Validity and Practicality of Integrated Student Worksheets (LKPD) Using the Project-Based Learning Model on the Mangrove Ecosystem to Improve Students' Science Process Skills

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Abstract: This study aims to produce Student Worksheets (LKPD) integrated with the Project Based Learning model on the mangrove ecosystem material to improve valid and practical science process skills. This study uses the ADDIE development model (analysis, design, development, implementation, and evaluation). The research parameters measured are the validity and practicality of the LKPD. Validity is reviewed from the presentation, content, and language. Practicality is reviewed from the implementation of student activities during the learning process using the LKPD. Data analysis of this study was carried out descriptively quantitatively. Based on the results of the study, the validity of the LKPD was 94% with very valid criteria. The practicality of the LKPD based on the implementation of the LKPD was 90.01% with very good criteria and the student response aspect obtained an average of 92.36% with very good criteria. Thus, the Student Worksheet (LKPD) integrated with the Project Based Learning model is considered valid and practical so it is suitable for use in the learning process.

Keywords: LKPD; Coastal Mangrove Ecosystem; Project Based Learning; Science Process Skills

Introduction

Biology learning has great potential to utilize the environment as a learning resource. One way to utilize the environment in biology learning is by assessing the local potential within the students' environment (Masihu & Augustyn, 2021). The local potential-based learning process utilizes a contextual approach, connecting learning to the real world. Presenting subject matter within the context of one's own life will make the subject more meaningful, and students will find meaning in each lesson, creating a more enjoyable and meaningful learning experience (Putri et al., 2022).

Regarding local potential that can be used as a learning resource, Langsa City is famous for its unique mangrove forests. The natural potential in the coastal areas of Langsa City can be developed into educational tourism destinations, one of which is the leading natural tourism destination in Langsa City is the mangrove forest tourism area located on the coast of West Langsa District, with its center in Gampong Kuala Langsa. This area is known as the Langsa City Mangrove Forest Park tourism (hereinafter referred to as the mangrove forest tourism), which is a natural tourist attraction with unique and relatively pristine coastal characteristics. Based on data from the Central Statistics Agency (BPS)

of Langsa City, it is noted that this mangrove forest has an area of 6,172.42 Ha, but only 119 Ha is used as a tourist attraction (BPS Langsa City, 2018).

Mangrove plants are group vegetation typical of growing in coastal areas with tropical and subtropical climates, which are ecologically influenced by the dynamics of sea water ebb and flow, substrate muddy, and own ability tolerance tall to salinity (Chandra et al., 2011; Noor et al., 2015). The presence of mangrove vegetation dominates area this not only gives mark aesthetics and power pull tourism but also has mark ecologically important. The mangrove ecosystem functions as a habitat for spawning, nursery ground, place look for eating (feeding ground), as well as protection for various types of aquatic biota such as fish, shrimp, and crab, so participate contribute in guard balance and sustainability ecosystem coastal areas (Idrus et al., 2018; Idrus et al., 2019; Sambu et al., 2018; Santoro et al., 2019). In addition, in general physique Mangrove forests also function as protector beach from abrasion and seawater intrusion. The results of research by Haruna, et al (2017) stated that students are very excited in carry out the learning process in the mangrove ecosystem. The existence of diversity biological mangrove ecosystem can be made into teaching materials based on ecosystem grove at level high school (Lorena, et al, 2019).

Based on interviews with biology teachers at a high school in Langsa City, it was discovered that ecosystems learning had never been integrated with local potential around the school. Furthermore, the development of learning media based on local potential has also not been implemented. The classroom learning process is still dominated by the use of textbooks and PowerPoint presentations without Student Worksheets (LKPD), making learning less engaging. This condition impacts students' difficulty in connecting ecosystem concepts to the real context of their environment. However, local potential around the school can be utilized as a contextual learning resource and integrated into engaging learning media to improve the quality of the learning process.

A possible solution to the aforementioned problems is to develop Student Worksheets (LKPD) based on the local potential of mangrove forests as a learning medium for ecosystem material. Developing LKPDs integrated with mangrove ecosystems will make learning more engaging (Sakinah et al., 2023). According to Irwandi & Fajeriadi (2019), utilizing mangrove ecosystems as a learning resource can increase student productivity. Furthermore, it can maintain the stability of the mangrove ecosystem, which is crucial for life (Aprilia & Suryadarma, 2020). LKPDs based on the local potential of mangrove forests can also make students more directly connected to the environment, which can increase students' interest in learning about the environment (Susanti, 2021). Therefore, the high diversity and function of mangrove ecosystems can provide benefits for the world of education by being used as a learning resource integrated with the mangrove ecosystem through the development of teaching materials in the form of Student Worksheets (LKPD).

