, one of which is in problem solving. In accordance with the characteristics of PBL that make problems as a reference for student learning, activities can be carried out by finding solutions to problems related to conservation through a critical thinking process (Astuti, 2019).

From the interview results, the science teacher at one of the middle schools in Malang City said that CTS were still not optimized in the teaching and learning process. The teacher had used the discovery learning model, but not all activities in the learning model were implemented due to time constraints. The obstacle experienced by teachers in delivering conservation material is the difficulty of what activities are suitable for the material so that they return to using the lecture method. Based on the questionnaire results of 33 students in class VIII, 90.9% of students consider science subjects difficult to understand. 72.7% of students also felt that learning science in class was boring. 90.9% of students revealed that learning requires interesting learning media, because in its application 100% of students stated that the teacher only used the Kemendikbud package book reference. For conservation material, 72.7% of students have difficulty understanding the material presented by the teacher so that 72.7% of students consider conservation material difficult to learn and 78.8% of students also have difficulty responding to a problem.

Based on previous research, showed that the PBL model can affect students' critical thinking on various materials, for example thermal material (Al-fikry & Syukri, 2018). Another study found that the use of educational Kit media in science learning can also improve students’ critical thinking (Paramita & Widodo, 2017). Educational Kit collaborated with the PBL has also been developed but has not been adjusted to enhance certain thinking skills (Fadilah et al., 2020). There is also no research that collaborates the development of PBL-based educational Kit, especially on conservation material that can promote CTS of junior high school students. This educational Kit is important to develop as a form of learning media innovation and to train students’ CTS to provide them with the skills to face the challenges and obstacles that will be encountered in life the 21st century era. The objective of this research is to develop educational Kit learning media about conservation in class VII, which is categorized as valid and practical, as well as effective in enhancing students' CTS.
Methods

This research uses research and development with the main activity of developing products and validating the products made (Sugiyono, 2019). The product to be made in this study is PBL-based educational Kit on the subject of conservation. There are five stages of the analysis, design, development, implementation, and evaluation (ADDIE) (Branch, 2009). The stages of ADDIE research in diagram form are presented in Figure 1.

![Diagram of ADDIE Stages]

The selection of the ADDIE research model is because the stages presented are simpler, making it easier to understand (Anggraini et al., 2016). In addition, the stages in this model are also systematic and sequential, between stages are interrelated so that the final product produced is the result of the previous product (Siregar, 2019). This research was conducted up to the effectiveness test stage applying a pre-experimental design type one group pretest-posttest. This type means conducting a pre and post-test in one group so that it can compare the situation before and after being given treatment (Effendi, 2013).

This study obtained qualitative and quantitative data. Qualitative data was obtained from the results of interviews, comments and suggestions from the validation of media experts and material experts, as well as comments from the practicality of teachers and students which were then analyzed using qualitative descriptive analysis techniques. Quantitative data was also obtained through media and material expert validation assessments, teacher and student practicality as well as student pretest and posttest scores to measure the level of CTS which were analyzed using SPSS software and percentage analysis techniques. The percentage analysis technique to analyze whether a product is valid or practical (Puspitasari et al., 2021).

The first stage in the ADDIE model is analyze which is a stage in identifying a problem, causes, and possible solutions to the problems found (Branch, 2009). Need assessment activities were carried out by studying literature, interviewing science teachers, and filling out questionnaires through google form links to VIII grade students at one of the middle schools in Malang City. Interviews with science teachers with interview guideline instruments were conducted to find out the learning conditions applied, constraints, and other information needed in accordance with the product to be developed. While the needs analysis questionnaire aims to find out the problems or needs of students during science learning takes place. At this stage, qualitative data is obtained which will be analyzed using qualitative descriptive analysis techniques.
The next stage is design, which is the stage of designing the development of the media to be developed (Cahyadi, 2019). At this stage, packaging design is carried out, educational components, manual books, design of learning devices in the form of teaching modules containing learning activities, learner worksheets (LKPD), handouts, and also assessment instruments.

