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ELEMENTARY SCHOOL TEACHERS' SCIENCE LITERACY CAPABILITIES IN DIY AND THEIR IMPLEMENTATION IN PREPARATION FOR THE *ASESMEN STANDARDISASI PENDIDIKAN DAERAH* (ASPD)

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ABSTRACT

This research analyzes the science literacy skills of elementary school teachers in the Special Region of Yogyakarta (DIY) and their implementation in preparing the Regional Education Standard Assessment (ASPD). Teachers' science literacy skills significantly impact the quality of primary education, especially in preparing for ASPD. PISA defines science literacy as the ability to interact with science-related issues and ideas of science as a reflective citizen. This study uses a qualitative approach with descriptive analysis methods. The respondents in this study were five elementary school teachers from various schools in DIY—the data collection technique for teachers' science literacy skills used science literacy questions from PISA 2015. Meanwhile, data on the implementation of science literacy were obtained using a Likert scale. The study results show that elementary school teachers in DIY have science literacy skills with a score of 44.3%. Teachers who possess science literacy skills have generally implemented them in their teaching. However, some teachers have yet to receive science literacy training and implement it in the classroom.

Keywords: *Asesmen Standardisasi Pendidikan Daerah (ASPD)*; elementary school teachers; primary education; science literacy skills

INTRODUCTION

Science explores the natural world to find factual information called scientific knowledge. Individual curiosity drives us to seek and gather factual information about the natural world[1]. The development of science and technology is a sign of the progress of civilization in the current era of globalization, which makes the need for developing scientific literacy in education very urgent[2]. A good education needs to facilitate students in science[3]. PISA defines scientific literacy as the ability to engage with issues related to science and with scientific ideas as a reflective citizen. The PISA definition includes the

[1] Gidele Gizaw and Solomon Sorsa Sota, "Improving Science Process Skills of Students: A Review of Literature," *Science Education International* 34, no. 3 (September 13, 2023): 216–24, https://doi.org/10.33828/sei.v34.i3.5.

[2] Amiruddin B, A S Budi, and M S Sumantri, "Enhancing Science Literacy Capabilities of Prospective Primary School Teachers through the STEM Project Learning Model," *Journal of Physics: Conference Series* 1869, no. 1 (April 1, 2021): 1–8, https://doi.org/10.1088/1742-6596/1869/1/012176.

[3] Andika Adinanda Siswoyo, "Developing Thematic Learning Module Based On Ethnoscience Oriented Outdoor Learning Strategy To Improve Student's Learning Outcomes In Primary School," *Al-Bidayah : Jurnal Pendidikan Dasar Islam* 13, no. 1 (August 4, 2021): 237–50, https://doi.org/10.14421/al-bidayah.v13i1.283.

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ability to explain phenomena scientifically, evaluate and design scientific research, and interpret data and evidence scientifically. This emphasizes the importance of the ability to apply scientific knowledge in the context of real-life situations. PISA also establishes a baseline level – a Level 2 proficiency level, on a scale of a high of 6 and a low of 1b – at which individuals begin to demonstrate competencies that enable them to participate effectively and productively in life as students, workers, and citizens[4]. Learning science literacy skills during elementary education can foster knowledge-based and scientific skills. Developing this capacity necessitates collaborative endeavors within a Professional Learning Community (PLC) framework[5]. Scientific literacy skills are becoming increasingly important in today's information age, where scientific knowledge plays a central role in decision-making in various fields, including health, the environment, and technology. Today's students are expected to have multiple skills to succeed in their future professional lives[6]. Since 2000, the OECD has been a prime mover in the renowned Program for International Assessment of Students (PISA), which aims to evaluate the academic performance of 15-year-old students worldwide. PISA primarily measures cognitive skills in three main subject domains: mathematics, science, and reading[7].

The 2018 PISA report was based on assessments of 600,000 15-year-old students from 79 countries, including high- and middle-income countries. Each student's reading, math, and science performance in this assessment is compared across countries participating in PISA. In 2018, Indonesia was ranked 74th out of 79 participating countries in the reading ability category, 73rd in the mathematics ability category, and 71st in the science ability category[8]. In Indonesia, scientific literacy is still a serious challenge. Data

[4] OECD, "How Does PISA for Development Measure Scientific Literacy?," in *PISA for Development Brief*, 2017.