LKPD is one of the teaching materials in it there is all over activity basic activities carried out by participants purposeful education for maximizing understanding and formation ability base in accordance with indicator achievement competencies (Aratake et al., 2017; Pradiptha & Wiarta, 2021). The LKPD developed or designed by the teacher himself where development or the design of the LKPD can be made based on condition school and environment (Oktricia et al., 2016). The designed LKPD or developed not only evaluate ability cognitive just but expected to be able to collaborate activity physique participant educate in understand draft material experiment both experimental and non- experimental (Ramadhayanti, Anggraeni, & Supriatno, 2020; Syafi'ah & Laili, 2015). Teachers are expected to be capable of developing or designing LKPD according to procedure making LKPD, where there are 3 requirements in development of LKPD, namely condition didactic, conditions construction and conditions technical. So that expected learning becomes more meaningful with the designed LKPD by the teacher himself as tool his /her customized help with conditions and environment participant educate (Oktricia et al., 2016b).

The use of LKPD will give opportunities for students for lots of practice and discover draft about a material until find creative ideas that are steps his learning Can done in a way systematic (Aditama et al., 2019; Puspita & Dewi, 2021). LKPD which developed with results studies mangrove ecosystem based on measurement on factors abiotic and biotic (Febri, et al, 2019). LKPD which developed own excess can utilise the diversity of existing fauna in mangrove ecosystem (Restu, et al, 2016). In addition, it can increase concern students towards environment around as well as more understanding draft ecosystem (Rimbun et al, 2018).

Understanding concept (conceptual understanding) of science is one of the indicator successes in studying science (Dewi et al., 2021). Strong understanding to the concept of science becomes base for students to think critically and scientifically in face various real problems. In the context of learning 21st century, students sued for capable give scientific solution to problems that exist in the environment surrounding areas (Kurniawati et al., 2022). One of the relevant science materials with real life and environment is ecosystem. According to Sardinah et al. (2012),

mastery science concepts, especially in the material ecosystem, can improved through approach learning based on project.

The Project Based Learning (PjBL) model is a learning model that directs student for understand and complete problem real through Work project in a way structured (Made et al., 2016; Setiono et al., 2020; Saputro & Rahayu, 2020). In its implementation, teachers play a role as a mediator or accompanying facilitator student in the process of inquiry, exploration, to compilation solution based on scientific (Nusa, 2021). Project Model Based Learning can help increase understanding of draft students. Concept and the theories that exist in Science Natural Science is one of the materials ecosystems (Sulistyaningrum, et al, 2015).

This study aims to determine the feasibility of the product resulting from the development of Integrated Student Worksheets (LKPD) Project Based Learning Model on Mangrove Ecosystem Material to Improve Students' Science Process Skills through validity and practicality tests. This LKPD is expected to be able to be used as an alternative learning media on ecosystem material for class X (phase E) so that it can increase learning motivation and make students more active during the learning process.

Method

This research is a Research and Development (R&D) study using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The research and product development took place in the Biology Education Undergraduate Program, Faculty of Teacher Training and Education, Samudra University, from May to June 2025. A limited trial of the student worksheet (LKPD) was conducted over three meetings at Muhammadiyah High School in June 2025.

The analysis stage involved analyzing the curriculum, students, concepts, learning objectives, and assignments to obtain information that would serve as a reference for designing a student worksheet tailored to the needs. The design stage resulted in an attractive student worksheet product. The development stage involved validation by experts and revisions to the product. The implementation stage involved a trial with 24 students to obtain data on practicality and effectiveness, along with comments and suggestions. The evaluation stage in the ADDIE development model is a continuous process, not just conducted at the end but at each stage to ensure that all stages are progressing according to plan.

This study used two research variables: validity and practicality. Validation was conducted by subject matter expert lecturers, media expert lecturers, and high school biology teachers. Validity consisted of aspects of presentation, content, and language. The resulting data were then analyzed and the average value calculated. The validation results were then analyzed using the adaptation feasibility categories from Riduwan & Sunarto (2013). The average value was calculated. The validity of the worksheet was declared valid if the percentage reached >75%.