The following stage is develop, which realize the product that has been previously designed and validated (Branch, 2009). At this stage, the activities include printing the box and completing the educational components in it, printing the manual book, compiling and printing teaching modules (RPP, LKPD, handouts, assessment instruments). Products that have been developed will then be tested for validity. Validity is a test or test to assess whether an instrument can be used in accordance with its purpose (Suharsono & Istiqomah, 2014). Experts or experts are needed for validity testing to evaluate the product to be developed (Sugiyono, 2019). In the validation activity, the data collection technique is a questionnaire. The media and material validation questionnaire instrument uses a Likert scale with the criteria presented in Table 1 (Yulianti et al., 2021). The concept correctness assessment applies a Guttman scale with the criteria "Yes" with a score of 1 and "No" with a score of 0 (Sugiyono, 2019).

![Table 1. Likert scale score criteria](image)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very clear/agree/good/interesting</td>
<td>4</td>
</tr>
<tr>
<td>clear/agree/good/interesting</td>
<td>3</td>
</tr>
<tr>
<td>Not clear/agree/good/interesting</td>
<td>2</td>
</tr>
<tr>
<td>Very unclear/agree/good/interesting</td>
<td>1</td>
</tr>
</tbody>
</table>

The fourth stage is Implement, which is the stage where the products that have been developed are applied in the classroom (Cahyadi, 2019). This stage includes teacher and student practicality tests to product effectiveness tests on students' CTS.

The Practicality Test

The practicality test was carried out with the aim of seeing the extent to which the product developed was easy and practical when used (Annisa et al., 2020).

Participants

The Educational Kit product developed was tested for practicality on 2 science teachers and 31 seventh grade students. The teachers were selected based on the teaching experience in science >10 years. The population of the research was seventh grade students, and the sample was selected in purposive sampling in regular class with the assumption criteria the cognitive abilities was equal and having experience learning in PBL using the educational kit in conservation.

Data Collection

The practicality data collection technique was a questionnaire with the instrument of the teacher and student practicality questionnaire sheet. The teacher questionnaire covered educational Kit, manual book, and learning modules. Meanwhile the students
questionnaire covered their experience using educational Kit, manual book, hand out, and student worksheet.

Data Analysis

The obtained data was scored by Likert for teacher questionnaire, meanwhile for students using Guttman scale. The obtained score was then averaged and converted into percentage. After obtaining the percentage value from the calculation using the equation above, the validity and practicality test results are categorized in Table 2 (Yulianti et al., 2021).

**Table 2. Category percentage validity and practicality**

<table>
<thead>
<tr>
<th>Validity and practicality (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 20</td>
<td>Not Practical/Valid</td>
</tr>
<tr>
<td>21 – 40</td>
<td>Less Practical/Valid</td>
</tr>
<tr>
<td>41 – 60</td>
<td>Practical/Valid Enough</td>
</tr>
<tr>
<td>61 – 80</td>
<td>Practical/Valid</td>
</tr>
<tr>
<td>81 – 100</td>
<td>Very Practical/Valid</td>
</tr>
</tbody>
</table>

The Effectiveness Test

The next step is to conduct an effectiveness test by reviewing and analyzing the acquisition of students' pretest and posttest scores through a series of tests. The effectiveness test is a test conducted with the aim of seeing how far the success of the product developed when applied in classroom learning (Yuliati, 2013). The success to be seen in this product is in practicing students' CTS. Data were collected using test techniques in the form of questions that have been justified to be valid and reliable which were tested on 31 seventh grade students. After obtaining the students' pre-post test scores, it will be followed by a normality test, paired sample t-test, and N-Gain calculation. The Evaluate stage in the ADDIE model is carried out at each previous stage by revising or evaluating, the evaluation results are used to provide feedback so that the product developed becomes more valid and reliable (Cahyadi, 2019).

Participants

The population of effectiveness test consists of the VIII Grade students in the school, and the sample used in this research was 31 students of VII F. The sample was selected in purposive sampling in regular class with the assumption criteria the cognitive abilities was equal.

