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Creating E-LKPD Containing Ethnoscience Model Problem Based Learning Material on Global Warming to Improve Students' Critical Thinking Skills

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ABSTRACT

This research is motivated by the low critical thinking skills of students on global warming material and the need for innovative teaching materials that integrate local wisdom with technology. This research aims to produce E-LKPD containing ethnoscience with a valid Problem Based Learning (PBL) model to improve students' critical thinking skills. The research method used is Research and Development (R&D) with the Dick and Carey development model. The validity of E-LKPD was assessed by five validators covering aspects of material substance, learning design, visual communication display, software utilization, ethnoscience, PBL model, and critical thinking skills. The validation results show an average score for each aspect as follows: material substance (0.95), learning design (0.96), visual communication display (0.96), software utilization (0.99), ethnoscience (0.85), PBL (0.99), and critical thinking skills (0.95). Overall, the average value of the validity of this E-LKPD containing ethnoscience is 0.94 with a very valid category. Thus, it can be concluded that the PBL-based E-LKPD containing ethnoscience on the global warming material is very valid and suitable for use in the learning process to improve students' critical thinking skills.

Keywords: E-LKPD, Etnoscience, PBL, Critical thinking skills, Global Warming.

I. INTRODUCTION

The 21st century has brought significant transformations to the global education paradigm, with the massive development of digital technology dominating various aspects of life and revolutionizing the entire instructional process in schools [1]. Given that conventional learning methods are no longer relevant in responding to the needs of a highly dynamic and competitive era, fundamental strengthening of learning innovation and increased student adaptability to rapid technological change is necessary [2]. In line with these demands, the development of the 4C competencies which include creativity, critical thinking, problem-solving, communication, and collaboration is a crucial pillar that must be integrated into the curriculum to equip students to face increasingly complex global competition [3]. Specifically, in science education, honing critical thinking skills is a top priority to address the challenges of current technological disruption, where students are required to analyze information accurately and objectively [4]

Critical thinking skills are essentially essential competencies for students to identify, analyze, and solve various daily life problems systematically and based on data. In an ideal learning ecosystem, the conceptualization and characteristics of critical thinking must be precisely defined, with the primary focus directed at mastering logical reasoning skills and decision-making skills when facing problems [5]. To optimize this potential, various innovative learning models can be implemented in the classroom, and one of the most representative models and proven effective in stimulating student reasoning is the Problem-Based Learning (PBL) model [6].

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Problem-Based Learning (PBL) is an instructional model that deliberately utilizes real-world contextual issues as triggers to stimulate critical thinking and problem-solving skills, both independently and in groups. Through a series of authentic investigations, this model facilitates students in correlating abstract theoretical foundations with real-world practice, a synergy that is crucial for strengthening conceptual understanding in science education [7]. In today's digital era, the successful implementation of student-centered PBL is further strengthened by the integration of Information and Communication Technology (ICT), which serves as a primary instrument for students to explore creative solutions to the complex problems they face in their environment.

The integration of ICT in the PBL model has been proven to significantly enrich the learning experience by enabling students to access unlimited global information resources and engage in effective digital collaboration in solving complex problems [8]. In the context of educational digitalization, ICT is no longer merely a supplementary medium, but rather a vital instrument that supports interactivity, flexibility, and independent student learning through the use of various online platforms and interactive multimedia media [9]. This implementation aligns closely with the School Literacy Movement, which emphasizes the ability to evaluate the accuracy of information, a cognitive process that becomes much more meaningful when students are confronted with real-world ethnoscience-based problems that are emotionally connected to their social environment [10]. The ethnoscience approach itself works by reconstructing indigenous community knowledge and local wisdom as an integral component of modern science learning to maintain cultural relevance [11][12].

However, based on the results of an in-depth needs analysis conducted at SMAN 1 Nan Sabaris in grade X Phase E, it was found that actual conditions on the ground still show a significant gap from the expected ideal standards. The low critical thinking skills of students at SMAN 1 Nan Sabaris are a pressing fundamental issue, as evidenced by the average score of only 44.85% on the Ennis indicator essay test, a figure that confirms that students' problem-solving strategies remain very low. This low achievement reflects the general challenges facing Indonesian education, where students' scientific literacy and higher-order reasoning skills require significant intervention through the development of innovative and relevant teaching materials [13].

