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Validity of Ethnoscience-Integrated Problem Based Learning Student Worksheet to Train Science Literacy and Creative Thinking

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Abstract: This research aims to develop appropriate student worksheet to train science literacy and creative thinking. This student worksheet was developed based on Problem Based Learning integrated with ethnoscience in elemental, compound, and mixed materials. This research focuses on the validation of student worksheet that has been developed to ensure its quality and feasibility as a teaching material. This type of research is Research and Development (R&D) and uses the ADDIE (analysis, design, development, implementation, and evaluation) model. The subject of the study is Grade VII junior high school. The validation results in the aspect of content feasibility with Aiken V index obtained score of 0.93 with a very valid category, a language feasibility aspect of 0.90 with a very valid category, a presentation feasibility of 0.86 with a very valid category, a display feasibility of 0.93 with a very valid category, and an ethnoscience orientation aspect of 0.92 with a very valid category. The average overall validation score is 0.91 with a very valid category. The reliability results in the aspects of content feasibility, language feasibility, presentation feasibility, display feasibility, and ethnoscience orientation are reliable with an average score of 93%. Based on these results, the student worksheet based on ethnoscience-integrated Problem Based Learning is very feasible (valid and reliable) to be used in learning activities to train science literacy and creative thinking. This study contributes to the practice of contextual science education in secondary schools by providing a validated and culturally relevant learning resource that enhances both literacy and creativity in science learning.

Keywords: Creative thinking; Ethnoscience; Problem Based Learning; Scientific literacy; Student worksheet.

Introduction

Education is a very big part of human life because it causes people to change their behavior and gain knowledge that is superior to what they had before (Astalini & Kurniawan, 2019). Advancement of science and technology is marked by rapid development. This means that the education system must adapt to provide opportunities and services that will help students and support the improvement of their abilities and quality (Asrial et al., 2019). Good education at least includes cognitive, affective, and psychomotor aspects (Santoso et al., 2015). These various aspects can be achieved by preparing and analyzing the needs of various models and media used in learning.

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Analysis of the needs of learning models or media that are adapted to the environment and conditions of students and learning objectives is highly recommended by several experts (Karnadi et al., 2021). There are several studies that show the integration of models and media and even analyze various learning models presented in the learning process in order to improve students' thinking skills or numeracy and literacy (Widya et al., 2019). In addition, students are also expected to be skilled in managing and analyzing news from various technologies needed to improve students' science literacy (Nurjannah, 2022).

Science literacy is one of the abilities needed by students to compete in the 21st century. Science literacy is the ability to use scientific knowledge, formulate questions to draw conclusions from facts and phenomena (OECD, 2023). Science literacy contains three main competencies, namely 1) scientifically explaining the phenomena that occur, 2) evaluating and designing scientific investigations, and 3) interpreting scientific data and facts (OECD, 2023).

The main skills that students need to have in order to achieve learning goals consist of four aspects, one of which is creative thinking (Hastawan et al., 2023). Creative thinking is an ability that students have in providing creative ideas in learning (Gazelci et al., 2022; Nogerbek et al., 2022). Creative thinking skills are part of higher-level thinking skills (Faturohman & Afriansyah, 2020; Mursidik et al., 2015) and are very important for students to face the world of work (Tok, 2022; Zulkifli et al., 2022; Ichsan et al., 2022).

However, the creative thinking skills and science literacy of students in Indonesia are still relatively low based on national and international studies (Putra et al., 2018; OECD, 2023). This condition is partly due to teacher-centered learning and the lack of contextual approaches that encourage problem-solving and creativity (Rosa & Pujiati, 2017; Yusuf et al., 2020). Therefore, it is necessary to develop learning media that can integrate cultural contexts with modern learning approaches.

Problem Based Learning (PBL) is one of the recommended learning models because it presents authentic and contextual problems that can encourage students to think critically, creatively, and scientifically (Nasution et al., 2018; Yew & Goh, 2016). Ethnoscience, which explores community-based knowledge and connects it with school science, has also been shown to strengthen contextual science learning (Parmin, 2017; Sudarmin, 2015). The integration of PBL with ethnoscience in learning materials has the potential to train both science literacy and creative thinking.

In line with this, the present study focuses on the development of a Problem Based Learning-based student worksheet integrated with ethnoscience on the topic of elements, compounds, and mixtures. The study is limited to the stages of analysis, design, and development within the ADDIE model, with a validation process to ensure the feasibility of the product. Although the research was conducted only until the development stage, the implementation and evaluation phases are planned for future studies to further examine the effectiveness of the developed worksheet in classroom practice.