Data Collection

The data collection using test. The test consists of pretest and posttest to measure the CTS. The instrument at this stage an it was also developed to measure CTS. The instrument is in the form of pretest and posttest questions which are prepared based on 6 indicators of critical thinking according to including interpretation, analysis, evaluation, inference, explanation and self-regulation (Facione, 2011). The pretest and posttest questions made each amounted to 6 questions in the form of descriptions, the questions presented were the same but with different contexts. Once finished, the questions will be tested for validity and reliability. Reliability is a measurement to determine the consistency
or how tough the instrument used is (Darma, 2021). Validity and reliability data were obtained by giving pretest and posttest questions to 62 grade VIII students who had taken conservation material. Then the data was analyzed using IBM SPSS statistic 25. The question can be declared valid when the correlation coefficient value is >0.3 and if the correlation coefficient value is <0.3 then the item is invalid and must be corrected (Sugiyono, 2019). Determination of question reliability is seen from the Cronbach's alpha value which must be greater than 0.60 then the question can be categorized as reliable (Roswirman & Elazhari, 2022).

Data Analysis

The normality test was carried out as a prerequisite test before the paired sample t-test was carried out by analyzing using IBM SPSS statistic 25 software. The data obtained can be known to be normally distributed by doing the Shapiro Wilk normality test criteria (Sign> 0.05) or the significance value must be greater than 0.005 (Prasetyawati et al., 2021). After the prerequisite test is carried out, a paired sample t-test is conducted to determine whether there is a difference between the results before and after the test to test the effectiveness of the treatment given to students. If the data obtained gets a significance value of less than 0.05, the data is considered to have a difference and H0 is rejected (Esomar, 2021). The following hypothesis is used in the paired sample t-test.

\[ H_1: \text{There is a significant difference in CTS of students before and after learning using educational Kit based on PBL on conservation material} \]

The next step is to calculate the N-gain to determine the difference in each indicator of students' CTS before and after learning. The N-Gain test can be calculated using the following equation 2.

\[ \text{Ngain} = \frac{\text{posttest} - \text{pretest}}{\text{Maximum Score} - \text{pretest}} \quad (2) \]

Then the N-gain value is categorized in Table 3 (Saputri & Tirtoni, 2022).

Table 3. N-gain score criteria

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>N gain ≤ 0.30</td>
<td>Low</td>
</tr>
<tr>
<td>0.30 &lt; N gain ≤ 0.70</td>
<td>Medium</td>
</tr>
<tr>
<td>N gain &gt; 0.70</td>
<td>High</td>
</tr>
</tbody>
</table>

Results and Discussion

This research produces PBL-based Educational Kit products to enhance students' CTS about conservation in class VII. The development was carried out by ADDIE (Branch, 2009). In the first step of analyze, a study was obtained that revealed that the cause of the level of critical thinking of students is still low because students are not accustomed to being presented with active learning that can increase thinking potential (Nuryanti et al., 2018). (Adilah, 2017) also stated that learning using conventional method, such as lecture, will make students feel bored because they are not required to build their own knowledge according to their potential. This is supported by data from structural interviews with
science teachers from one of the Junior High Schools in Malang city, stating that the implementation of learning mostly uses conventional lecture methods and students' CTS have not been optimized. At the same time, 72.7% of students felt that learning science in class was boring and 78.8% of students also had difficulty responding to a problem critically. Learning media also takes a role in presenting active learning, because with the right media selection students will participate in learning and minimize teacher-centered activities (Wahid, 2018). However, in its application, learning carried out by teachers on conservation material only uses Kemendikbud package books with teacher-centered learning patterns, 90.9% of students need interesting learning media.

In the second stage of design, the packaging or box design of the educational Kit shown in Figure 2 was carried out and designed what components would be in the educational Kit along with the manual book. The selected components include miniature animals, miniature plants, synthetic grass, dry grass, plastic tray ice cream sticks, decorative stones, beach sand, blue, glue, scissors and cutters. In addition, the design of learning devices in the form of teaching modules which include lesson plans, LKPD, handouts, and also assessment instruments.