The practicality of the worksheet was assessed by the implementation of activities and student responses after using the worksheet. Practicality data were obtained from observation sheets completed by four observers, each observing two small groups. The student response questionnaire contained questions as a form of student response. The results were then analyzed using the practicality adaptation interpretation criteria from Riduwan & Sunarto (2013), and the average value was calculated. The practicality of the worksheet was declared good if the percentage reached >75%.

Result and Discussion

Integrated Student Worksheets (LKPD) with Project-Based Learning Model

The Integrated Student Worksheets (LKPD) with Project-Based Learning Model on mangrove ecosystems for Grade X (Phase E) are a learning tool developed by researchers. The following is a preview of the LKPD.
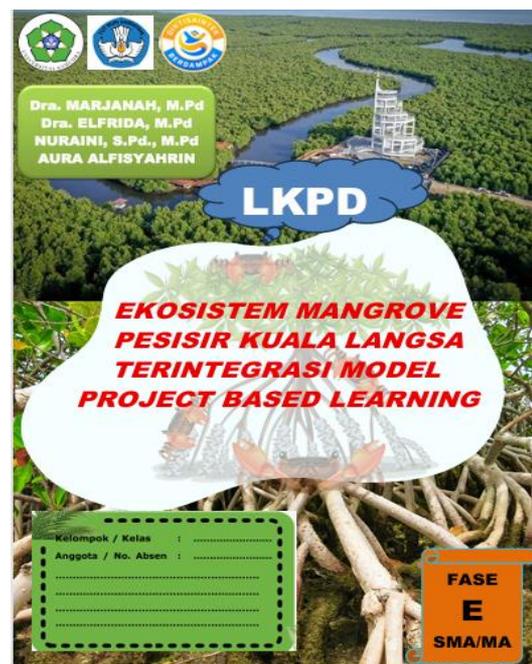

Figure 1. Cover of Student Worksheet (LKPD)

The validity data for the Student Worksheet (LKPD) was obtained through validation by three expert validators: two lecturers from the Biology Education

Study Program, Faculty of Teacher Training, Samudra University, and one biology teacher from Muhammadiyah Langsa Senior High School. This is in accordance with Sugiyono's (2021) statement that product validation can be conducted by several experts experienced in assessing newly designed products.

The purpose of product validation is to determine the feasibility of the developed LKPD. In addition to validation from expert lecturers and subject teachers, criticism and suggestions were also obtained to improve the developed LKPD. The criticism and suggestions provided by the validators regarding product weaknesses and shortcomings can be used as a reference for product refinement, ensuring its suitability as a learning medium for mangrove ecosystems.

Student Worksheet Validity

Validation was conducted by three validators: a subject matter expert lecturer, a media expert lecturer, and a high school biology teacher. The results of the student worksheet validation are presented in Table 1.

Table 1. LKPD validation results

No.	Aspek yang dinilai	Validator			RR (%)	KI
		V1	V2	V3		
				A.	Presentation	
1.	Display	4	4	4	100	SV
2.	Cover Appropriateness	4	4	4	100	SV
3.	Color Appropriateness	4	3	4	91.6	SV
4.	Font Type and Size	4	4	4	100	SV
5.	Image Quality	4	4	3	91.6	SV
6.	Video Quality	4	4	4	100	SV
7.	Link Appropriateness	4	4	4	100	SV
8.	QR Code Appropriateness	3	4	4	91.6	SV
9.	Inclusion of Identity	4	4	4	100	SV
Average Score for Presentation Aspect					97.2	SV
				B.	Content	
10.	Accuracy of Content in Material	4	4	4	100	SV
11.	User Instructions	3	4	4	91.6	SV
12.	Time Allocation	1	4	4	75	SV
13.	Learning Instructions	4	4	4	100	SV
14.	Practical Work Instructions	4	4	4	100	SV
15.	References	3	4	4	91.6	SV
16.	Appropriateness of Student Worksheet (LKPD) with Project Based Learning (PjBL) Syntax	4	4	4	100	SV
Average Score for Content Aspect					94,02	SV
				C.	Language	
17.	Language Appropriateness	3	4	4	91.6	SV
18.	Use of Terminology	3	4	4	91.6	SV
Average Score for Language Aspect					91.6	SV
Overall Average Score for All Aspects					94	SV

