

Identification of the Characteristics of Elementary School Scientific Literacy

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Abstract

This study aims to develop diagnostic science literacy in elementary school students. In the first semester of 2018, 30 students in grade VI made up the sample group. which is an instrument in developing the quality of scientific literacy diagnostic tests developed through the analysis of PISA results. There are three components, namely knowledge, context, and attitude. Multiple choice questions, analysis of data based on the level of a construct's dependability, discrimination, and difficulty validity by validating factor analysis as a feature of the diagnostic test. The conclusion of the study shows that the diagnostic test is a viable solution for assessing scientific literacy because it is based on real data. The sample group was shown to have misconceptions about what, in context, constitutes scientific literacy.

Keywords: diagnosis, scientific literacy, elementary school students

Introduction

In contemporary knowledge-based societies, science is an important component of culture. As a result, the advancement of cognitive science has been given top priority in many countries. Because it is connected to everyone's daily activities and work, including technology, tools, and goods easy for humans to use existence and work, science plays an important role in both the present and future of society. Science develops critical thinking skills, the ability to solve problems methodically and with various data that can be verified as information, as well as the ability to think rationally, creatively, analytically, and critically. According to the UNESCO-declared EFA (Education For All) goals, literacy is a key component of international education today. People with higher literacy rates, in UNESCO's opinion, will solve more problems and promote sustainable development. In addition, the relationship between essential

skills and the complexity of everyday life is necessary given the continuous developments in today's society. One of the eight crucial literacy challenges for pupils is scientific literacy, according to *Learning in the 21st Century: Century Skills*, which is representative of the important figures in digital literacy.

The OECD is an organization of developed countries that have shown an interest in improving the capacity of their population to deal with such circumstances. A study on the success of the member countries' education systems was conducted, and the findings provide insight into whether their education systems are adequate to equip students to prosper in the future (Sari & Lestari, 2019).

The OECD has studied this issue for the past ten years and has created a significant evaluation program called the "Program for International Student Assessment (PISA)" which evaluates how the education system is prepared for students to succeed and participate in society in the future. Along with reading and mathematics, One of the key areas of assessment is scientific literacy. (Agustin, Asrizal, and Festiyed 2021; Bauer and Booth 2019; Listiana, Abdurrahman, and ... 2019; Ni'mah 2019). Along with 65 other participating countries, The PISA program has included Indonesia since 2000. However, a 2009 assessment revealed that Indonesian students aged 15 years had a 47–49 average in scientific literacy, lower than the OECD average and below standard (Ulfah, 2019).

PISA results show that the Indonesian science curriculum does not meet international standards in terms of preparing students for competitions. Therefore, the strategic objective of the second decade of education reform (2009–2018) is to improve the standard of living and education in Indonesia compared to other countries. this accomplishment strives to raise math and science instruction to at least the global average. (Crato 2020; Nugrahanto and Zuchdi 2019; She, Lin, and Huang 2019; Susiani 2022) To laying the groundwork for pupils to succeed competence in higher education, it is necessary to support the improvement of students' scientific literacy starting from the elementary level. Teachers must have a fundamental understanding of the children and diagnose problems in their classes for each student uniquely if they are to develop learners more successfully. Such diagnostics would require evaluating student learning information in relation to the acquisition of desired knowledge and abilities, or student misinterpretations of ideas or information provided by the teacher. Teachers may use this information to enhance their lessons afterward. Therefore, the development of diagnostic skills is very important so that teachers can use them to find students' faults, shortcomings, and areas for growth at both an academic and psychological level (Holiuk et al. 2019). Researchers in this study examined the scientific evaluation employed by PISA and utilized it as a framework to create a diagnostic test for the features of primary school pupils' scientific literacy. Teachers can use information about pupils' features and background scientific literacy from the results of the assessment to plan and create lessons and learning experiences that are in accordance with the abilities and characteristics of their students.

Scientific literacy is a 21st century life skill that improve the quality of human resources and improve the standard of living thus determining the progress of a nation (Akhyar and Suryani 2019). Upgrade strategy science skills need to be carried out on an ongoing basis and involve all school members, families, and all components of society (Epstein 2018). This strategy is necessary formulated together and adapted to the context of needs and conditions diverse socio-cultural communities (Prosperi et al. 2019). making it easy to identify and diagnose science literacy tests for primary schools.