The third stage is develop with activities including printing the box and completing the educational components in it, printing the manual book, compiling and printing teaching modules (RPP, LKPD, handouts, assessment instruments), and making pretest and postest questions. The educational Kit box has a size of 28 x 23 x 10 cm. The material chosen also uses thick cardboard with a fullprint layer. The inside of the educational Kit box has 2 levels, at the bottom of the box is filled with plastic trays, black sand and synthetic grass. While the top is separated by a small box to store smaller educational components such as miniature animals, miniature plants, dry grass, ice cream sticks, decorative stones, beach sand, blue sand, glue, scissors and cutters. Each educational component is put into a plastic clip so that the materials look neater and not mixed with other materials. The display of the edutainment box and its components is presented in Figure 3.
The education kit is also equipped with a manual book and learning tools in the form of teaching modules. The manual book is made with a leaflet layout model. This manual book contains general information about the edukit, edukit components, usage procedures, storage methods, and work safety. Learning module consists of teaching modules developed include lesson plans, LKPD, handouts, and assessment instruments. Learning steps and LKPD are arranged based on the syntax of the PBL and are also adapted to the indicators of students’ CTS. The student activities include “Ayo Berpikir”, “Ayo Menyimak”, “Ayo, Menyelidiki”, “Ayo Menyajikan”, and “Ayo Menilai”. "Ayo Berpikir" activity where this activity stimulates students to enter the problem raised. Students are presented with readings and infographics about forest fires that have an impact on living things and the environment which will later identify problems and solutions to these problems. The next activity is "Ayo Menyimak" with the activity of listening to the teacher's direction regarding the next activity. Followed by the activity "Ayo Menyelidiki" which requires students to dig for information and look for relevant supporting evidence in developing solutions to the problems presented. Students look for supporting information in deciding the right conservation method solution for animals affected by forest and land fires. In the second meeting, there is a "Ayo Menyajikan" activity with students pouring ideas and ideas for solving problems in the form of replica models using the mini conservation replica educational Kit according to the chosen conservation method. After the replica model has been made, group representatives convey ideas and ideas about the chosen solution and its reasons. Other groups are given the opportunity to ask questions or give comments. After finishing, students do the "Ayo Menilai" activity by evaluating the process of finding and determining the conservation method chosen as a solution to solving the problem of animals affected by forest and land fires. The handout contains material about conservation, the material presented also presents some additional information that complements the student handbook from the Ministry of Education and Culture. Furthermore, to measure the level of students’ CTS, pretest and posttest questions were developed. The pretest and posttest questions made each amounted to 6 questions in the form of descriptions, the questions presented were the same but with different contexts. The questions are also adjusted to the 6 indicators of critical thinking based on Facione including interpretation, analysis, evaluation, inference, explanation and self-regulation (Widodo, 2021). The appearance of the manual book and teaching module learning device is presented in Figure 4.

![Figure 4. Learning set display: (a) teaching module, (b) LKPD, (c) handout, (d) manual book](image-url)
After the developed product has been completed, media and material validity tests are carried out by one science education lecturer for media and material expert. The results of validation by media expert are presented in Table 4.

**Table 4. Media expert validity score**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Media expert validity score (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational graphics</td>
<td>92.04</td>
<td>Very valid</td>
</tr>
<tr>
<td>Teaching module graphics</td>
<td>97.11</td>
<td>Very valid</td>
</tr>
<tr>
<td>Usage aspect</td>
<td>95</td>
<td>Very valid</td>
</tr>
<tr>
<td>Language</td>
<td>90</td>
<td>Very valid</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>93.54</strong></td>
<td>Very valid</td>
</tr>
</tbody>
</table>

The results of the validation of PBL-based educational Kit media on the subject of conservation in class VII obtained an average of 93.54% with very valid criteria. From the overall assessment of media expert lecturers, each indicator does not need to be revised, the comments given also show that the media developed is good. In some aspects that are lacking, only verbal suggestions are given by media expert lecturers to be used as learning when developing other better products later. On the indicator of educational Kit graphic obtained 92.04% by reviewing aspects of size, box design, display of tools and materials, and manual book. The suggestion given on this indicator is that the title on the manual book presented would be better if it is not too pulled over. In the teaching module graphical indicators obtained 97.11% by reviewing aspects of identity, core components, text, images, layout, and benefits of teaching modules. In the use aspect indicator, it obtained 95% with the suggestion that the images presented in the LKPD and handouts were consistent in their placement. The language indicator obtained 90% by reviewing aspects of straightforwardness, communicativeness, accuracy according to language rules, and reference writing.