Other real-world conditions indicate that teachers still tend to employ conventional, one-way learning patterns and are unable to optimally accommodate the diverse learning styles of students. A heavy reliance on physical textbooks, whose material is considered less contextual, makes it difficult for students to connect physics lessons to real-life phenomena. Furthermore, a questionnaire showed that the majority of students (77.42%) have a visual learning style that requires visual and video stimulation. Furthermore, the integration of local wisdom (ethnoscience) into Student Worksheets (LKPD) has not been systematically implemented, resulting in students' understanding of topics such as global warming remaining abstract and merely rote. Therefore, a digital learning medium is needed that can concretely visualize the phenomenon of climate change while linking it to the real impacts felt by local communities to make learning more effective [14]

As a strategic solution to address these various problems, the development of an E-LKPD for Physics with an ethnoscience theme was carried out using a systematically designed ICT-based PBL model. The use of E-LKPD is believed to produce a more efficient learning process because it can transcend the limitations of space and time and provide more flexible learning resources for students [15]. Through this research, it is hoped that the validity of the developed E-LKPD can be properly tested, thus becoming an innovative tool for improving students' critical thinking skills in the future.

II. METHOD

This study uses the Dick & Carey learning design model. This model begins with identifying general objectives, conducting learning analysis, analyzing students and their context, formulating specific learning objectives, developing assessment instruments, developing learning strategies, developing and selecting teaching materials, designing and conducting formative evaluations, conducting revisions, designing and selecting summative evaluations. A picture of the steps in the Dick & Carey model can be seen in Figure 1.

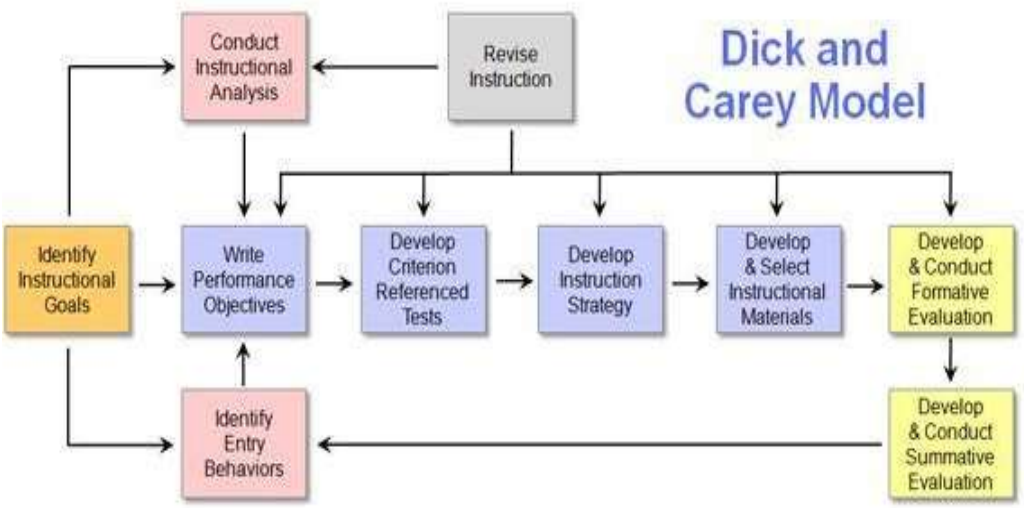

Fig. 1. Dick and Carey Model

In making this product, it is limited to stage 9, namely making revisions. This validation process was carried out by three physics lecturers at FMIPA UNP and two physics teachers at SMAN 1 Nan Sabaris. This instrument was made in accordance with the Ministry of National Education 2010 [16]. This instrument has parts including material substance, learning design, visual communication display, software utilization, Ethnoscience, PBL model, critical thinking skills. After validation by experts, improvements were made based on the suggestions that have been given to produce a quality product. This validation sheet was designed using a Likert scale as a measuring tool with indicators compiled to assess various aspects of instrument feasibility referring [17], namely:

Table 1. Likert Scale

Score	Category
1	Strongly Disagree
2	Don't agree
3	Agree
4	Strongly agree

The validator's assessment was then analyzed using the validity index compiled by Aiken's V

$$V = \frac{\sum S}{[n(c-1)]} \times 100$$

With

$$S = r - lo$$

Description:
V = Rater Agreement Index
S = Smallest score in the category used and applied by the validator
r = Score given by the validator
lo = Lowest validity assessment score
c = Highest validity assessment score
n = Number of validators

The categories for carrying out validity can be seen in Table 2.

Table 2. Aiken Validity Criteria,s

Interval	Penilaian
V < 0,4	Invalid
0,4 < V ≤ 0,8	Valid
0,8 < V	Very Valid

[18]

III. RESULTS AND DISCUSSION

RESULTS

1. Identifying General Objectives

The initial stage of the research was conducted through interviews with 10th-grade physics teachers in Phase E at SMAN 1 Nan Sabaris. The interviews revealed that the learning process remains conventional and has not yet implemented a model capable of fostering student enthusiasm and critical thinking skills. Furthermore, the use of information technology (IT) has not been optimal, and although educators have understood the concept of ethnoscience-based learning, its implementation in the classroom has not yet been implemented.

