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Analysis of Scientific Literacy Availability in Physics Worksheets for Grade XI in Senior High Schools in Padang City

Muhammad Virell Bramasta [1], Hidayati[1*], Putri Dwi Sundari[2]

[1] *Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia*
Corresponding author. Email:hidayati@fmipa.unp.ac.id

ABSTRACT

This research addresses the issue of scientific literacy in Indonesian education, specifically focusing on Physics text books used in Grade XI Semester 1 in Padang City. Despite the recognized importance of scientific literacy in building high-quality human resources, the results of the 2015 and 2018 PISA assessments indicate a decline in scientific literacy skills among Indonesian students. Interviews revealed discrepancies between scientific literacy in textbooks and the 2013 revised curriculum, and low scores in the national university entrance exam (UTBK) in Padang, attributed to the lack of scientific literacy in the learning materials. Analysis of textbooks from four high schools in Padang showed variations in the availability of scientific literacy components, with the context component having the lowest percentage. In this context, improving the quality of Physics textbooks needs to focus on the context aspect, ensuring the implementation of scientific literacy in real-world situations, to enhance students' understanding and prepare them to face increasingly complex global challenges.

Keywords: *Availability Analysis; Worksheet; Scientific literacy.*

I. INTRODUCTION

21st-century education emphasizes the importance of mastering 21st-century skills, one of which is scientific literacy. Scientific literacy involves the ability to explain, analyze, and interpret scientific phenomena accurately and critically [1,2]. Proficiency in scientific literacy plays a crucial role in helping students understand scientific concepts more deeply[3,4,5]. Therefore, scientific literacy serves as a fundamental foundation in education, providing a strong basis for students to face the challenges of the 21st century.

The scientific literacy skills of students are influenced by several factors, namely: 1) instructional materials, 2) teaching models, 3) learning media, 4) student worksheets, and 5) assessment tools based on scientific literacy [6]. The low scientific literacy skills of students may be attributed to the fact that these five factors have not been implemented in the teaching process.

The real situation indicates a low level of scientific literacy among students in Indonesia. OECD results revealed that students' scientific literacy skills fall into the low category, with an average score of 389, significantly below the standard score of 489[7]. Scientific literacy is closely related to problem-solving abilities in everyday life. In scientific literacy, information is related to content, context, and competencies[8,9]. Learning methods focused on memorization have a negative impact on students' mastery of scientific literacy, especially in physics[10]. Proficiency in scientific knowledge aids in problem-solving[11]. Presenting comprehensive materials based on real-world concepts helps enhance students' scientific literacy[12,13]. The lack of emphasis on inquiry-based learning and the availability of learning resources are reasons behind the low level of scientific literacy[14].

In an ideal school setting, supporting scientific literacy mastery necessitates providing adequate learning resources. The presence of learning materials containing information relevant to the content, context, and physics competencies associated with the real world plays a crucial role in strengthening scientific literacy proficiency[15]. This capability aims to establish a robust scientific foundation for addressing global issues[3,4,5]. With the availability of such learning resources, it is expected that students can attain a strong grasp of scientific literacy..

One form of self-learning resource that can support scientific literacy is worksheets. Worksheets play a crucial role in guiding students to understand physics concepts effectively[16]. They help train students' skills in solving physics problems[17]. Physics worksheets are available in various forms in both print and online learning. Thus, the availability of worksheets plays a vital role in assisting students in mastering the material to enhance scientific literacy.

Previous researchers have reported various issues related to the low levels of scientific literacy. The use of teaching materials, both in print and online formats such as worksheets, aids in improving scientific literacy. Scientific literacy can be enhanced through students' performance using these worksheets to solve physics problems[18,19]. The presentation of physics learning materials based on scientific literacy aspects is still rarely implemented in teaching[20]. Therefore, further analysis and investigation regarding the availability of scientific literacy worksheets need to be conducted

II. METHOD

This study employed a descriptive approach using qualitative methods. The aim of this method is to describe a problem based on real-life situations. The subjects of this research were student worksheets used in high schools in Padang City. The study involved samples from 4 schools, including SMAN 10, SMAN 8, SMAN 16, and SMAN 4 in West Sumatra, which were used as learning resources. The focus of the analysis was on the physics worksheets for the 11th-grade students in the first semester. The data obtained from this research consisted of categorizing the indicators of scientific literacy found in these student worksheets. The analyzed topics included the dynamics of rigid body equilibrium, elasticity and Hooke's law, static fluids, dynamic fluids, temperature, heat, and kinetic gas theory. The results were grouped and presented in the form of descriptive data analysis.

An instrument is a tool used to approach the research objectives.[21] states that research instrument is a tool used to measure observed natural or social phenomena.

The research instrument used in this study will be self-developed and its validity will be tested. According to [22], to create a good instrument, several steps need to be taken:

1) *Planning:* In this stage, a literature review is conducted to formulate the objectives, determine variables, and decide what categories will be included in the instrument and which ones are appropriate for the instrument to be created.