Method

The type of research used is Research and Development (R&D) type of research and development. The development research design used in developing the Student Worksheet is adapted from the ADDIE development model. The ADDIE development model consists of 5 stages, namely Analysis, Design, Development, Implementation and Evaluation (Rayanto and Sugianti, 2020). However, this research only reaches three stages, namely design analysis, and development. At this stage of analysis, it is carried out through interviews with science teachers which includes several aspects, namely needs analysis is carried out to find out the basic needs and problems faced in learning, analysis of student characteristics is aimed at finding out the characteristics of students which include abilities, cultural background, and learning achievements, curriculum analysis aims to determine the suitability of the material and learning outcomes to be taught by analyzing the teaching modules. This analysis was carried out to develop learning objectives. At the design stage, models and media are selected, a learning process plan is prepared, and research instruments are prepared. The researcher chose a Problem Based Learning model with media in the form of student worksheet, designed a device in the form of a Learning Objective Flow, Teaching Module, student worksheet based on Problem Based Learning that is ethnoscience contextulate, and compiled a grid of research instruments. At the development stage, learning tools in the form of a Learning Objective Flow, teaching modules, student worksheet based on Problem Based Learning integrated with ethnoscience, and evaluation instruments were made. Furthermore, a device validation test was carried out by three validators. The validity instrument of the learning tool is in the form of a validation questionnaire given to the validators.

The data analysis technique used to measure the validity of the student worksheet based on ethnoscience-integrated Problem Based Learning made by the researcher is by using Aiken's V formula as follows (Aiken, 1985).

$$V = \frac{\sum S}{n(c-1)} \quad (1)$$

Information:
V : Index of expert agreement on the validity of items
S : R – lo
Lo : Lowest validity rating
c : Highest validity rating
r : Figures given by appraisers after analysis
n : Number of validators

Then the data will be interpreted based on validity criteria. The validity level is determined based on Table 1 (Akbar, 2013).

Table 1. Validity Score Criteria

Aiken V shoes	Category
0 – 0.020	Highly invalid
0.21 – 0.40	Invalid
0.41- 0.60	Less valid
0.61 – 0.80	Valid
0.81 – 1.00	Highly valid

a. Analysis of Reliability Test Results

Percentage of Agreement (PA), which is the percentage of value agreement between the first, second, and third validators, is used in the Borich method to determine the reliability of the validation results of learning tools (Borich, 1990).

$$PA = 1 - \frac{A-B}{A+B} X\ 100 \quad (2)$$

Information:
PA : Percentage of Agreement
A : Highest score
B : Lowest score

The average value of the Percentage of Agreement is determined by combining the validation results of the three validators. A combination of the first and second validators (V12), the second and third validators (V23), and the third and first validators (V31). The results of the validation of learning media can be said to be reliable, if the reliable value is obtained ≥ 0.75 or ≥ 75% (Makhrus et al., 2020).

Result and Discussion

Student worksheet based on PBL integrated with ethnoscience to train science literacy and creative thinking using the ADDIE model including analysis, design, and development.

Analysis stage

Based on the results of interviews with one of the science teachers in Mataram, the researcher obtained information that students use teaching materials in the form of science books provided in the library, so the number is limited because usually students take turns to bring them. The teaching materials used do not contain activities that can foster science literacy and creative thinking of students. From the results of the interview observation, the use of student worksheet is not always part of learning activities, and if it is used, it is usually during practicum. Teachers admit that student worksheet is not always made or developed by themselves, but sometimes uses sources from the student's handbook or the teacher's own handbook. This may indicate a lack of contextual or integrated learning materials with ethnoscience that can better support students' understanding.

Students' learning achievement in science subjects tends to be low, which is caused by students' low learning motivation and numeracy skills. This low motivation and basic ability has an impact on the achievement of the Minimum Completeness Criteria that has been set, which is 75. The teacher also noted that, cognitively, most students have not reached this Minimum Completeness Criteria, although the final score is still influenced by other aspects such as assignments and attitudes.