Description:
V1: Validator 1, RR: Average, KI: Interpretation Criteria, SV: Highly Valid

Based on the data in Table 1, the validation results indicate that the developed LKPD obtained an overall average score of 94%, categorized as highly valid. These research results align with Siti (2021), who explains that if the presentation, content, and language criteria are met, a product can be declared valid. Similarly, Salim (2019) stated that a product with a high level of validity is capable of producing realistic and accurate output and can be used to achieve learning objectives. Therefore, this LKPD is deemed suitable for use in the learning process. The presentation feasibility component, which encompasses nine aspects, obtained an average score of 97.2%, categorized as highly valid.

In line with the research of Wahyuni & Zulyusri (2023), it was stated that good presentation can foster students' curiosity in utilizing LKPD during learning. The content feasibility component obtained an average of 95.82% with very valid criteria. In the language aspect, an average of 91.6% was obtained with very valid criteria, which indicates that the language used in LKPD is suitable for implementation. The validation results are in line with previous studies, namely Fara et al., (2022) and Sakinah et al., (2023) that the development of LKPD based on local potential on ecosystem material was declared valid or suitable for use in the learning process. After the LKPD was validated by the three validators and the product was declared valid or suitable for use in the learning process, the next step was to test the product's readability.

The validation test results were assessed after revisions were made based on input and suggestions from the validator. According to Riyati & Suparman (2019) in Atika et al., (2020), in order to improve the developed LKPD, input and suggestions from the validator were used as considerations for making revisions. In line with research conducted by Arsyad et al., (2019), it was explained that the validity of the LKPD was achieved because each learning section was in accordance with the indicators set out in the LKPD validity instrument. These indicators include seven assessed aspects, namely content quality, accuracy of material and questions, up-to-dateness of material and questions, appearance and content, language, graphics, and characteristics. Based on the validation test by the three validators, only the validation from the media expert was not revised. This means that the developed

LKPD can be directly used in the learning process after a readability test was carried out first. This aligns with the validation criteria used in Hasanah & Siregar's (2023) study, which found that a score of 81–100 given by media experts indicates the media is highly valid and can be used without revision. Furthermore, previous research by Wiyanti et al. (2023) found that the average score obtained by media experts was 90%, categorized as "very valid," meaning the developed product can be used without revision.

Practicality of Student Worksheets

The practicality of Student Worksheets is assessed through observations of student activities during learning using the Student Worksheets and student responses after using the Student Worksheets.

Table 2. Results of LKPD Implementation

No	Aktivitas	KA		KI
		Y (%)	T (%)	
				Component LKPD
1.	Students read the user instructions	100	0	SB
2.	Students read the learning objectives	100	0	SB
3.	Students write down the differences among the three pictures provided in the LKPD	100	0	SB
4.	Students scan the QR Code to access and watch the learning video on the mangrove ecosystem subtopic	100	0	SB
	Phase 1: Determining Fundamental Questions			
5.	Students read the article and understand the introduction to the fundamental problem for the project, as indicated by completing the task in syntax	97.29	2.71	SB
	Phase 2: Designing a Plan for the Project			
6.	Students develop a project plan, indicated by recording their plan in syntax 2	97.29	2.71	SB
	Phase 3: Creating a Schedule			
7.	Students determine the activity schedule for completing the project, indicated by recording the schedule in syntax 3	94.59	5.41	SB
	Phase 4: Monitoring Student Work and Project Progress			
8.	Students carry out the project by recording observation results and giving their opinions on the project observations in syntax 4	94.59	5.41	SB
9.	Students create a poster of the practicum results and communicate their work in groups	94.59	5.41	SB
	Phase 5: Assessing the Work Results			
10.	Students present their project results effectively, and the teacher provides an assessment using the teacher's LKPD in syntax 5	94.59	5,41	SB
11.	Students listen to and respond to the practicum results and presentations of other groups	97.29	2.71	SB
	Phase 6: Evaluating the Experience			
12.	Students write an evaluation of the practicum activities they have conducted	100	0	SB
13.	Students fill in the reflection column after participating in the learning activities (Self-regulation)	94.59	5.41	SB
	Average Implementation		90.01	SB