In addition to the media validity test, the products developed were also tested for material validity. The results of validation by material experts are presented in Table 5.

**Table 5. Material expert validation score**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Material expert validation score (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching module</td>
<td>81.25</td>
<td>Very valid</td>
</tr>
<tr>
<td>Handouts</td>
<td>100</td>
<td>Very valid</td>
</tr>
<tr>
<td>LKPD</td>
<td>89.71</td>
<td>Very valid</td>
</tr>
<tr>
<td>Presentation feasibility</td>
<td>90.62</td>
<td>Very valid</td>
</tr>
<tr>
<td>Language feasibility</td>
<td>100</td>
<td>Very valid</td>
</tr>
<tr>
<td>Contextual assessment</td>
<td>100</td>
<td>Very valid</td>
</tr>
<tr>
<td>Conceptual correctness</td>
<td>100</td>
<td>Very valid</td>
</tr>
<tr>
<td>Pretest and posttest questions</td>
<td>96.67</td>
<td>Very valid</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>94.78</strong></td>
<td>Very valid</td>
</tr>
</tbody>
</table>
The material validation resulted 93.54% that classified into very valid. In the feasibility of the teaching module content obtained 81.25% by reviewing aspects of the suitability of the material with learning outcomes and objectives, suitability with the PBL model, and suitability with critical thinking indicators (CTI). The comments given on this indicator are that the objectives do not appear to be conditions that lead to PBL activities and evaluation activities should lead to an evaluation of the problem-solving process. From the comments given, revisions have been made to bring up conditions according to PBL activities on learning objectives and also improve student activities in evaluating. On the indicator of the feasibility of the handout content obtained 100% by reviewing aspects of the suitability of the material with learning outcome, the accuracy of the material, and the recency of the material. In the LKPD content feasibility indicator, it obtained 89.71% by reviewing aspects of suitability with the selected learning model as well as CTI. This indicator received comments on the PBL syntax "develop and present work" which is contained in 2 student activities "Ayo Merancang" and "Ayo Menyajikan" making PBL activities vague and ambiguous in the PjBL learning model. From these comments, revisions were made regarding student activities in the syntax of "developing and presenting work". In this syntax, which originally had 2 activities, namely "Ayo Merancang" and "Ayo Menyajikan", after being revised, it was made into 1 activity "Ayo Menyajikan" only with the focus of activities to explain the solution chosen to solve the problem based on the results of finding information in the previous activity. In the presentation feasibility indicator, 90.62% was obtained by reviewing presentation techniques, supporting presentation, presentation of learning, and the sequence of thought flow. On the indicators of language feasibility, contextual assessment, and conceptual correctness, all three obtained 100% with very valid criteria. In the last indicator, namely the pretest and posttest questions obtained 96.67%. In this indicator, comments were received to improve the cognitive level on questions that contained the CTI "explanation". From the comments obtained, improvements have been made. Based on the description of the results of the media and material validity tests, it can show that the products developed are very valid for use in learning.

The questions used to measure students' CTS were tested for validity and reliability before being used for experiments. The questions were given to VIII grade students who had received conservation material and the scores were analyzed using IBM SPSS statistic 25. The question items are categorized as valid if the correlation coefficient value is > 0.3 and if the correlation coefficient value is less than 0.3 then the question item is invalid and must be corrected (Sugiyono, 2019). After being analyzed, all items obtained a correlation coefficient value of more than 0.3 so that the question was categorized as valid. The validity test results are shown in Table 6. Meanwhile, in the reliability test, the question is justified as reliable if the Cronbach alpha value is greater than 0.60 (Roswirman & Elazhari, 2022).

**Table 6. Validity test results (pretest and posttest)**

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Correlation Coefficient</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.637</td>
<td>Valid</td>
</tr>
<tr>
<td>2</td>
<td>0.341</td>
<td>Valid</td>
</tr>
<tr>
<td>3a</td>
<td>0.643</td>
<td>Valid</td>
</tr>
<tr>
<td>3b</td>
<td>0.767</td>
<td>Valid</td>
</tr>
<tr>
<td>4</td>
<td>0.649</td>
<td>Valid</td>
</tr>
<tr>
<td>5</td>
<td>0.623</td>
<td>Valid</td>
</tr>
</tbody>
</table>
The next stage is implement by conducting teacher and student practicality tests and testing the effectiveness of the product on students' CTS. The practicality test was carried out with the aim of knowing how far the product developed was easy and practical when used (Annisa et al., 2020). Quantitative data on the practicality of 2 science teachers and 31 seventh grade students were analyzed using percentage analysis techniques. The score of the teacher and student practicality tests are shown in Table 7.