Based on the results of interviews with one of the science teachers in Mataram, students still have difficulty understanding science material. This is also supported by students who do not like discussions in science learning and have not been able to give answers using their own sentences. This can be the reason that in the learning process they have not practiced science literacy and creative thinking. The cultural background of the students comes from the Sasak tribe. This cultural background is a strong basis for implementing ethnoscience in learning, with the aim of making it easier for students to understand scientific concepts through the cultural context they are already familiar with. The ethnoscience objects raised are the process of making salt in Pejot Village and making keris in Sakra Village, both in East Lombok. In addition, it is known that students' motivation to learn in science subjects tends to be low, which contributes to their low learning outcomes.

This analysis refers to the independent curriculum at the junior high school/MTs level which aims to find out the learning schedule to be in accordance with the learning outcomes to be taught. The learning outcomes used in this study are: At the end of phase D, students understand changes in physics and chemistry, as well as simple mixture separation. In addition, the learning objectives in this study that must be achieved are:

a. Students are able to understand the concepts of elements, compounds, and mixtures.
b. Students are able to explain the difference between physical and chemical changes.

c. Students are able to relate the separation method to local cultural practices.
d. Students are able to relate the benefits of elements, compounds, and mixtures to local life and culture.

Design stage

The design stage includes several student worksheet development plans, including the following activities:

a. Designing the preparation of student worksheet in learning by reviewing learning outcomes to determine learning materials. The material used is grade VII junior high school first semester material on Elements, Compounds, and Mixtures.
b. Make an initial design of the outline of the content of the student worksheet and the student worksheet framework which is based on the PBL learning model to train students' science literacy and creative thinking.
c. The competencies expected from the creation of this student worksheet are to train science literacy and creative thinking.
d. Creating a supporting framework for student worksheet consisting of a Learning Objective Flow, Teaching Modules, student worksheet assessment instruments, designing teacher and student response questionnaires. The instrument is used to determine the validity, practicality, and effectiveness of the student worksheet developed.

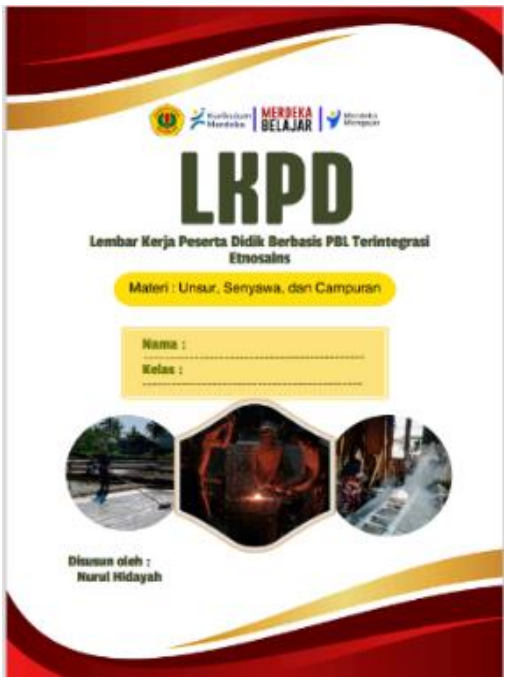

Figure 1. Cover of student worksheet

Development stage

The results of the validation of the device in the form of the Learning Objectives Flow, teaching modules, science literacy and creative thinking instruments, and the ethnoscience-integrated Problem Based Learning-based student worksheet can be described in detail as follows.

Results of Validation of the Learning Objectives Flow.

Table 2. Learning Objectives Flow validation and reliability results

Assessed aspects	Validator			V	Percentage of Agreement (%)
	1	2	3		
Content Eligibility	26	26	24	0.87	96
Eligibility of serving	8	8	7	0.94	93
Language eligibility	8	8	6	0.89	86
Average				0.90	92

Based on the validation results, the average score of Aiken's V was 0.90 with the very valid category and the percentage of agreement was 92% with the reliable category. Validator suggestions and revisions can be seen in Table 3.

Table 3. Validator suggestions and syllabus revision

Validator advice	Revision
Get the latest learning achievements	The latest learning achievements is taken from the Curriculum Standards and Education Assessment Agency Number 032 of 2024
Learning objectives is only a fraction of learning achievements	Learning objectives is made in accordance with learning achievements and learning materials

Teaching Module Validation Results

Table 4. Validation results and reliability of teaching modules

Assessed aspects	Validator			V	Percentage of Agreement (%)
	1	2	3		
Content eligibility aspects	70	70	70	0.89	100
Language eligibility aspects	28	26	24	0.95	92
Aspects of eligibility	24	22	24	0.96	96
Average				0.94	96

Based on the validation results, the average Aiken's V score was 0.94 with the very valid category and the percentage of agreement was 96% with the reliable category. Suggestions from validators and revisions can be seen in Table 5.