[5] Novianti Muspiroh, Udan Kusmawan, and M. S. Sumantri, "Professional Learning Community Efforts in Building Scientific Literacy Skills of Islamic Primary School Teachers," in *AIP Conference Proceedings*, 2022, 060030, https://doi.org/10.1063/5.0130289.

[6] Esra Kabataş Memiş, Sümeyra Zeynep Et, and Elif Sönmez, "Integration of Technology into Science Teaching: A Phenomenological Study on the Experiences of the Pre-Service Teachers," *Science Education International* 34, no. 3 (September 13, 2023): 166–76, https://doi.org/10.33828/sei.v34.i3.1.

[7] Olesya Gladushyna and Rolf Strietholt, "Measuring Education: Do We Need a Plethora of Assessment Studies or Just a Single Score?," *International Journal of Educational Research Open* 5 (December 2023): 100281, https://doi.org/10.1016/j.ijedro.2023.100281.

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from various research and educational institutions shows a significant gap in scientific literacy skills among the Indonesian population.

The government takes the PISA results very seriously and has responded by making various efforts through the Ministry of Education and Culture. One of the steps taken was to revise the education curriculum in Indonesia[9]. Examining the relationships between school science literacy and school context as assessed by various factors related to students, teachers, and administrators can reveal how these variables are associated and operate as a system for schools to achieve better[10]. Although there have been efforts to increase scientific literacy through formal education programs, such as school curricula, and informal ones, such as science popularization programs, various problems still need to be solved. These obstacles include lack of access to quality science education, lack of resources, the role of teachers that may not be optimal, and cultural issues that influence attitudes towards science[11]. As a result, low scientific literacy can have a negative impact on scientific and technological development in Indonesia, as well as on society's active participation in complex scientific issues.

There is a close relationship between teachers' and students' scientific literacy abilities. Teachers are models for students[12]. Teachers' scientific literacy abilities will influence how students view and approach science material. An educator possessing scientific and technological literacy can mentor students in their self-development, teaching them when and how to inquire, encouraging critical thinking, and fostering the capacity to make decisions grounded in facts and logical reasoning rather than emotions or superstitious beliefs[13]. They can describe science concepts well and help students understand them. Process Teaching in science subjects primarily focuses on conveying

[9] Hewi and Shaleh.

[10] Cody Ding, "Examining the Context of Better Science Literacy Outcomes among U.S. Schools Using Visual Analytics: A Machine Learning Approach," *International Journal of Educational Research Open* 3 (2022): 1–11, https://doi.org/10.1016/j.ijedro.2022.100191.

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[12] Siti Aisyah, Minnah El Widdah, and Sukarno Sukarno, "Analysis of Science Literacy Ability and Teachers' Capability in Implementation of Learning by Science Literacy Oriented in Islamic Kindergarten at Bangko City," *Jurnal Penelitian Pendidikan IPA* 7, no. SpecialIssue (November 24, 2021): 77–83, https://doi.org/10.29303/jppipa.v7iSpecialIssue.1125.

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information or knowledge to students[14]. Teachers skilled in scientific literacy can design immersive learning experiences to stimulate students' interest in science. This can encourage students to develop their scientific literacy skills. Teachers can integrate science approaches that suit student needs. Curriculum reflects a country's specific context, economic growth, and educational traditions that shape students' development and academic performance. In other words, teachers' scientific literacy abilities can directly impact students' scientific literacy abilities[15].

Scientific literacy and *Asesmen Standardisasi Pendidikan Daerah* (*ASPD*) are closely related to improving education. The *Asesmen Standardisasi Pendidikan Daerah* (*ASPD*) is important in demonstrating student competency as a substitute for the *Ujian Nasional (UN)*. The competencies that need to be achieved are high-level thinking skills *(HOTS)*. Educational assessments oriented towards higher-level thinking focus on critical, evaluative thinking skills and the ability to relate information, not just remembering theory[16]. The results of this assessment can be used to identify effective learning programs or strategies, allocate resources wisely, and improve school curriculum and teaching[17]. Scientific literacy assessment can be an important factor in regional education policy planning. The *ASPD* results can help policymakers design educational programs that are more effective in advancing scientific literacy among students. This assessment is designed to generate accurate information to enhance the quality of teaching and learning, which, in turn, will improve students' outcomes[18]. Activities in the scientific method such as observation, asking questions, formulating hypotheses, experiments, data analysis and interpretation, and concluding are Science Process Skills (SPS). As elements of the scientific method, Science Process Skills (SPS) improve students' ability to do science; that is, how they know what they want to know[19]. So, scientific literacy and *ASPD*

[14] Gizaw and Sota, "Improving Science Process Skills of Students: A Review of Literature."