**Table 7. The test results of practicality**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Practicality test results (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Practicality</td>
<td>98.67</td>
<td>Very Practical</td>
</tr>
<tr>
<td>Student Practicality</td>
<td>88.86</td>
<td>Very Practical</td>
</tr>
<tr>
<td>Average</td>
<td>93.76</td>
<td>Very Practical</td>
</tr>
</tbody>
</table>

The practicality test results of the teacher and student obtained 93.76% with very practical criteria. From the teacher’s practicality questionnaire, suggestions and comments were obtained regarding the layout of the teaching module cover which would be better if the writing was not too to the edge. From the student’s practicality questionnaire, suggestions were obtained to clarify the images presented. Based on the results of the teacher and student practicality tests, it results that the PBL-based educational Kit media is very practical to be implemented in learning conservation materials.

At this stage, the effectiveness of the product on students' CTS was tested. During the data collection process, 1 observer who is a science teacher was accompanied to oversee the implementation of the activity stages listed in the teaching module. The implementation of the activity stages in the teaching module showed 100% results, indicating that all stages were carried out appropriately.

Learning activities were carried out 2 times a meeting with details of 5 JP with each JP for 40 minutes. This means that the time allocation needed during data collection is 200 minutes. In the first meeting, students' initial CTS were tested by working on pretest questions. After that, the learning activities followed the syntax of PBL and the students worked on the LKPD following step “Ayo Berpikir”, “Ayo Menyimak”, “Ayo, Menyelidiki”, “Ayo Menyajikan”, and “Ayo Menilai”. Furthermore, students' CTS were tested after using edukit media by working on pretest questions. The results of the pretest and posttest scores obtained will be analyzed to determine the effect of the media provided. There is a prerequisite test, namely the normality test, the data is said to be normally distributed when the significance value is more than 0.05 (Sign > 0.05) (Prasetyawati et al., 2021). After analyzing the pretest-posttest difference value, a significance value of 0.549 > 0.05 is obtained. The result declares that the data is normally distributed (Table 8).

**Table 8. Normality test analysis results**

<table>
<thead>
<tr>
<th>Data</th>
<th>Significance value</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest-Posttest Difference</td>
<td>0.549</td>
<td>Normal</td>
</tr>
</tbody>
</table>

After the data is determined to be normally distributed, proceed to the paired sample t-test. If the data obtained gets a significance value <0.05, the data is considered to have a difference and H0 is rejected (Esomar, 2021). After being analyzed, a significance value of 0.00 (0.00 < 0.05) was obtained, meaning that the pretest and posttest data were
different and the $H_1$ hypothesis was accepted. Therefore, it can be decided that educational Kit based on PBL can enhance students' CTS.

The next analysis is to determine the differences in each indicator of students' CTS before and after learning by comparing the average pretest and posttest scores. Indicators of critical thinking according to (Facione, 2011) include interpretation, analysis, evaluation, inference, explanation and self-regulation. A comparison of the pretest and posttest scores is presented in Figure 5.

![Figure 5. Pretest and posttest scores for each CTI](image)

The next test is the N-gain which counted to determine the extent of the effectiveness of the product given toward students' CTS (Oktavia et al., 2019). From the calculation, the Interpretation indicator obtained a value of 0.352, the analysis indicator obtained a value of 0.465, the evaluation indicator obtained a value of 0.371, the inference indicator obtained a value of 0.673, the explanation indicator obtained a value of 0.444, the self-regulation indicator obtained a value of 0.344. The average of N-gain is 0.442 classified into moderate criteria (Table 9).