Table 5 Suggestions for validators and revision of teaching modules

Validator advice	Revision
Separate or learning objectives mark each meeting	Learning objectives is separated for each meeting
Learning objectives does not load Condition and Degree	Learning objectives contains Condition and Degree
Need to anticipate differentiated learning	There is an anticipation of differentiated learning

Results of Validation of Ethnoscience Integrated Problem Based Learning-Based student worksheet

Table 6. Results of student worksheet validation based on ethnoscience-integrated Problem Based Learning

Assessed aspects	Validator			V	Percentage of Agreement (%)
	1	2	3		
Content eligibility aspects	64	64	65	0.93	99
Language eligibility aspects	28	26	24	0.90	92
Aspects of eligibility	26	26	23	0.86	94
Viewability aspects	22	26	28	0.93	88
Ethnoscience orientation	14	15	16	0.92	93
Average				0.91	93

Based on the validation results, the average Aiken's V score was 0.91 with a very valid category and a percentage of agreement of 93% with a reliable category. Validator suggestions and revisions can be seen in Table 7.

Table 7. Validator suggestions and student worksheet revision

Validator advice	Revision
No glossary	There is a glossary
There is no reflection sheet at the end of the learning activity	There is a reflection sheet at the end of the learning activity

Results of Validation of Science Literacy and Creative Thinking Instruments

Table 8. Results of validation of science literacy and creative thinking instruments

Assessed aspects	Validator			V	Percentage of Agreement (%)
	1	2	3		
Serving	8	8	7	0.94	93
Fill	12	10	11	0.89	91
Language	12	12	9	0.89	92
Average				0.91	92

Based on the validation results, the average score of Aiken's V was 0.91 with the very valid category and the percentage of agreement was 92% with the reliable category.

The validation results indicate that the ethnoscience-integrated Problem Based Learning (PBL) worksheet is in the "very valid" category with high reliability across all assessed aspects. This shows that the developed worksheet is feasible to be used as a teaching material to support science literacy and creative thinking in junior high school students. These findings are consistent with previous studies that reported the effectiveness of PBL-based worksheets in enhancing higher-order thinking skills. For instance, Astuti et al. (2018) and Milatti & Fitrihidajati (2024) emphasized that PBL-oriented student worksheets are not only valid but also practical and effective in improving critical and creative thinking skills.

The strong validation scores in content and language feasibility confirm that the worksheet provides clear and scientifically accurate information while remaining accessible for students. Similar findings were reported by Iswantini (2017), who demonstrated that well-structured worksheets facilitate students' ability to engage in scientific literacy tasks. Likewise, the integration of ethnoscience within the worksheet strengthens its contextual relevance, allowing students to connect scientific concepts with their cultural background. This aligns with the arguments of Parmin (2017) and Atmojo (2012), who highlighted that ethnoscience-based learning can significantly improve students' engagement and comprehension through meaningful contextualization.

The very high score in ethnoscience orientation (Aiken's V = 0.92) reflects that the worksheet successfully incorporates local knowledge, such as the salt-making process in Pejot Village and keris-making in Sakra Village. Such integration is not only important for contextual learning but also contributes to preserving local wisdom while fostering scientific literacy (Mahendrani & Sudarmin, 2015; Sudarmin, 2015). As noted by Sya'diyah et al. (2023), ethnoscience-integrated PBL worksheets can enhance both cognitive learning outcomes and interpersonal intelligence, making them highly beneficial in science classrooms.

Furthermore, the reliability results (average 93%) indicate consistency among validators, confirming that the developed product meets quality standards for use in science education. This is consistent with the findings of Darubekti (2021) and Arifuddin et al. (2018), which showed that PBL not only supports critical thinking but also significantly enhances students' science literacy when consistently applied.

Taken together, the results suggest that the developed worksheet is a valid and reliable medium to

train both creative thinking and science literacy skills. Beyond its methodological contributions, this research also provides practical insights for teachers seeking to adopt contextual learning resources in line with the independent curriculum. In particular, integrating ethnoscience ensures that science education becomes more meaningful and culturally relevant, thereby addressing students' low achievement in science literacy as reported by OECD (2023).

Conclusion

Based on the results and discussions, it can be concluded that the Problem Based Learning-based student worksheet integrated with ethnoscience on elemental, compound, and mixed materials is very feasible (valid and reliable) to be used in learning activities to train science literacy and creative thinking.

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