[15] Gladushyna and Strietholt, "Measuring Education: Do We Need a Plethora of Assessment Studies or Just a Single Score?"

[16] Arifatul Hikmah et al., "Keterampilan Berpikir Aras Tinggi Asesmen Standardisasi Pendidikan Daerah Mata Pelajaran Bahasa Indonesia," *Fon: Jurnal Pendidikan Bahasa Dan Sastra Indonesia* 19, no. 1 (March 30, 2023): 102–15, https://doi.org/10.25134/fon.v19i1.6327.

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[18] Wulandari Wulandari et al., "Digitalisasi Assessmen Di Sekolah Dasar Di Era 4.0 ," in *Seminar Nasional Pendidikan Guru Sekolah Dasar* (Yogyakarta: Universitas Sarjana Wiyata Tamansiswa, 2022), 165–69.

[19] Gizaw and Sota, "Improving Science Process Skills of Students: A Review of Literature."

are interrelated because students' scientific literacy and teachers' scientific literacy abilities can be one of the aspects assessed in *ASPD*. Increasing scientific literacy among teachers and students can contribute to better *ASPD* outcomes and, in turn, to improved educational quality at the regional level.

This research aims to analyze the scientific literacy abilities of elementary school teachers in the Special Region of Yogyakarta (DIY) and their implementation in preparation for the *ASPD*. These steps are very important in facing today's global challenges, which are increasingly complex and rely heavily on a solid understanding of science and technology. Existing assessment research addresses different learning outcomes in education and follows specific assessment frameworks and methodological procedures. However, researchers point out that the results of large-scale educational assessments tend to be uniform and, therefore, provide similar conclusions about the academic performance of examinees[20].

RESEARCH METHODS

This research uses a qualitative approach with descriptive analysis methods. The research was conducted in the Special Region of Yogyakarta, a student city with government policy in the form of an ASPD. The respondents who were the subjects of this research were five elementary school teachers spread across schools in DIY. Data collection techniques to measure teachers' scientific literacy abilities, researchers adopted the PISA questions created by the OECD in 2015 in the context of scientific literacy. The questions used were eight items adapted to three scientific literacy competency indicators. Data was obtained using a Likert scale questionnaire (1-4) to see the implementation of elementary school teachers' scientific literacy. The questionnaire was developed based on literature related to scientific literacy and preliminary studies conducted. The questionnaire consists of several statements that refer to various aspects of scientific literacy and its implementation. Each statement is given a Likert scale with four response options: 1 (Disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly Agree).

[20] Gladushyna and Strietholt, "Measuring Education: Do We Need a Plethora of Assessment Studies or Just a Single Score?"

RESULTS AND DISCUSSION

This research aims to analyze the scientific literacy abilities of elementary school teachers and their implementation to prepare the Asesmen Standardisasi Pendidikan daerah (ASPD). The data in this research comes from answer scores on scientific literacy questions adopted from the 2015 Program of International Student Assessment (PISA), which includes three indicators of scientific ability. Below is presented Table 1, which describes the results of scientific literacy competency per indicator.

Table 1
Percentage of Elementary School Teachers' Science Literacy Competencies

No	Indicator	Science Literacy Competency
1	Explain Phenomena Scientifically	53%
2	Evaluate and design scientific inquiry	40%
3	Interpret data and evidence scientifically	40%
	Average	**44.3%**

Based on Table 1 above, less than 50% of the total respondents who participated in this research, around 44.3% to be precise, they have needed more scientific literacy skills. This reflects serious challenges in improving the quality of primary education in this area. Even though scientific literacy makes it easier for students to adapt to the ever-growing advances in science and technology, scientific literacy can stimulate their imagination and creativity[21].

The OECD defines four interconnected dimensions of scientific literacy: competence (science process), science knowledge or content, science context, and attitudes. The competency dimension (scientific method) means a person's function in answering a question or solving a scientific problem[22]. The competency dimension is divided into three indicators: explain the Phenomenon Scientifically, Evaluate and design scientific inquiry, and interpret data and evidence scientifically. Scientific literacy skills are needed by every college student, especially for prospective elementary school

[21] Nofriza Efendi, Nelvianti, and Refli Surya Barkara, "Studi Literatur Literasi Sains Di Sekolah Dasar," *Jurnal Dharma PGSD* 1, no. 2 (2021): 57–64.

