Development of Scientific Literacy-Based Student Worksheets (LKPD) for the Classification of Living Organisms Learning Materials

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A B S T R A C T

Indonesian students' scientific literacy remains relatively low, as indicated by PISA results, which placed Indonesia among the bottom 10 countries, and AKMI data shows that 51% of madrasah students are at the "basic" level. This study aims to develop scientific literacy-based Student Worksheets (LKPD) on classifying living organisms for learning. The research method employed is *Research and Development* (R&D) using the 3D model, which includes the *Define*, *Design*, and *Develop* stages. The research subjects included material and media expert validators, a class X biology teacher, and 25 class X students at MAN 1 Bandung. The instruments used were validation sheets, readability questionnaires, and student response questionnaires. Data analysis was conducted using qualitative and quantitative approaches with the help of a Likert scale. The results showed that the developed LKPD is feasible for use, with material expert validation at 85.556% (highly valid), media expert validation at 72.25% (valid), teacher readability at 80.80% (easy to understand), student readability at 85.35% (easy to understand), and student responses at 86% (highly positive). Therefore, the scientific literacy-based LKPD on the classification of living organisms is suitable for use and can serve as effective teaching material to support the learning process.

1. Introduction

Scientific literacy is vital in education, yet data shows that Indonesian students' scientific literacy remains low. The PISA (Programme for International Student Assessment) results place Indonesia among the bottom 10 countries (Hidayati, 2023), with students scoring below the OECD average in scientific literacy (OECD, 2023). Similarly, the Indonesian Madrasah Competency Assessment (AKMI) conducted by the Ministry of Religious Affairs of the Republic of Indonesia reveals that 51% of madrasah students are at the "basic" level, indicating low scientific literacy proficiency (Ditjen Pendis, 2023). Several contributing factors to this low

literacy include inappropriate learning resources, misconceptions, poor reading skills, and unsupportive learning environments. Furthermore, the lack of practical experience makes it difficult for students to relate scientific knowledge to real-world phenomena (Fuadi et al., 2020).

An interview with a biology teacher at MAN 1 Bandung revealed that students' scientific literacy still needs improvement. Despite the school having participated in the AKMI twice, students struggle to answer questions correctly, particularly those with long narrative formats. Moreover, using Student Worksheets (LKPD) at MAN 1 Bandung is still limited, highlighting the need to develop LKPD based on scientific literacy to classify living organisms materials as a learning tool aligned with students' needs.

Student worksheets (LKPD) are alternative learning materials that serve as learning guides for students, containing tasks and exercises to be completed (Oktaviani, 2020). LKPD plays a crucial role in improving the effectiveness of learning, facilitating individual learning progress monitoring, and promoting active participation in the learning process (Resi et al., 2023). It benefits both educators and students by guiding instruction, activating student learning, developing conceptual understanding, training process skills, and helping students take notes through structured learning activities (Muslimah, 2020).

Instructional materials that can enhance students' scientific literacy are essential for classifying living organisms. This topic involves describing and grouping living things based on their characteristics, which is often perceived as difficult due to the need for a deep understanding of biological concepts (Anwar & Rusna, 2024). One important aspect is understanding the classification of fish within the Animalia kingdom, which involves many complex terms and concepts (Suastikarani, 2019). Indonesia is rich in fish biodiversity, with around 8,500 species—approximately 45% of the world's total (Azis, 2020). Making it important to understand fish identification as part of national biodiversity awareness.

Several previous studies support the relevance of this research. Rahmadani et al. (2022) reported that the scientific literacy level of class X students at SMAN 1 Kuripan remained low, with 34% categorized as moderate and 66% as low. Hidayati (2023) found that scientific literacy-based LKPD facilitates student learning, with teacher questionnaire results showing a score of 88.33%, classified as "very feasible." Meanwhile, Fajri et al. (2018) developed an LKPD based on marine fish inventory in Bengkulu Province, which was deemed highly feasible for implementation in senior high school biology education by expert validators.

