



# Scientific Literacy Skills of State High School Students In Singkawang City

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**Abstract:** Scientific literacy research by the Program for International Student Assessment (PISA) in the period 2000-2015 shows that the scientific literacy ability of Indonesian students is at a low level. This study aims to determine the scientific literacy ability of state high school students in Singkawang City. The method used is descriptive qualitative. The research was conducted in two public high schools in Singkawang City, namely SMA 1 and SMA 2 Singkawang. The samples taken were 127 students selected based on the simple random sampling technique. The research instrument used was a scientific literacy test in multiple-choice questions consisting of the dimensions of context, knowledge and competence. The results showed that the average science literacy test scores of SMA 1 students in the context dimension were 38%, the knowledge dimension was 40%, and the competence dimension was 39% which were very low. SMA 2 has 40% context dimension, 41% knowledge dimension and 39% competency dimension, classified as very low. So it can be concluded that SMA 1 and SMA 2 Singkawang students have very low scientific literacy skills based on three dimensions of scientific literacy ability.

**Keywords:** Scientific literacy; Aspects of scientific literacy; Senior High School; PISA.

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## Introduction

The 21st century is an era of globalization that is full of challenges. The development of science and technology in all fields is very rapid, one of which is the field of education. Indonesian education is expected to face some challenges (Sanjaya et al., 2017). Education in the 21st century aims to encourage students to have skills that support them to be responsive to changes in line with the times (Sutrisna, 2021). 21st-century skills such as the ability to think creatively, innovatively, critically, problem-solving skills, communication, collaboration, technology literacy and leadership, so that quality human resources (HR) are needed and able to compete (National Science Teacher Association, 2011).

According to (OECD, 2016) Scientific literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on scientific evidence to understand and make decisions regarding nature and its

changes due to human activities. So that scientific literacy skills must be possessed by students to be able to study and apply scientific designs to solve problems in life (Jufrida et al., 2019).

Scientific literacy is divided into three dimensions: the Competency/scientific process dimension, the second is Knowledge/science content dimension, and the third is the context of the application of science and science attitudes. Science competence consists of three aspects, namely explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific data and evidence. Scientific knowledge consists of content knowledge, procedural knowledge and empirical knowledge. The context of the application of health and disease science, natural resources, environmental quality, hazards and the latest developments in science and technology. Meanwhile, science attitude refers to further developing scientific knowledge, pursuing a career in science, and using

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scientific concepts and methods in life (OECD, 2015). One of the international education evaluation tools is PISA (Basam et al., 2016).

PISA (Program for International Student Assessment) is a global education assessment that aims to monitor the results of the education system periodically every three years in influencing the achievement of 15-year-old students in reading, mathematics and science. The organizers are countries that are members of the Organization for Economic Cooperation and Development (OECD). The OECD launched PISA in 1997, but implementation began in 2000 (OECD, 2017).

Based on the results of observations of student scientific literacy conducted by the Program for International Student Assessment (PISA), Indonesian students got an average PISA science literacy score in the 2000-2015 range with a score of 392 out of a total score of 500. The score means that Indonesian students have low science literacy skills (Azrai et al., 2020). The low scientific literacy ability of students must be addressed immediately because scientific literacy is considered necessary in the current era of globalization so that students will be able to learn further and live in modern society, which is currently heavily influenced by the development of science and technology (Yuliati, 2017).

(Huryah et al., 2017) stated that the scientific literacy ability of students in the city of Padang showed that grade X students in four schools, namely SMAN 1, SMAN 8, SMAN 13 and SMAN 16 the average results obtained fell into the category of low scientific literacy abilities. (Erniwati et al., 2020) also stated that the power of high school students in Kendari City showed scientific literacy skills, it was obtained that the average scientific literacy ability was in a low category. (Bagasta et al., 2018) stated that the scientific literacy ability of state high school students in Sragen City based on seven indicators showed that students had low scientific literacy skills. The findings are in line with (Mahmudah et al., 2020) stated fact that the scientific literacy of Indonesian students is still very low, so real solutions are needed to improve it. (Sari et al., 2017) noted that scientific literacy is an educational problem in Indonesia that requires immediate attention because students' scientific literacy skills are low.

The Human Development Index (HDI) of Singkawang City has a high status in West Kalimantan Province. This makes the human development of Singkawang City continue to progress during the 2010-2020 period; HDI is an important indicator to measure success in efforts to build the quality of human life in an area (BPS, 2020). (Febriana et al., 2021) stated that scientific literacy is very important for students because it has great potential in supporting the development of talented and quality human resources to face the challenges of the globalization era. This study aims to

determine the scientific literacy ability of state high school students in Singkawang City. Seeing the development and importance of scientific literacy, it is necessary to evaluate scientific literacy skills in Singkawang City to provide an overview of students' scientific literacy abilities, which are expected to be able to build higher quality education in the future.