<table>
<thead>
<tr>
<th>Indicators</th>
<th>N-gain</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpretation</td>
<td>0.35</td>
<td>Medium</td>
</tr>
<tr>
<td>Analysis</td>
<td>0.46</td>
<td>Medium</td>
</tr>
<tr>
<td>Evaluation</td>
<td>0.37</td>
<td>Medium</td>
</tr>
<tr>
<td>Inference</td>
<td>0.67</td>
<td>Medium</td>
</tr>
<tr>
<td>Explanation</td>
<td>0.44</td>
<td>Medium</td>
</tr>
<tr>
<td>Self-organization</td>
<td>0.34</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.44</td>
<td>Medium</td>
</tr>
</tbody>
</table>
The interpretation indicator is a skill where a person is able to understand and re-describe the information obtained (Simanjuntak, 2019). The questions presented focus on the sub-indicator of clarifying meaning, namely describing information to be clearer by paraphrasing (Widodo, 2021). The average student score on this indicator was pretest 58.87 and posttest 73.39 with an N-gain 0.352 on the effectiveness classified as moderate criteria. Activities carried out in practicing the interpretation indicator are found in the "Ayo Berpiikir" activity. Students are asked to describe the important information in the passage and infographics about forest fires that have an impact on living things and the environment using language that is easier to understand. In addition, it is also practiced in the "Ayo Menyelidiki" activity by presenting pictures of different conditions of the National Park and Zoo then students are asked to describe the differences that exist. In accordance with a study carried out by (Maslakhatunnimah et al., 2019) stated the interpretation is the skill of being able to describe the information obtained using one's own language to make it easier to understand. Likewise, a study conducted by (Wahyuni, 2015) states that inference skills can be trained through comparing activities of a variety.

The analysis indicator presents the focus of the question on the sub-indicator of analyzing arguments, namely a person's skill in identifying and describing the intent in presenting an argument (Widodo, 2021). The average student score on this indicator is pretest 65.32 and posttest 81.45 with N-gain 0.465 on medium criteria. Activities carried out in practicing analysis indicators are found in the "Ayo Berpiikir" activity. Continuing from the previous activity, students are then asked to identify problem findings and formulate problem solving along with an explanation of the solution. In addition, this skill is also trained in the student activity "Ayo Menyelidiki" in the part where students write down the characteristics and components that must be present in a good conservation ecosystem from the results of comparing pictures of the conditions of the National Park and Zoo. In line with a study carried out by (Rokhim et al., 2018) explained that analysis skills are obtained from examining existing data or information to obtain or form an opinion.

The evaluation indicator presents the focus of the question on the sub-indicator of assessing arguments, namely a person's skill in assessing the strength of a statement or argument (Widodo, 2021). The average student score on this indicator is 71.77 pretest and 82.25 posttest with an N-gain 0.371 classified as moderate criteria for the effectiveness. The activities carried out to train this skill are in the "Ayo Menyelidiki" activity where students are asked to assess whether animal evacuation activities are important to carry out or not accompanied by the reasons that build these assessments. In addition, in the "Ayo Menyajikan" activity, when group representatives present the results of their discussion, other participants are asked to judge whether they agree with the results that their friends have presented. In addition to assessing the results of other groups, evaluation activities are also conducted by assessing the solution chosen to solve the problem whether it is appropriate or not based on the results of joint discussions in class. In accordance with the statement from (Simanjuntak, 2019) which states that this evaluation activity can be an assessment by measuring and comparing to decide the strength of the information obtained.

The inference indicator presents the focus of the question on the sub-indicator of looking for evidence and alternatives, namely a person's skill in collecting and considering evidence or information used to strengthen a conclusion (Widodo, 2021). The average student score on this indicator is pretest 62.9 and posttest 87.9 with N-gain 0.673 on the effectiveness of moderate criteria. The activities carried out to train this skill are found in the "Ayo Menyelidiki" activity. Students are asked to find supporting information to determine what conservation method is appropriate to solve the problems found. Inference activities are done by digging up information about what is meant by conservation, what principles are carried out in conservation, types of conservation methods along with their characteristics and examples. This information is made as the basis for determining the
conclusion of conservation methods to solve the problem of forest fires. In accordance with a study done by (Putri et al., 2015) describes that inference skills can be trained by the process of collecting supporting evidence to solve problems found around.