2. Conduct Learning Analysis

This stage was conducted by directly analyzing the teaching materials used in the lesson. The analysis revealed that the primary learning resource used was the printed Physics textbook by Ni Ketut Lasmi. The textbook was deemed to not present in-depth material based on contextual (real-world) problems and lacked a variety of practice questions, thus not optimally stimulating students' critical thinking skills..

3. Analyzing students and context

The results of interviews with physics teachers show that global warming is the most difficult material for students to understand. This is in line with the results of the critical thinking ability questionnaire compiled based on Ennis' indicators Ennis [19]. namely providing simple explanations, building basic skills, concluding, providing further explanations, arranging strategies and tactics. Detailed data regarding the low level of critical thinking ability can be seen in the table below. The results of the analysis of students' critical thinking abilities can be seen in Table 3.

Table 3. Results of students' critical thinking ability test

Indicator of critical thinking abilities	Percentage
Provide a simple explanation	55,0%
Build basic skills	47,1%
Conclude	45,7%
Provide further explanation	45,7%
Set strategy and tactics	32,1%

The table shows that students' critical thinking skills are still low, with the highest average score being giving simple explanations (55.0%) and the lowest (32.1%).

A questionnaire was also distributed to assess students' learning styles. This questionnaire covered visual, auditory, and kinesthetic learning styles. The results of the students' learning styles are shown in Table 4.

Table 4. Student learning styles

Learning Style	Percentage
Visual learning style	77,00%
Auditory learning style	69,42%
Kinesthetic learning style	72,48%

Based on the data presented in Table 4, an overview of the learning style tendencies of grade XI Phase F students at SMAN 1 Nan Sabaris is obtained, the visual learning style occupies the highest percentage, namely 77.00%. This indicates that the majority of students find it easier to absorb information through visual observation, such as through pictures, diagrams, graphs, and visual demonstrations. In the context of ICT, these findings indicate that the use of digital-based media such as virtual simulations, learning videos, and interactive graphics in E-LKPD will be very effective in helping students visualize abstract physics concepts..

4. Write down specific goals

Based on an analysis of the learning context and the identification of material that students found difficult to understand, researchers analyzed the Learning Outcomes of the independent curriculum to determine Learning Objectives that align with student abilities.

5. Develop assessment instruments

Before creating a product, it is first necessary to develop validity through a validity sheet. The validity sheet is developed with provisions in accordance with the product quality that has been validated by the supervisor. This validity questionnaire consists of aspects of material substance, learning design, visual communication display, software utilization, Ethnoscience, PBL models, and critical thinking skills [16].

6. Develop learning strategies

Based on interviews, it was discovered that physics teachers had implemented teaching materials using the Problem-Based Learning (PBL) model, but had not integrated ethnoscience elements into their learning. Based on these findings, a PBL learning model containing ethnoscience was developed. The implementation of this model is expected to facilitate students in achieving Learning Objectives (TP) and improve their critical thinking skills..

7. Developing and selecting teaching materials

Based on the problems encountered at the school, a solution was found: the creation of electronic student worksheets (LKPD) with a PBL model containing ethnoscience to improve students' critical thinking skills. The design of this ethnoscience-based PBL-based e-LKPD can be seen in Figure 2.