Purpose of the Research

Although this scientific literacy has been found in several previous studies in various countries, this research specializes in identifying the scientific literacy test of students in Indonesia in the context of PISA, especially in North Bali.

Method

The purpose due identification assessment for the growth of scientific literacy characteristics in elementary school students is to develop and test a tool for assessing the scientific literacy characteristics of 6th graders based on three factors following the science assessment framework developed by PISA. (Oktaviani & Ariyani, 2022) , as shown in Table 1.

Researchers studied other materials as a scientific literacy diagnostic test developed for 6th graders to determine queries that adhere to the scientific evaluation body of work issued by PISA (2009). The selection of questions is relatively simple in accordance with Analyzing the caliber of science content for students who have finished the second level (grades 4-6) in accordance with the BE 2551 Basic Education Core Curriculum and science textbooks for grades 4-6, one can learn the fundamentals of diagnostic test design (Fauziah, 2019) . Second, the researcher wants to make this evaluation tool for students so that teachers can quickly use the information and understand the basic qualities of their students' scientific literacy. As a result, the diagnostic test items for each factor are less than what the design principles suggest for the diagnostic test.

Table 1. Aspects of tests to identify scientific literacy

Dimension factor	Definition of factor
Knowledge	<ol style="list-style-type: none"> 1. Scientific understanding: familiarity with the natural world 2. Information relating to science: Information about science
Context	<ol style="list-style-type: none"> 1. Understanding how science and technology affect human health, natural resources, environmental quality, risks and losses, and the range of what science and technology can do;
Attitude	<ol style="list-style-type: none"> 1. Show interest and reactivity in science 2. Encourage scientific knowledge inquiry 3. Show accountability for issues relating to science

The participants of this study were elementary school students in grade 6. A total of 30 students were randomly selected as a group sample. The diagnostic exam for scientific literacy, which has three multiple choice questions, serves as a research tool. Diagnostic exams are mainly created by researchers using the PISA scientific evaluation methodology (Pratiwi, 2019) . There are three components to this: context, attitude, and knowledge. The diagnostic test has a total of 15 items, with 5 questions for each factor.

Results and Discussion

Results regarding the reliability, difficulty, and discrimination of the tools

Cronbach's Alpha coefficient reveals that the components of knowledge, context, and attitudes in the analysis of diagnostic tests of scientific literacy features in elementary school

children are 0.506,614 and 0.325, respectively. The researchers capable to categorize respondents on the spectrum from moderate to very good using relatively easy tests for each aspect. Based on Table 2, the knowledge difficulty index ranged from 0.67 to 0.93 and between 0.40 and 0.47 for the discrimination index. The difficulty of the context factor ranged from 0.70 to 0.93 and the discrimination index ranged from 0.25 to 0.47, and the difficulty of the attitude factor ranged from 0.57 to 0.87 and the discrimination index ranged from 0.27 to 0.60.

Table 2 shows the diagnostic test difficulty index and discriminatory practice for the scientific literacy features determined by the analysis of each question for each factor.

factor	Question	difficulty index	discrimination index
Knowledge	P1	0.67	0.41
	P2	0.77	0.47
	P3	0.93	0.40
	P4	0.65	0.42
	P5	0.77	0.44
Context	k1	0.58	0.25
	22	0.57	0.26
	k3	0.90	0.35
	k4	0.93	0.47
	k5	0.70	0.40
Attitude	s1	0.57	0.27
	s2	0.63	0.60
	s3	0.93	0.47
	s4	0.87	0.35
	s5	0.83	0.28

Results about the validity of the tool construct

The scientific literacy diagnostic test for elementary students has a strong Figure 1 illustrates the construct validity, in accordance with the findings of the verifying factor analysis regarding the construct validity of the instrument.