Based on previous studies, the development of scientific literacy-based LKPD for classifying living organisms has not been conducted at MAN 1 Bandung. Therefore, this study aims to develop such LKPD as a learning material to support this subject's teaching and learning process.

2. Methodology

This study employed a *Research and Development* (R&D) method, referring to the 3D model, which consists of three stages: *Define*, *Design*, and *Develop* (Arkadiantika et al., 2020). The research was conducted from December 2024 to May 2025 in Bandung City.

In the *Define* stage, data were collected through interviews with class X biology teachers and literature reviews on the classification of living organisms and scientific literacy indicators. The *Design* stage involved the preparation of the initial draft of the LKPD. In the *Develop* stage, data collection included validation testing using validation sheets assessed by subject matter and media experts, readability testing by teachers and students through readability questionnaires, and gathering student responses through questionnaires administered to 25 class X students at MAN 1 Bandung. These instruments evaluated the appearance, presentation, and language of the developed LKPD.

In this study, data were analyzed qualitatively and quantitatively. Qualitative analysis was obtained from expert input and suggestions to improve the LKPD product, interview results, and literature review. Quantitative analysis was based on the validation test by subject matter and media experts, the readability test by class X biology teachers and students, and student responses. The data analysis technique used a Likert scale for validation tests, readability tests, and student responses. According to Riduwan & Sunarto (2019), the Likert scale used in this study consists of five assessment levels from lowest to highest. A score of 5 is given for the category "Very Good," a score of 4 for "Good," a score of 3 for "Fair," a score of 2 for "Poor," and the lowest score of 1 is given for the category "Very Poor."

The total score obtained from the validation, readability, and response questionnaires was then recapitulated and analyzed by calculating the percentage using the formula: total obtained validation score divided by the maximum score multiplied by 100%. The percentage average was interpreted based on the score interpretation criteria with the following intervals: if the value is between 81–100%, it is categorized as "highly valid" in the validation test and "highly positive" in student responses. If the value is between 61–80%, it falls into the "valid" category in the validation test and "positive" in student responses.

A 41–60% value is interpreted as "invalid" in validation and "neutral" in student responses. A score between 21–40% is considered "not valid" in validation and "negative" in student responses, and if the value is between 0–20%, it is categorized as "very invalid" in validation and "very negative" in student responses (Riduwan & Sunarto, 2019). Meanwhile, for the readability test results, the score interpretation criteria are as follows: if the value is between 61–100%, it is categorized as "easy to understand"; if the value is between 41–60%, it is "moderately understandable"; and if the value is between 21–40%, it is categorized as "difficult to understand" (Kusjuriansah & Yulianto, 2019).

3.   Results and Discussion

Define Stage

In the *Define* stage, a preliminary study was conducted in the form of a needs analysis and identification of problems faced by students through interviews with a class X biology teacher at MAN 1 Bandung. The analysis revealed that students had low scientific literacy skills, as evidenced by their limited ability to solve problems, difficulty answering questions correctly, and difficulty responding to questions with long narratives. This is due to students' lack of exposure to scientifically literacy-based questions. The current learning materials, particularly the Student Worksheet (LKPD) on classifying living organisms, are not yet based on scientific literacy. Therefore, developing an LKPD that supports the learning process in the classroom is necessary.