[22] Candra Puspita Rini, Saktian Dwi Hartantri, and Aam Amaliyah, "Analisis Kemampuan Literasi Sains Pada Aspek Kompetensi Mahasiswa PGSD FKIP Universitas Muhammadiyah Tangerang," *JURNAL PENDIDIKAN DASAR NUSANTARA* 6, no. 2 (January 30, 2021): 166–79, https://doi.org/10.29407/jpdn.v6i2.15320.

teachers, because they are a resource that is highly expected to become professional teachers who have reliable scientific literacy skills and are at the forefront of improving the abilities of students in Indonesia in terms of scientific literacy[23].

The highest score is for the first indicator, namely explaining the phenomenon scientifically, at 53%. The questions asked respondents to explain or provide a statement that flowers cannot produce seeds without pollination. In this item, respondents were asked to remember the appropriate scientific knowledge. According to Ogundeji et al. (2019),[24] there is a statistically significant relationship between students' scientific explanation of the phenomenon and students' understanding of physics concepts; by applying this first indicator, it is hoped that someone will be able to identify, use, and create appropriate explanatory models and representations; make and justify appropriate predictions; offer an explanatory hypothesis[25].

The second indicator is to evaluate and design scientific inquiry with an achievement score of 40%. Questions that include this indicator ask respondents to identify the independent and dependent variables in an experiment based on the graph displayed. The third indicator is interpreting data and evidence scientifically, with an achievement score of 40%. The question item containing this indicator asks respondents to interpret a graph that depicts data corresponding to the relationship between insecticide concentration, and the rate of bee colony collapse over time.

Furthermore, the research results show that most teachers with adequate scientific literacy skills have a science education background or have taken relevant professional training. They can better explain science concepts and use a more interactive learning approach in teaching science material.

However, most teachers with adequate scientific literacy skills feel less confident presenting science material and need help explaining complex concepts to students. These results underscore the need for greater attention to the development of elementary school teachers' scientific literacy skills, especially for those who do not have a strong science education background. Implementing scientific literacy in schools takes work. Still,

[23] B, Budi, and Sumantri, "Enhancing Science Literacy Capabilities of Prospective Primary School Teachers through the STEM Project Learning Model."

[24] Oluwatomisin Marvellous Ogundeji, Barnabas Chidi Madu, and Clement Chizoba Onuya, "Scientific Explanation of Phenomena and Concept Formation as Correlates of Students' Understanding of Physics Concepts.," *European Journal of Physics Education* 10, no. 1 (2019): 10–19.

[25] OECD, "PISA 2015 Releases Field Trial Cognitive Items," *ETS*, 2015.

teachers need to get used to implementing scientific literacy by stimulating students to think critically, implementing learning methods/models suitable for science learning, and teaching science not only as concepts[26].

Several factors were found to influence elementary school teachers' scientific literacy abilities. Some of these factors include educational background, insufficient funding, professional training, and lack of school policies regarding scientific literacy. Professional teachers continually enhance their expertise by thoroughly understanding the content they teach during instructional sessions. They consistently refine their skills, honing their knowledge and practical experience in teaching and learning environments[27]. Teachers who have a background in science education or special training in scientific literacy tend to have a better understanding of science concepts. The implementation of scientific literacy needs to be improved by insufficient funding allocation, which is also a significant obstacle in increasing the scientific literacy of elementary school teachers. Schools must invest in adequate educational resources and support teachers in developing their scientific literacy.

Professional teachers must be able to carry out all stages of activities in the learning process with good management to get proper learning outcomes. The fact is that more teachers need more skills to implement learning[28]. Teachers who have scientific literacy skills have generally implemented them in learning. However, some teachers have never experienced scientific literacy training, so they have not implemented it in the classroom. This impacts the need to instill Science Process Skills (SPS) more.

Prioritizing teachers' scientific literacy skills is key to ensuring adequate regional primary education. To achieve sustainable improvements in scientific literacy, teachers must develop a positive attitude toward science. The formation and development of lifelong learning skills are necessary to ensure the ability to investigate and educate regarding new scientific developments[29]. Teachers can transfer scientific knowledge to

[26] Efendi, Nelvianti, and Barkara, "Studi Literatur Literasi Sains Di Sekolah Dasar."