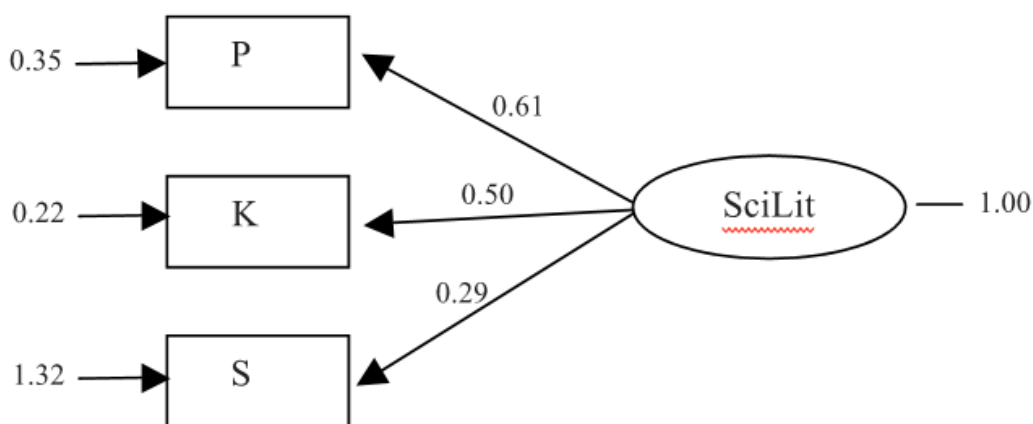


Figure 1. Construct validity of the diagnosis test for scientific literacy

The finding of the sample's features are associated with its level of scientific literacy.

An evaluation of the average level of scientific literacy was moderate to good for each of the 30 traits of sixth graders that were associated to it. Compared to the attitude component, which had the greatest average score and good standards, the context factor, which included the knowledge factor, had the lowest average score and medium standards, as shown in Table 3. Analyzing the results for each element, however, showed that the context factor had a high score. lowest average and medium standard.

Table 3. Students' scientific literacy standards and mean, standard deviation, and arithmetic

Scientific literacy factor	x	SD	standard
Knowledge	2.80	1.03	Currently
Context	2.77	0.68	Currently
Attitude	3.83	1.26	Good
total	3.13	0.90	Currently

Developing and assessing the validity of diagnostic tests for the characteristics of scientific literacy is the aim of this study on the scientific literacy of elementary school children. The exam which includes components of knowledge, context, and attitude of scientific literacy is made in accordance with the scientific evaluation framework provided by PISA (Cansiz and Cansiz 2019; Hastuti 2020; Kembara et al. 2020; Simamora, Widodo, and ... 2020) . There are the diagnostic test had 15 questions in all. The diagnostic test's quality is fairly high in terms of reliability, complexity, discriminating, and construct validity. Evaluations of the sample group's scientific literacy were conducted, and the results showed a generally modest quality. The knowledge and context components got a lower average score than the attitude elements. According to the PISA framework, the teaching and learning of science subjects for primary school students is not sufficiently basics-centred and does not promote scientific literacy, research findings show. This result could be significant given the very low standard of PISA's scientific literacy assessment for Thai students aged 15 at that time. To encourage and promote these goals, utilizing the results of diagnostic tests, teachers and school administrators should work more collaboratively in preparation related to promote scientific literacy in elementary school. Research conducted only by Marakrong namely the scientific literacy model according to the STS method for sixth graders (Songkhwae & Onthanee, 2017) . This means that the methodology for encouraging educational activities for elementary school students in Indonesia to improve their scientific literacy competence is still limited. The majority of scientific literacy development research centers on students in junior secondary education. Another intriguing conclusion from the evaluation of diagnostic tests was that the factored questions provide important information about how teaching and learning tactics employed by scientific teachers might promote positive attitudes in group activities. Over 80% of students say they prefer group activities than solo ones, consider using their scientific knowledge in daily life, and value scientists and their contributions to mankind. However, these results also show that students' misconceptions about these two criteria can be the cause of moderate scientific literacy standards in terms of knowledge and context factors. One context statement, for example, stated that "the classroom is an area of greater stress than the peak area." Despite the fact that the statement was factual, 80% of students who answered disagreed. Over 80% of the sample group either disagreed or were unsure about other statements being true, such as "train tracks must follow the rule that solids expand when heated and contract when cooled" and "it takes the earth one day to rotate on its axis while the moon takes a month to revolve around the earth" (more uncertain than disagree)

Conclusions and recommendations

These findings suggest that teachers should pay more attention to learning and teaching that emphasize concepts that are appropriate for students, build self-confidence, and develop a relationship between teaching and learning and the environmental settings in which students live. To prevent links between student misunderstandings and other connected areas of learning, teachers should pay attention to misunderstandings and implement necessary corrective actions. Therefore, the teacher will be able to clearly see the student's shortcomings thanks to the data from the scientific literacy diagnosis. Students should be diagnosed regularly by the teacher using formative and summative evaluations.

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