Design Stage

The next stage is *Design*, which involves planning a solution to the identified problems. Based on various considerations, it was decided to develop a scientific literacy-based LKPD on the classification of living organisms. The format of the LKPD was selected to enhance students' learning motivation, create an enjoyable learning environment, encourage comprehensive understanding, and provide direct learning experiences. The worksheet was designed using the Canva application and exported in PDF format. Afterward, the developed design was reviewed with the academic supervisor and revised to produce a high-quality product. Several displays of the developed scientific literacy-based LKPD on the classification of living organisms are shown in Figure 1.
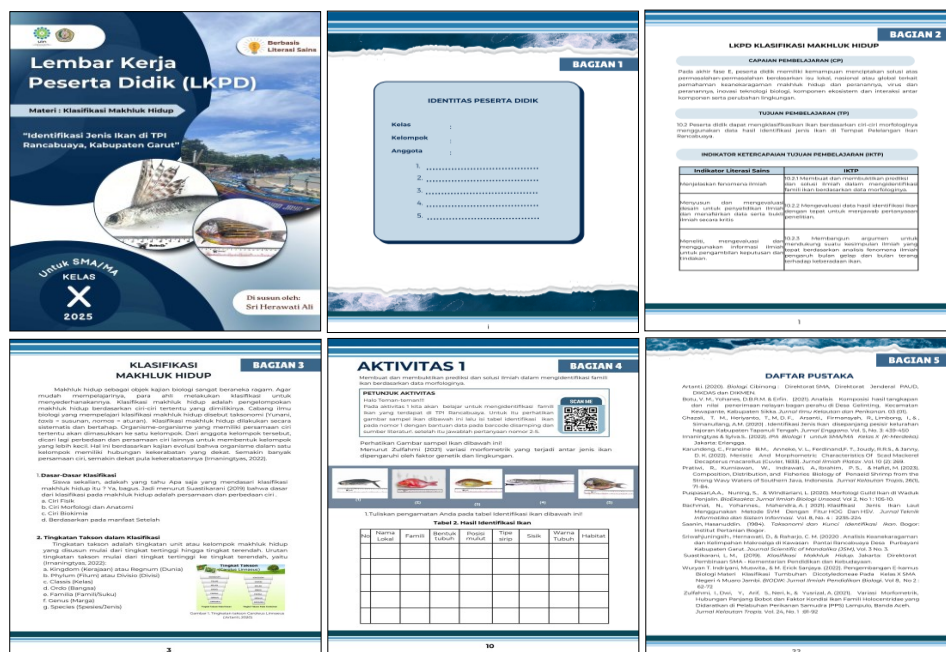

Figure 1. Several views of the results of the development of scientific literacy-based LKPD on the materials of classification of living things

Develop Stage

The *Develop* stage was validated by material and media experts, readability tests by the class X biology teacher at MAN 1 Bandung and 25 class X students from the same school, and student responses to the developed LKPD.

a. Validation Test

According to Putra et al. (2021), material and media validity data analysis was conducted to measure the developed product's validity level. This analysis involved calculating the score obtained from expert validator assessment instruments. The data were then converted into percentages to determine the validity qualification level of the designed material and media. Media revisions were made to improve and refine the product based on the validation results from both subject matter and media expert validators. Feedback provided by the validators was used to enhance the developed media further. The results of the material expert validation are presented in Table 1.

Table 1. Material Expert Validation

No	Assessment Aspect	Percentage (%)	Category
1.	Material quality aspect	80	Valid
2	Accuracy of the material and questions	90	Highly Valid
3.	Currency of material and questions	86,667	Highly Valid
Total		**85,556**	**Highly Valid**

The validated product was then revised based on the suggestions and feedback from the validators to improve the LKPD and ensure its feasibility for classroom use, as shown in Figures 2, 3, and 4. The following are suggestions and feedback provided by the material expert validator:

1. Enhancing visual aspects with sharper image quality and adequate descriptions, as shown in Figure 2a before revision and Figure 2b after revision.
2. Increasing variety of questions based on Higher Order Thinking Skills (HOTS) and expanding the learning context beyond coastal environments to include other ecosystems relevant to students, as shown in Figure 3a before revision and Figure 3b after revision.
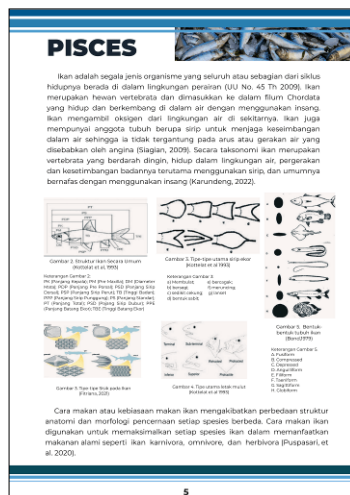3. A glossary for scientific terms is added, as shown in Figure 4.
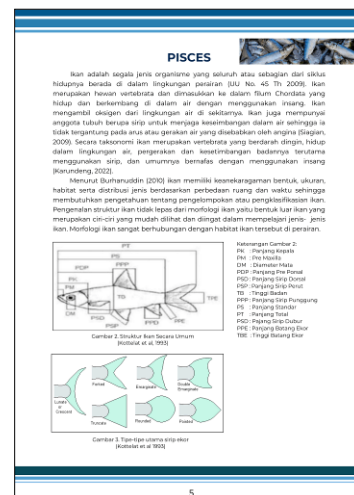
Figure 2a. Before revision