[27] Irham Nugroho et al., "Teacher Professionalism in the COVID 19 Pandemic: A Literature Review," Al-Bidayah : Jurnal Pendidikan Dasar Islam 14, no. 1 (2022): 1–18.

[28] Fitri Yuliawati and Siwi Aminah Pangestu, "Analysis of Teacher Errors in Applying The Problem-Based Learningmodel in the Teacher Professional Education Program-in-Service Program," *Al-Bidayah : Jurnal Pendidikan Dasar Islam* 14, no. 1 (2022): 81–94.

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the classroom, but the process of science and scientific literacy can be implemented in a variety of methods of teaching[30].

To increase teachers' scientific literacy, there is an opportunity to revise and improve the science curriculum taught in schools. This can help in adapting the curriculum to existing needs. Curriculum materials are textbooks, modules, syllabi, and guides for teaching. Curriculum materials can assist teachers in selecting teaching methods, using teaching aids, providing activities for students, and preparing lesson plans with the potential to instill Science Process Skills (SPS) in students. Strong evidence shows that the improvement of objectives, activities, and methods with a role in the development of specific SPS in students' curriculum materials and monitoring their implementation in the teaching process has a significant contribution to the development of the necessary SPS in students[31]. The study conducted by Fiordelli et al. (2023)[32] highlights the importance of building didactic content using a participatory approach to avoid overlap with the school curriculum and, most importantly, to understand specific gaps. A single didactic curriculum adapted to different secondary school programs should be trialed.

Teachers must update their competency profiles to suit student learning in the 21st century[33]. Teachers in science and technology should receive training in their roles regarding the definition of scientific literacy and methods for its cultivation. Additionally, educators involved in the teaching program should be acquainted with research on enhancing students' scientific literacy levels. Throughout the educational process, it is essential to monitor whether students are effectively acquiring the skills of reading, writing, and correctly using scientific terminology as instructed in the existing science and technology curriculum[34]. To improve teachers' scientific literacy and the quality of primary education in DIY, concrete efforts need to be made to provide relevant

[30] R. Ahmad Zaky El Islami and Prasart Nuangchalerm, "Comparative Study of Scientific Literacy: Indonesian and Thai Pre-Service Science Teachers Report," *International Journal of Evaluation and Research in Education (IJERE)* 9, no. 2 (June 1, 2020): 261–68, https://doi.org/10.11591/ijere.v9i2.20355.

[31] Gizaw and Sota, "Improving Science Process Skills of Students: A Review of Literature."

[32] Maddalena Fiordelli et al., "Strengthening Adolescents' Critical Health Literacy and Scientific Literacy to Tackle Mis- and Dis-Information. A Feasibility Study in Switzerland," *Frontiers in Public Health* 11 (September 1, 2023): 1–9, https://doi.org/10.3389/fpubh.2023.1183838.

[33] Memiş, Et, and Sönmez, "Integration of Technology into Science Teaching: A Phenomenological Study on the Experiences of the Pre-Service Teachers."

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professional training, adequate resources, and a school environment that supports the development of teachers' scientific literacy abilities. This is important in facing the complex challenges faced in primary education today.

The main strategy of the Science Literacy Movement for teachers in elementary schools is to implement cross-curriculum scientific literacy. Scientific literacy and critical thinking are vital components of science education, aiming to prepare students to think and function as responsible citizens in a world increasingly affected by science and technology[35]. Steps that can be taken include consistency and dissemination of the application of scientific literacy throughout schools to support the development of scientific literacy for all students. Although scientific literacy skills are taught explicitly in certain subjects, students are given various opportunities to apply knowledge outside of science subjects in multiple situations[36]. Implementing good scientific literacy in preparation for the ASPD requires a thorough and planned strategy.

CONCLUSION

Elementary school teachers in the Special Region of Yogyakarta have a scientific literacy capacity of 44.3%. Several factors were found to influence elementary school teachers' scientific literacy abilities. Some of these factors include educational background, insufficient funding, professional training, and lack of school policies regarding scientific literacy. Teachers who have scientific literacy skills have generally implemented them in learning. However, some teachers have never experienced scientific literacy training, so they have not implemented it in the classroom.

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DECLARATION OF CONFLICTING INTEREST

At this moment, I declare that the researcher has no potential conflict of interest with this article's research, authorship, and publication.

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