2) *Drafting the Instrument Framework:* During the process of drafting the instrument, an outline of the instrument is created first. The instrument framework table contains the indicators to be analyzed, sub-indicators, and item numbers for the instrument to be developed. The instrument framework can be found in the appendix. Subsequently, the instrument is developed based on the prepared framework. The framework for this research can be seen in the appendix.

3) *Writing Instrument Items*: After outlining the instrument framework, the next step is the creation of the instrument items. The instrument is structured based on the previously prepared framework and guided by the supervisor. The instrument for this research can be found in the appendix.

4) *Pilot Testing, Validity Testing*: The instrument's pilot testing is conducted to determine its suitability for use in the research, considering its validity. Before the validity test, the examiners provide guidance to the supervisor twice. The validity assessment of the instrument is carried out by three validators using the instrument validation sheet, which can be seen in the appendix. The validity assessment of the analysis instrument for Physics worksheets related to scientific literacy components is in the form of a checklist with categories indicating the presence or absence of the instrument in the worksheets.

The overall validity results were determined using Aiken's V formula.:

$$V = \sum s/[n(C-1)] \quad (1)$$

Where*:*
s = r – lo
lo = Lowest possible score
C = Highest possible score
r = Score given by the validator
n = Number of validators

At the end of the assessment, the instrument's content validity score was obtained. The validity categories for an instrument are shown in Table 1.

Tabel 1. Categories of Instrument Validity Levels

Kategori	Interval
$V \leq 0,8$	Very High
$0,4 \leq V < 0,8$	Moderate
$V < 0,4$	Low

(Source: Ref [23])

5) *Revising the instrument:* After validation by experts, the instrument is revised based on the comments and suggestions provided by the experts. The final instrument used is the one that has been improved according to the comments and suggestions given by the experts.

Data collection technique in this research involves documentary study, extracting information from various written sources and related documents. The data analyzed pertains to the usage of Physics worksheets for Grade XI Semester 1 in public schools in Padang City, specifically focusing on scientific literacy.

Data processing in the research is crucial as it influences the research outcomes. The analysis technique employed is content analysis, a method used to deduce communication messages from books or documents. This allows for a comprehensive understanding of the conveyed messages.

The data processing techniques applied in this research include:

1) Summing up the occurrences of scientific literacy indicators in each analyzed worksheet.

2) Calculating the percentage of Physics worksheets for Grade XI in public high schools that can facilitate the presence of scientific literacy in each analyzed worksheet.

using the following formula:

$$\frac{\sum indikatorliterasisainsyangmuncul}{total \sum indikatorliterasisains} x100\% \qquad (1)$$

3) Determining the average percentage proportion of each category of scientific literacy instrument from all analyzed Physics worksheets.

4) Establishing the criteria for presenting Grade XI Physics worksheets in high schools that can facilitate the presence of scientific literacy, as shown in the table below.

Table 2. Criteria for Presenting Grade XI Physics Worksheets Facilitating Scientific Literacy Components

Interval presentase	Criteria
81-100	Highly Facilitative
61-80	Facilitative
41-60	Moderately Facilitative
21-40	Slightly Facilitative
0-20	Not Facilitative

(Source: Ref [24])

5) Drawing conclusions from the obtained data is crucial in research analysis.

III. RESULTS AND DISCUSSION

After analyzing the availability of scientific literacy indicators in High School Physics Workbook for Grade XI Semester 1, varied percentage results were found across the five workbooks. Each workbook exhibited a different percentage, ranging from not facilitating to facilitating the components of scientific literacy indicators. The following is a discussion of the analysis results of scientific literacy indicator components in the High School Physics Workbook for Grade XI Semester 1.

1) **Context**

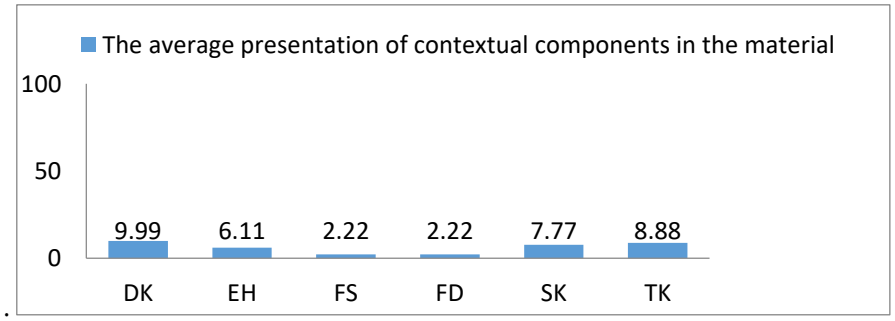

Figure 1. *Percentage Results of Context Components in Each Topic*

Explanation: DK: Dynamics and Equilibrium of Rigid Bodies
EH: Elasticity and Hooke's Law
SK: Temperature and Heat
FS: Static Fluids
FD: Dynamic Fluids
TK: Kinetic Theory of Gases

The analysis of context components in each topic of the 5 workbooks revealed varying percentage values. The highest percentage was obtained in the topic of dynamics and equilibrium, with a value of 9.99%, categorized as not facilitating. The lowest percentage was found in the topics of static and dynamic fluids, with a value of 2.22%, also categorized as not facilitating. In the topics of elasticity and Hooke's law, the percentage was 6.11%, categorized as not facilitating. For the topics of temperature and heat, the percentage was 7.77%, categorized as not facilitating, while the topic of kinetic gas theory received the same category, not facilitating, with a percentage of 8.88%. In the context component, the percentage for all topics was very low and did not facilitate.