**Method**

The method used in this research is descriptive with a qualitative approach. The population of this study were students of class X SMA Negeri 1 Singkawang and SMA Negeri 2 Singkawang in the academic year 2020/2021. The sample was determined based on the selection and population table with an error rate of 5% developed by Isaac and Michael in (Sugiyono, 2011) The sample taken in the study amounted to 127 students. The selection of the 127 people was made using a simple random sampling technique.

The instrument for students' scientific literacy abilities was obtained from the 2015 PISA scientific literacy test. The selected questions focused on as many as ten biological materials covering the theme of ecosystems, environmental problems, and efforts to overcome them. Instrument validation is calculated using the Product Moment Correlation formula.

The research data results were analyzed by calculating the percentage of scientific literacy achievement in the aspects of competence, knowledge, and context, which were calculated with the help of the Microsoft Office Excel program. The interpretation of the percentage of scientific literacy ability is carried out based on categories according to (Djaali, 2008) In Table 1.

**Tabel 1:** Criteria for Assessment of Scientific Literacy

Criteria	Grade
Very good	86-100
Good	72-85
Enough	58-71
Low	43-57
Very low	≤42

**Result and Discussion**

The overall scientific literacy ability is obtained by calculating the score of the scientific literacy ability test results. The results of students' scientific literacy skills are presented in Figure 1.

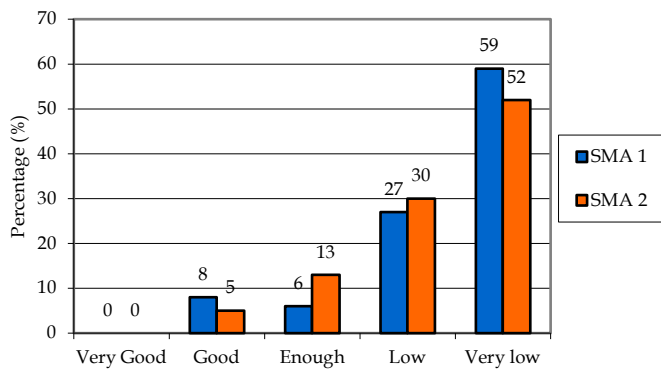


Figure 1. Students' Science Literacy Ability

The average scientific literacy ability of SMA 1 and SMA 2 Singkawang students is deficient. SMA 1 Singkawang there are 59% students with shallow criteria, and SMA 2 Singkawang, there are 52% students with superficial criteria. The data obtained from research related to scientific literacy skills in each context dimension, knowledge dimension and scientific competence dimension were obtained by calculating the percentage of test results per aspect in the context dimension, knowledge dimension and competency dimension.

Table 2: Science Literacy Ability Test Results Context Dimensions

Name of School	Aspect Context of Science Literacy	Percentage (%)	Criteria
SMA 1	Local/National	41	Very Low
	Global	35	
Average		38	
SMA 2	Local/National	39	
	Global	40	
Average		40	Very Low

The average scientific literacy ability of the students' context dimension is still shallow, namely SMA 1 38% and SMA 2 40%. (Erniwati et al., 2020) stated that the context dimension refers to situations in everyday life that become the ground for applying processes and understanding scientific concepts. In this regard, PISA divides the fields of application of science into three groups, namely life and health, earth and the environment and technology. The actual situation that becomes the context of applying science in PISA is not explicitly taken from the material learned in school but from everyday life (Nofiana, 2017).

Judging from each aspect in the context dimension of SMA 1, students in the local/national context aspect of 41%, the global context aspect of 35% with an average percentage of 38%. In SMA 2, the international context aspect is 40%, the local/national context aspect is 40%, with an average percentage of 40%. In line with (Nofiana, 2017) research, SMP in Purwokerto City obtained an average rate of students' scientific literacy

skills in the context aspect of 32,41% or the deficient category. This is because the teacher's tendency to provide material without relating it to real-life causes students to find it challenging to convey the knowledge obtained to real-life situations.

Table 3: Science Literacy Ability Test Results Knowledge Dimension

Name of School	Knowledge Aspects of Scientific Literacy	Percentage (%)	Criteria
SMA 1	Procedural	43	Very Low
	Content	37	
Average		40	
SMA 2	Procedural	45	
	Content	37	
Average		41	Very Low

The dimension of scientific knowledge shows that students' average scientific literacy ability is still deficient, namely SMA 1 40% and SMA 2 41%. According to (Wulandari & Wulandari, 2016), the purpose of the scientific literacy ability test in the knowledge aspect is to describe the extent to which students can apply their knowledge in contexts that are relevant to their lives.

Each aspect of SMA 1 students' procedural knowledge of 43% and 37% of the content. SMA 2 on the element of procedural knowledge of 45% and 37% content. The low ability of students in the knowledge aspect is caused by the science learning process, which tends to transfer knowledge from teachers to students, which is done verbally and does not emphasize the process (Suciati, 2014). Therefore, students' understanding of biological concepts is limited to rote memorization. In the process of learning biology, the teacher must guide students to find their knowledge.