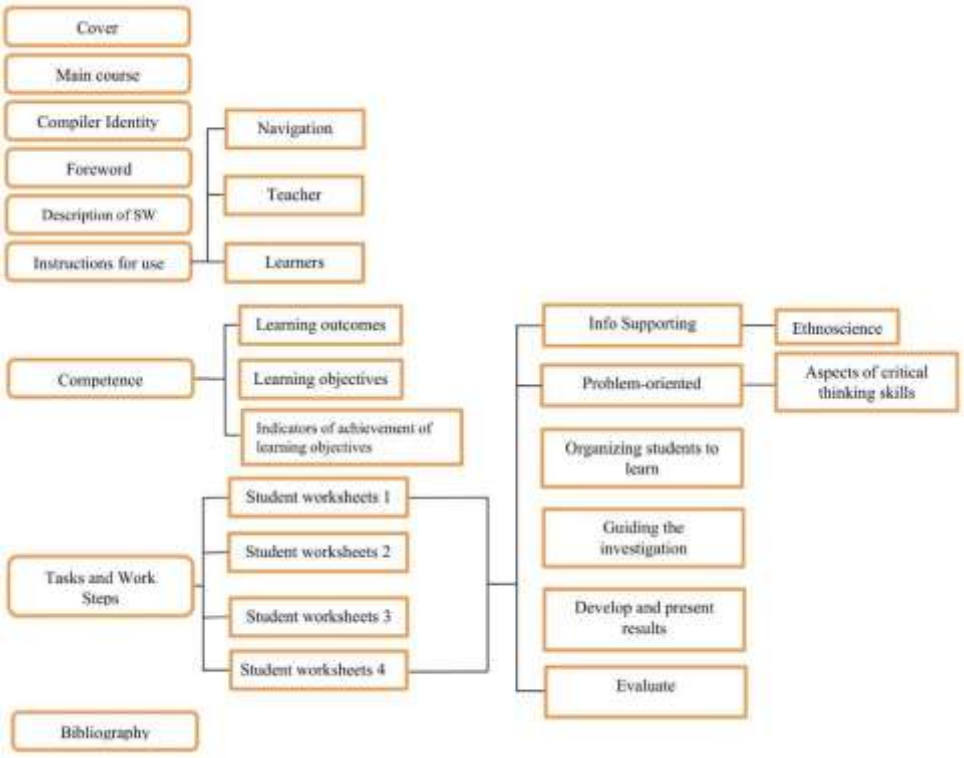

Fig. 2. E-LKPD design containing ethnoscience

8. Designing and conducting formative evaluation

At this stage, E-LKPD validation is performed. The results of this validation are obtained from the validation sheet, which has been validated by five expert validators. The validation results can be seen in Figure 4.

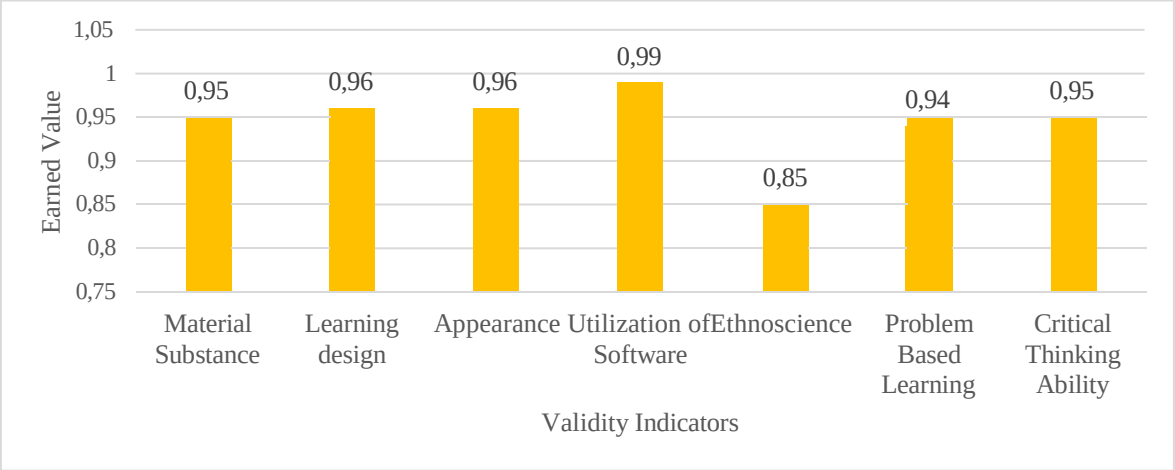

Fig. 3. Validation Results

The figure above shows that the validation indicator values are 0.95, 0.96, 0.96, 0.99, 0.85, 0.94, and 0.95. The average validation value for the E-LKPD containing Ethnoscience is 0.94, categorized as very valid. Therefore, the validation value for the E-LKPD containing Ethnoscience using the PBL model to improve students' critical thinking skills is valid for use.

9. Revision Stage

The revision stage is carried out if there are improvements to the E-LKPD. This revision includes suggestions from each validator, and revisions are continued until the product is declared valid.

DISCUSSION

Based on research that has been conducted previously at SMAN 1 Nan Sabaris in class X of phase E. In the needs analysis carried out through teacher interview sheets, questionnaires on students' critical thinking skills and questionnaires on students' learning styles, teaching materials are needed in the form of E-LKPD containing ethnoscience with a problem-based learning model that can improve students' critical thinking skills. Which states that developing a PBL-based e-LKPD enriched with an ethnoscience approach can be an effective solution to address this challenge. This approach will help students become more engaged in physics learning, improve critical thinking skills, and connect physics concepts to everyday life and local wisdom [20].

Next, the researchers developed a product validation instrument. This product validity was conducted by five experts, including indicators of material substance, learning design, visual communication display, software utilization, ethnoscience, the PBL model, and critical thinking skills. This stage aimed to determine the feasibility of the e-LKPD as a product. After being tested for feasibility by the validator, the product's average value was 0.94, indicating that the product was highly suitable for use.

IV. CONCLUSION

Based on this research, it can be concluded that the creation of E-LKPD containing ethnoscience with the Dick and Carey model. The instrument assessment components consist of material substance indicators, learning design, visual communication displays, software utilization, Ethnoscience, PBL models, critical thinking skills. The results of the validity using the Aiken Validity Criteria, s have a validity value of 0.94 which means the product is in the very practical category. So it can be concluded that E- E-LKPD containing ethnoscience with a problem-based learning model to improve students' critical thinking skills on global warming material is very valid to use.

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