Figure 2b. After revision

Figure 3a. Before revision
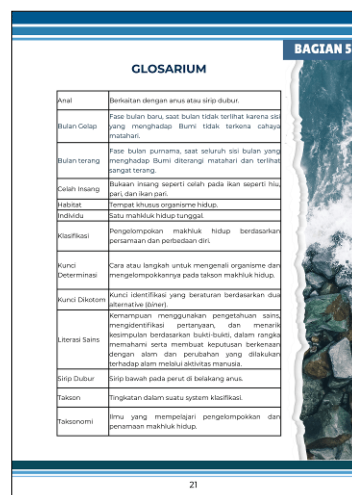

Figure 3b. After revision

Figure 4. After revision

Improving image quality is a crucial aspect to be considered in developing the LKPD, as it significantly influences students' learning motivation. This aligns with the view of Magdalena et al. (2021), who state that images can provide stimuli that increase students' interest in learning. Images can transform abstract material into more concrete forms. The second suggestion involved adding a greater variety of HOTS-based questions to optimize the development of the LKPD. This is supported by Razak et al. (2021), who found that HOTS-based questions had a 45.70% influence on students' scientific literacy skills, while lesson study contributed 35.19%, with an effect size of 2.01, categorized as high. Thus, it is important to include diverse HOTS questions in the revisions. Finally, a glossary is necessary to help students understand unfamiliar terms and concepts presented in the LKPD. This aligns with Suryani & Sandika (2022), who argue that glossaries containing new or foreign terms can help students comprehend the content more easily. Next, the media expert validation test results are presented in Table 2.

Table 2. Media Expert Validation

No	Assessment Aspect	Percentage (%)	Category
1	Display and content	70	Valid
2	Language use	75	Valid
3	Graphics	64	Valid
4	Characteristics	80	Valid
Total		**72,25**	**Valid**

The product that had undergone the validation process was then revised based on the suggestions and input from the media expert validators to improve the LKPD further and ensure its feasibility for classroom use, as illustrated in Figures 5, 6, 7, and 8. The following are some of the suggestions provided by the media expert validator:

1. Addition of LKPD identity information, as shown in Figure 5.
2. Addition of material instructions, enlargement and enhancement of image quality, as shown in Figure 6a before revision and Figure 6b after revision.
3. Clarification of activity instructions, removal of informal narration such as "Hello friends," and enlargement of images, as shown in Figure 7a before revision and Figure 7b after revision.
4. Addition of the author profile, as shown in Figure 8.