2) **Competence**

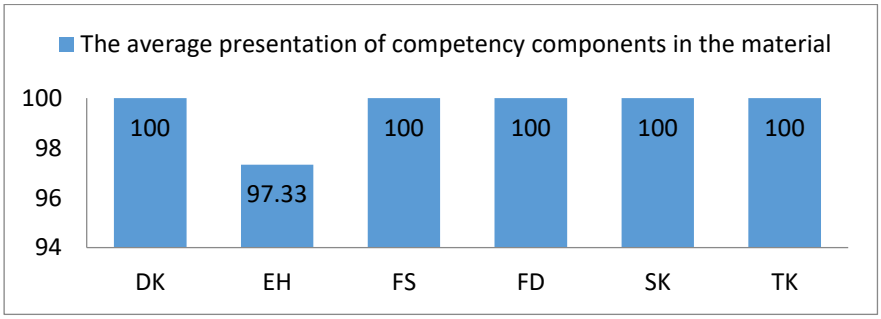

Figure 2. *Percentage Results of Competency Components in Each Topic*

Explanation: DK: Dynamics and Equilibrium of Rigid Bodies
EH: Elasticity and Hooke's Law
SK: Temperature and Heat
FS: Static Fluids
FD: Dynamic Fluids
TK: Kinetic Theory of Gases

The analysis of competency components in each topic of the 5 workbooks for Grade XI Semester 1 revealed consistent results. In the topics of dynamics and equilibrium, static fluids, dynamic fluids, temperature and heat, and kinetic gas theory, the percentage was 100%, categorized as highly facilitating. However, in the topic of elasticity and Hooke's law, the percentage was slightly lower at 97.33%, still categorized as highly facilitating.

3) **Knowledge**

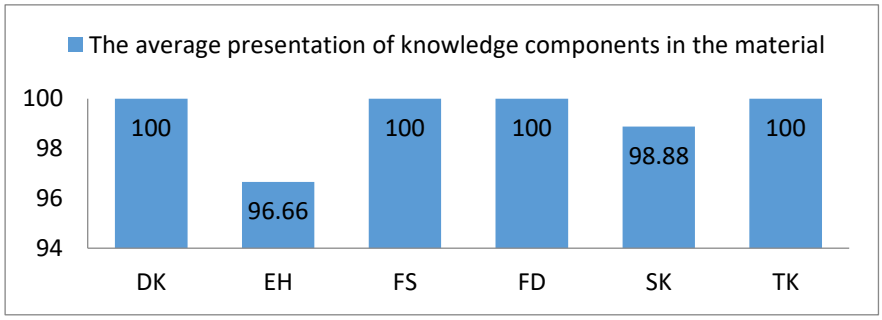

Figure 3. *Percentage Results of Knowledge Components in Each Topic*

Explanation: DK: Dynamics and Equilibrium of Rigid Bodies
EH: Elasticity and Hooke's Law
SK: Temperature and Heat
FS: Static Fluids
FD: Dynamic Fluids
TK: Kinetic Theory of Gases

The presentation of knowledge components in each topic of Grade XI Semester 1 in the 5 analyzed workbooks varied but maintained consistent percentages. In the topics of dynamics and equilibrium, static fluids, dynamic fluids, and kinetic gas theory, the percentage was 100%, categorized as highly facilitating. In the topic of elasticity, the percentage was 96.66%, still classified as highly facilitating. Similarly, the topic of temperature and heat achieved a very facilitating category with an average percentage of 98.88%.

In the three tables above, disparate percentages were observed, with high percentages achieved for knowledge and competency indicators, while the context indicator obtained the lowest percentage. The substantial difference in these percentages indicates an imbalance in the proportions of science literacy aspects within instructional materials. According to[25], the proportions of science literacy aspects in instructional materials can be considered balanced when the percentage differences between each indicator are not overly significant.

IV. CONCLUSION

The research findings indicate that the Scientific Literacy indicators on the Student Worksheets (LKS) used by Physics teachers in Grade XI Semester I at high schools in Padang City already cover Scientific Literacy components, although they fall within the categories of not facilitating and highly facilitating. The context component obtained the lowest percentage, thus categorized as not facilitating. In comparison with the knowledge and competence components, this component is considered highly facilitating.

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