

# Profile analysis of data literacy capability based on NGSS junior high school students in Takalar, South Sulawesi

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**Abstract.** This study aims to identify the data literacy ability of junior high school students associated with NGSS learning standards. This study uses a qualitative descriptive study to analyze the results of the test of students' data literacy abilities in several junior high schools. The method used is a test with a sample determined by purposive sampling technique. The subjects of the study sample consisted of 74 junior high school students in class VIII 2019/2020. The research instrument is in the form of 10 essay data literacy questions. The results of the analysis of the ability of data literacy with the highest percentage of 34.93% in the indicators of decision making and the lowest percentage were in the indicators evaluating decisions of 22.83%. For the percentage of the dimensions of the NGSS, it showed a result of 24.31% in the indicators of analyzing and interpreting data and the dimension of cause and effect obtained 34.42%. The results of this study indicate that the ability of literacy based on NGSS grade VIII students in Junior High School Takalar Regency is in the low category. Thus, the data literacy ability of students in learning science needs to be developed.

**Keywords :** *analysis, data literacy, NGSS*

## 1. Introduction

Education is currently facing challenges in preparing students to face life in the future. The era of globalization in the 21st century is marked by the rapid development of science and technology. So that competent contributions and knowledgeable human resources are needed so that they are able to face global competition [1].

The success of education that has been designed by the government is directly related to the learning process created by educators in schools. An educator must continually strive to adapt learning to changing academic standards [2]. Natural science is one of the lessons that must be considered by every educator to use a systematic way that allows students to master knowledge in the form of facts, concepts, principles and discoveries.

The National Research Council Association, the National Science Teachers Association in the United States released the Next Generation Science Standards (NGSS) science framework [3]. NGSS has the aim to create a standard or framework that must be achieved by students in the field of science by involving engineering, technology and application of science so that students are more active in learning Science, Technology, Engineering, and Mathematics (STEM) [4]. Next Generation Science Standards are international education standards integrated by three dimensions that are characteristic of NGSS. Dimensions of science and engineering practices skills, students are expected to not only learn content but understand the method of scientists (inquiry). The understanding dimension of crosscutting concept, which provides interrelationships between scientific disciplines, ideas that underlie the keys that are



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common to a number of topics. Dimension of content a core disciplinary (content), the core idea which consists of specific content and fields of study [5], [6].

The purpose of the NGSS is to improve science education for all students. NGSS lead states (2013) also stated the purpose of NGSS is to create standards or general guidelines for teaching, and develop a greater interest in science among students. Approaches to learning science can help achieve the goals and vision of NGSS [7]. NGSS explained that an effective way of conveying learning is through investigation, collecting and analysing data (collection and analysis of evidence), logic and communicating information (communication of information) [8].

Literacy is the ability to read, write and count that is needed to meet the demands of everyday life [9]. Data literacy is an important capability needed in various disciplines, with a process of how to collect, process, evaluate and apply data used in evidence-based decision making [10]. Data literacy is the ability to obtain (access), assess (assess), manipulate (manipulate), summarize (summarize), present (present) data [11], [12]. Data literacy ability also allows students to be able to manipulate data, identify information and problems based on data, take, evaluate, use data to make decisions and ask and answer questions [13], [14]. Data literacy has advantages when applied in education which is to make students always rely on data in making decisions, make students more active, think processes become critical and innovate in solving problems [11].

Achievement in improving data literacy skills can be supported by a learning process involving three dimensions, namely Science and Engineering Practices (SEPs) NGSS, there is one skill that can help in the learning process, namely Analysing and Interpreting Data which explains that analysing a data in science is done to draw an explanation while for engineering, the results of data analysis that have been collected in the investigation can enable students to find solutions and determine the best solution design [15], involving Crosscutting concepts (CCs) with cause and effect aspects that require students to associate understanding of a relationship causative cause and effect of a matter in the form of mechanisms and explanations, these aspects can support the dimensions of the Disciplinary Core Ideas (DCIs (content)) by choosing one of the right materials namely the interaction of living things with the environment [8]. Based on the above, the study was conducted to determine the analysis of NGSS-based data literacy abilities of junior high school students.