Figure 5. After revision

Figure 6a. Before revision
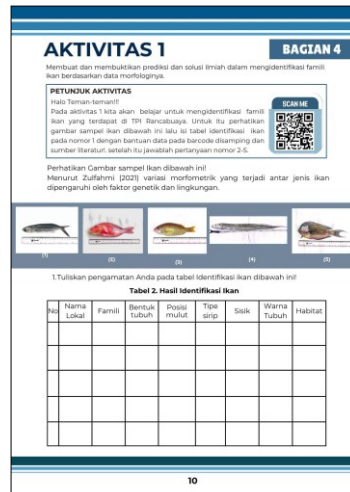

Figure 6b. After revision
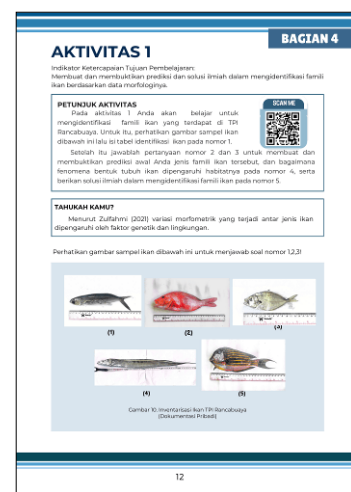

Figure 7a. Before revision

Figure 7b. After revision

Figure 8. After revision

The LKPD identity and author profile were added to provide users with clear information and indicate the worksheet's authorship. This aligns with the statement by Manurung et al. (2023), who explain that including LKPD identity helps teachers and students use the LKPD more effectively during the learning process. Furthermore, clarity and quality of the LKPD are crucial for ensuring media effectiveness. According to Dermawati et al. (2019), the LKPD design should be attractive, utilize vibrant colors, and feature relevant images related to the learning content to capture students' interest and encourage them to engage with the material. The media expert validation yielded a score of 72.25%, categorized as valid. This finding is consistent with Rahmawati (2022), who noted that a learning medium can be considered valid if the average score across all assessed aspects meets the minimum threshold for the "valid" category. Therefore, to enhance the quality of the developed LKPD, revisions were made based on feedback from media validators.

b. Readability Test

Once the LKPD was deemed feasible by the validators, a readability test was conducted by a class X biology teacher to determine whether the developed LKPD was understandable for use in schools. A good LKPD is easy to understand and supports students in learning. The results of the teacher readability questionnaire are shown in Table 3.

Table 3. Readability Test Class X Biology Teacher

No	Assessment Aspect	Percentage (%)	Category
1	Content quality aspect	84	Easy to understand
2	Accuracy of the material and the question aspect	80	Easy to understand
3	Currency of the material and the question aspect	80	Easy to understand
4	Appearance and content aspect	86.667	Easy to understand
5	Language use aspect	75	Easy to understand
6	Graphics aspect	80	Easy to understand
7	Characteristics aspect	80	Easy to understand
Total		**80,80**	**Easy to understand**

The readability test by the class X biology teacher resulted in a score of 80.80%, which falls into the "easy to understand" category. Based on the feedback, the LKPD product was revised to improve its quality, as shown in Figures 9, 10, and 11. The following are suggestions provided by the biology teacher at MAN 1 Bandung:

1. Addition of image descriptions in the material section, as shown in Figure 9a before revision and Figure 9b after revision.
2. Enlargement of font size for graph labels, as shown in Figure 10a before revision and Figure 10b after revision.
3. The table numbering in question number 1 of activity 3 was corrected, as shown in Figure 11a before revision and Figure 11b after revision.
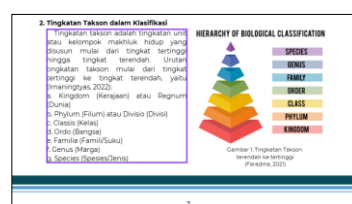
Figure 9a. Before revision

Figure 9b. After revision
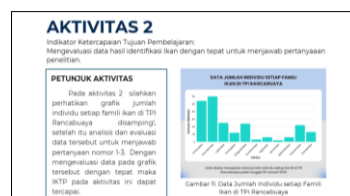

Figure 10a. Before revision
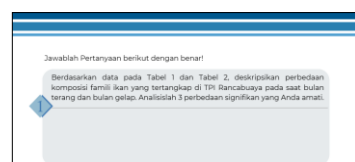

Figure 10b. After revision

Figure 11a. Before revision

Figure 11b. After revision

Explaining image and table descriptions is an important element in developing LKPD. This aligns with Nareswari et al. (2021), who state that an easily understood LKPD is influenced by several factors such as explicit content, usage instructions, appropriate font size, and the inclusion of fill-in-the-blank sentences that encourage students to think critically, thereby increasing their learning motivation. Teachers are educators who best understand students' characteristics. According to Rahima et al. (2022), the readability level of learning materials can significantly impact students' success in comprehending content when reading at an ideal pace. If the material is too difficult, students must read slowly and repeatedly to understand it fully.

Following the readability test by the biology teacher, a student readability test was then conducted with class X students to determine whether the developed LKPD was easy to understand and capable of supporting students in improving their scientific literacy skills. The results of the student readability questionnaire are presented in Table 4.