Table 4: Science Literacy Ability Test Results Competency Dimensions

Name of School	Aspek Kompetensi Literasi Sains	Percentage (%)	Criteria
SMA 1	Using scientific evidence	38	Very Low
	Explain scientific phenomena	40	
Average		39	
SMA 2	Using scientific evidence	38	
	Explain scientific phenomena	40	
Average		39	Very Low

The dimension of scientific competence shows that students' average scientific literacy ability is still deficient, namely 39% in SMA 1 and SMA 2. The low level of students' scientific literacy competence is in line with (Zhasda & Sumarmin, 2018) The study results show

that the science literacy competence of junior high school students in Solok City is low due to the low level of high-level thinking ability of students. Experiments conducted by (Ardianto & Rubini, 2016) show that integrated science learning with guided discovery and PBL models can improve scientific literacy skills in concept and competency aspects.

According to the developmental theory proposed by Piaget, Class X high school students have entered the operational phase (age 11-adult age). In this phase, the child's thinking has moved from concrete thinking to abstract thinking and hypotheses. This means that children can carry out rational thinking processes and can solve problems scientifically, namely thinking processes that are carried out systematically starting with difficulties, understanding issues, proposing hypotheses or quick answers to the problem solving, collecting and verifying data and drawing conclusions, namely whether the proposed idea can be accepted or rejected (Sains, 2017).

Overall, the school obtained very low scientific literacy achievements because the percentage of mastery of scientific literacy obtained  $\leq 42\%$  (Table 2, Table 3, Table 4) is classified as very low. Several factors influence students' low scientific literacy ability (Sutrisna, 2021). The factor that causes Indonesian students' low scientific literacy ability based on the PISA assessment is that Indonesian students have not been trained in solving questions with characteristics such as those on PISA (Hasasiyah et al., 2019). Teachers also need evaluation tools based on scientific literacy to improve scientific literacy or scientific literacy. Teachers often ignore scientific literacy-based evaluation tools because they do not understand how to make these evaluation tools (Fraenkel & Wallen, 2012). (Rokhmah et al., 2017) stated that learning resources and learning programs support scientific literacy skills. The fact shows that students have more time interacting with textbooks than with teachers (Erniwati et al., 2020).

The low achievement of scientific literacy skills of State Senior High School students in Singkawang City is essential in determining the quality of education. So that quality human resources are needed and can compete (Sanjaya et al., 2017). (Pratiwi et al., 2019) Measuring the level of students' scientific literacy is very important to determine the extent of students' literacy of the science concepts they have learned.

(Wulandari & Wulandari, 2016) Several factors influence the mastery of scientific literacy skills, including the approach or method of learning science used by teachers in building learning concepts. A learning process that can encourage students' enthusiasm to solve problems presented by the teacher and arouse curiosity about learning topics will build science process skills that are part of the domain of scientific literacy competence (Nurwulandari, 2018). In

the research conducted by (Lestari et al., 2021), the provision of the STEM approach blended learning model showed an increase in students' scientific literacy skills before and after blended learning with the STEM approach, and this indicates that the STEM approach combined teachers can use knowledge to improve scientific literacy skills. Parental support in the form of motivation, providing various kinds of learning resources at home and playing an active role in assisting children in learning is also essential to increase student understanding (Hartono et al., 2022)

An effective learning strategy to achieve scientific literacy skills is learning that raises the context of science, including issues or problems in the surrounding environment (Hafizah & Nurhaliza, 2021). according to (Nurtanto et al., 2020), one of the practical learning models in growing scientific literacy skills is the Problem-based learning (PBL) model. The PBL model is defined as a potential learning model that carries authentic issues as a stimulus for students to develop thinking and problem-solving skills (Hafizah & Nurhaliza, 2021). (Duda & Susilo, 2019) explain that the practicum-based PBL model supported by authentic assessment is more significant than the PBL model learning. Besides PBL, a blended learning station rotation (BLSRM) model improves students' scientific literacy skills. According to (Hadiprayitno et al., 2021) To increase the knowledge of scientific literacy, BLSRM learning needs to be combined with other learning models such as problem-solving so that it is expected to increase students' understanding of scientific literacy.

## Conclusion

The scientific literacy ability of SMA Negeri 1 Singkawang students in the context dimension is 38%, the knowledge dimension is 40%, and the competency dimension is 39%, SMA Negeri 2 Singkawang at the context dimension is 40%, the knowledge dimension is 41%, and the competency dimension is 39%, the average is in the category of achievement "very low". Using a practicum-based PBL model, BLSRM, and blended learning with a STEM approach can be made to build and develop students' scientific literacy skills. These learning innovations can be used and are ideal for future learning.

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