Description:
KA: Activity Implementation, Y: Yes, N: No, KI: Interpretation Criteria, SB: Very Good

Based on the implementation data for the Student Worksheet (LKPD) on the topic of mangrove ecosystems, a percentage of 90.01% was obtained, which falls into the very good category. This finding indicates that almost all activities designed in the LKPD were optimally implemented by students. This high level of implementation is influenced by various factors, including student motivation in participating in the learning, new experiences gained during the activities, clarity of teacher explanations, diversity and attractiveness of learning resources, the appropriateness of the learning model used, involvement in practical activities or experiments, and the relevance of the material to everyday life (Hidayat & Hidayati, 2023).

The results of the implementation analysis, although generally classified as very good, still found several obstacles that require attention. According to Nuraisah (2022), one of the main characteristics of the Project-Based Learning (PjBL) model is that students are expected to be able to design a project as a solution to a problem. Based on the results of the implementation observation, it was found that there were several

unsatisfactory assessments, caused by some students who did not fully understand the use of LKPD. The results of this study, in accordance with the opinion of Fitrahtunnisa (2022), emphasized that to measure and determine the level of practicality of LKPD, a response questionnaire containing questions related to experience and ease of use of LKPD can be used.
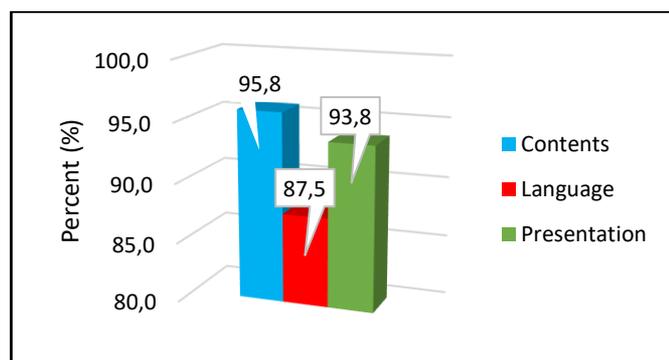

Figure 1. Student Response Results

Based on on the graph in Figure 1, the results of the feasibility assessment of the three main components of the Student Worksheet (LKPD) product as a learning tool show variations in the percentage achievement for each component assessed. The content component achieved the highest percentage, at 95.8%, indicating that students considered the LKPD content to be highly relevant, clear, and aligned with learning objectives. The presentation component came in second with a percentage of 93.8%, indicating that the layout, visualization, and flow of the material presentation in the LKPD were considered very good. Meanwhile, the language component achieved a percentage of 87.5%, which, while still in the very good category, is relatively lower than the other two components. This indicates that language aspects, such as sentence clarity, vocabulary choice, and readability, still have room for improvement to optimally support student understanding.

Overall, this graph shows that the three components—content and presentation—are of very good quality and at the same level, while the language component scored slightly lower but remains in the good category. The results of this study represent student responses to the student worksheets used in learning, thus reflecting the user's direct perception of the quality of content, presentation, language, and graphics. This condition suggests that although the content, presentation, and language aspects are optimal, the content component still has room for further development. This is in accordance with the results of research by Ardhiantari et al., (2021), the results of student responses to the attractiveness aspect of student worksheets based on science process skills (SPS) can be said to be interesting and not boring, thus increasing

student interest in learning. Atiyah et al., (2016) stated that student worksheets based on science process skills enable students to work on learning activities independently through practice or non-practice and can complete assignments and exercises related to the material taught to achieve learning objectives

Conclusion

This research produces Student Worksheets (LKPD) Based on Integrated Project Based Learning Model on the mangrove ecosystem material to improve valid and practical science process skills. The validity of Student Worksheets (LKPD) Based on Integrated Project Based Learning Model obtained an average of 94% with a very valid category. The practicality of Student Worksheets (LKPD) Based on Integrated Project Based Learning Model is said to be very practical in terms of the implementation aspect which obtained an average of 90.01% with very good criteria and the student response aspect obtained an average of 92.36% with very good criteria.

Author Contributions
Marjanah: Designing Student Worksheets, Elfrida: Creating Science Process Skills Instruments, Nuraini: Creating Product Feasibility Test Instruments, Nurhasnah Manurung: Product Validator.

Conflicts of interest
The authors declare that there is no conflict of interest regarding the publication of this paper

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