Table 4. Readability Test Class X Students

No	Score Category	Percentage (%)	Category
1	Highest Score	100	Easy to understand
2	Lowest Score	69,23	Easy to understand

The readability test results from 25 class X students showed an average score of 85.35%, which falls into the "easy to understand" category. Student scores varied, with the lowest at 69.23% and the highest at 100% within the same interpretive category. These results indicate that all students could easily comprehend the

developed LKPD, making it appropriate for classroom use. According to Suriadiata et al. (2022), readability tests are used to determine students' level of comprehension of the learning media, which is essential for assessing the suitability of the material for classroom use. Rahima et al. (2022) also argue that the developed media is suitable for learning when a readability test meets the "very good" criteria. The readability of learning materials is influenced by various factors, including sentence length, number of syllables per paragraph, use of specific terminology, and the grammatical structure employed.

c. Student Response Questionnaire Test

Before distributing the response questionnaire, a limited trial of the developed LKPD was first conducted with 25 students. The average score from this trial was 87.05, indicating that the LKPD was easy for students to understand. Febriani et al. (2021) state that product trials involve a limited testing phase to gather initial student feedback on the developed learning media or evaluation tools. The results of the limited trial conducted with class X students at MAN 1 Bandung are presented in Table 5.

Table 5. Limited Trial Results

No	Group	Score
1	Group 1	88,3
2	Group 2	88,3
3	Group 3	85
4	Group 4	86,6
Average		**87,05**

The limited student trial showed excellent results, with an average score of 87.05, confirming that the LKPD was well understood. This aligns with the view of Rafiudin et al. (2021), who emphasized that LKPDs designed by teachers should meet the criteria of high-quality learning materials; they must be engaging, aligned with learning objectives, factual, easy to understand, efficient, systematic, relevant, and responsive to students' needs. Based on student feedback, one of the motivating factors in completing the LKPD was the presence of clear images. This supports the findings of Farida & Rachmadiarti (2024), who state that images in learning materials help students understand abstract concepts more effectively.

The distribution of the student response questionnaire was aimed at evaluating how students responded to the developed LKPD. Student responses are crucial in determining whether the LKPD contributes positively to their learning motivation. The results of the student response questionnaire are shown in Table 6.

Table 6. Class X Students' Response Questionnaire

No	Student Initials	Percentage (%)	Category
1	Highest Score	100	Sangat Positif
2	Lowest Score	74	Positif

The response questionnaire completed by 25 students at MAN 1 Bandung yielded an average score of 86%, which was classified as highly positive. The highest score was 100%, while the lowest was 74%, both of which fall within positive categories. According to Nurani & Rachmadyanti (2022), student response questionnaires are used to assess students' challenges in using LKPDs and their varying abilities and perceptions, which often result in different response scores. This variation is standard, as each individual has a unique way of understanding and interpreting learning materials. Based on student feedback, the lowest response scores were attributed to unfamiliar vocabulary. Mahendra et al. (2022) stated that language feasibility includes readability, clarity of information, grammatical accuracy, and the effective and efficient use of language. This aligns with Syahputri et al. (2023), who emphasize that effective language use in instructional materials can help students better understand the subject matter. To solve this issue, the glossary in the LKPD product was expanded to help students understand unfamiliar vocabulary more easily.

After undergoing the student response test, it can be concluded that the scientific literacy-based LKPD is well understood and feasible for implementation as a learning medium for biology, particularly on the classification of living organisms.

4.   Conclusion

Based on the research results, it can be concluded that the scientific literacy-based Student Worksheet (LKPD) on the classification of living organisms is feasible for use as instructional material to support the learning process in this subject. The validation results indicated that the material expert evaluation was categorized as highly valid, the media expert validation as valid, the readability tests by both the teacher and students were in the easy-to-understand category, and the student response was categorized as highly positive. Through revision and feedback from validators, the scientific literacy-based LKPD on the classification of living organisms was successfully refined and deemed suitable for classroom learning.

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