The explanation indicator presents the focus of the question on the sub-indicator of presenting results and arguments, namely a person's skill in producing a statement or conclusion by providing reasons (Widodo, 2021). The average student score on this indicator is pretest 56.45 and posttest 75.8 with N-gain 0.444 on the effectiveness of moderate criteria. The activities carried out to train this skill are found in the "Ayo Menyajikan" activity. Students are asked to present the results of reasoning to make a solution to a problem. After students determine a suitable conservation method to overcome the impact of forest fires on animals, a conservation replica model is made. When presenting in front of the class, students explain the reasons for choosing the conservation method chosen, as well as explain the reasons for choosing the components in the conservation replica model. In accordance with a study conducted by (Ramadhanti & Agustini, 2021) which shows that the activity of explaining the relationship of a conclusion with reasons can train explanation skills.

The self-regulation indicator presents the focus of the question on the self-assessment sub-indicator, namely a person's skill in reflecting on his reasoning process (Widodo, 2021). The average student score on this indicator is pretest 27.41 and posttest 52.41 with an N-gain 0.344 on the effectiveness classified as moderate criteria. The activities carried out to train this skill are found in the "Ayo Menilai" activity, students are asked to reflect on the process carried out in determining the solution or resolution of the problem presented. In addition, students are asked to write down the shortcomings and advantages they have in making the solution presented in the form of a conservation replica model and the improvement plan that will be carried out. In line with (Maslakhatunnimah et al., 2019) which declares that activities that can be included in the inference indicator can be in the form of assessing and self-reflecting and continuing to correct mistakes because of the reflection that has been done.

Of the six CTI described, the highest N-gain test results were in the inference indicator with a value of 0.673. This can happen because the activities in this lesson can facilitate students in gathering information that supports to make conclusions about the right solution to the problem presented. Although this indicator only appears in one activity, namely "Ayo Menyelidiki", the number of items used to train inference skills is more than the other CTI. It is proved by the results of student practicality in the inference indicator obtaining the highest percentage compared to the value of other indicators, which is 91.13%. Meanwhile, the lowest N-gain test results were in the self-regulation indicator obtaining 0.344. This can occur due to the lack of training of self-regulation indicators in the activities or learning steps implemented. This indicator is only trained in one activity, namely "Ayo Menilai" with only 1 item presented. These results are supported by the lowest student practicality score among other indicators, which is 83.87% and teacher practicality on self-regulation indicators obtained a score of 3 while on other indicators obtained a score of 4. At the time of filling out the practicality questionnaire, the teacher also conveyed verbally if the reflection activity was relatively difficult for students to do because in learning it was usually rarely done, so it needed habituation of student activities to reflect. This shows that the learning model applied previously is also influential. It is also supported by the findings during the needs analysis, where teachers more often use lecture learning models in science learning. The application of this conventional method has disadvantages, one of which is the absence of opportunities for students to discuss and bring up courage in expressing opinions so that it is difficult to assess the extent of their level of understanding (Wirabumi, 2020). This makes students less able to reflect and correct mistakes according to themselves.
In general, educational media combined with learning steps using PBL model facilitate students to practice CTS through the problems presented. Both PBL learning model and the educational Kit media contribute equally to practice CTS. PBL stage presents student activities using educational Kit accompanied by LKPD that has been adapted to train CTS and handouts to provide additional information in finding information in problem solving. In line with the research of (Rokhim et al., 2018) through problem solving activities can enhance critical thinking. Also supported by studies that state learning that facilitates the enhancement of students’ CTS is that which applies a student centered approach, namely students as the center of learning to form their own knowledge and applies a learning model with steps that activate students in learning (Simanjuntak, 2019).

Conclusion

The educational Kit based on PBL on conservation topic obtained very valid criteria for media and material validity, the teacher and student practicality tests resulted very practical, and the effectivity gained moderate criteria to enhance CTS. The skills were trained following syntax of PBL that completed by educational Kit that facilitate students to solve the contextual problem in conservation material. The highest increasing indicator was obtained by inference indicator, meanwhile the lowest increasing was gained by self-organization criteria with the sama medium category.

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