## 2. Research method

This study used descriptive qualitative method. Determination of the subject uses purposive sampling technique where this technique is in accordance with research that gives special emphasis to a variable and the process of sampling from data sources with consideration of several criteria that are considered important [16]. In purposive sampling also referred to as judgment sampling or representative, chosen from the population. The assumption is that the judgment in the election will compensate one another [17]. The test sample consisted of 74 grade VIII students in several junior high schools in Takalar District, South Sulawesi in the academic year 2019/2020. Students are chosen through a random sampling method. The test instrument consisted of 10 essay questions developed with reference to the synthesized data literacy capability, and based on the Next Generation Science Standards (NGSS) dimension in the form of Analysing and Interpreting Data and Cause and Effect.

The form of the essay test was chosen because it is useful for measuring complex achievement indicators including the ability to provide data rather than merely indicating, interpreting, and applying data [18]. Questions are developed by researchers and validated by experts. Students' answers are assessed referring to the rubric with a range of scores set in this study is 0 to 3 for each indicator on each question item. A score of 0 is obtained if the question is not answered, a score of 1 if the answer given is wrong, a score of 2 if the answer given is still an error, and a score of 3 if the answer given is correct and complete [18]. Data literacy indicators that are used based on the results of synthesis consist of 1) discovery and data collection, 2) data conversion, 3) identifying problems using data, 4) decision making based on data, and 5) evaluating decisions based on data [10], [12]-[14]. Scores obtained by each student are converted into percentages and grouped according to category. Calculation of percentage of data literacy capabilities based on NGSS uses the formula:

$$NP = \frac{R}{SM} \times 100\%$$

Where NP = Percent value, R = Number of scores for each indicator, and SM = If all questions were answered with a score of 3 by students[19].

**Table 1.** Percentage of rating categories [20]

Persentase (%)	Category
$81 < X \leq 100$	Very high
$61 < X \leq 80$	High
$41 < X \leq 60$	Average
$21 < X \leq 40$	Low
$0 < X \leq 20$	Very low

### 3. Results and Discussion

This research was conducted to analyze the initial profile of NGSS-based data literacy skills of students in Takalar Regency Middle School in science learning. Data literacy is an effort to use data and information to answer any problems that are concrete and relevant. The ability of data literacy in science learning can be supported by the existence of a framework in K-12 science education that contains knowledge and skills that are expected to be mastered in an integrated way of students namely NGSS [6].

The initial profile of students' data literacy abilities is based on five indicators of achievement. The first indicator is in the form of discovery and data collection which shows how the students step in obtaining data related to the problem they want to know, students use the right tools or techniques to collect data [11], [21]. The second indicator is data conversion which represents the ability of students to process data and change data so that it is easier to understand [10], how students are able to process data in the form of graphs, images, charts, into good information. Third, identifying problems using data, students are trained to solve a problem with data aids and are able to refocus the problem to be solved so that it is not too broad and unclear [21], [14] in other words how students are trained to find out relevant and whether or not the data found to solve the problem. Fourth, decision-making based on data that represents the ability of students to use and analyze data and information to make the right decision [10]. Fifth, evaluating decisions based on data, where students are able to use data to select data, provide explanations, criticize and provide input on a data that is considered inappropriate [21], [13], not only that students must also be able to check the suitability of the results the data selection it does or the people around it.

NGSS-based learning is intended to prepare students to have the skills and knowledge at the end of the secondary school level to enter the tertiary level and career through science learning [22], and to support the achievement of 21st century education vision, namely the various skills needed in the STEM field, namely thinking critically, analyze information and solve problems [5]. So that NGSS can indirectly help improve the data literacy capabilities needed by future generations.

The NGSS-based data literacy ability test given to students includes two dimensions of NGSS namely the science and engineering practices dimension which has 8 skills but is used only to focus on analyzing and interpreting data skills, and the crosscutting concept dimension which has 7 aspects of understanding [23] but used only to focus on understanding cause and effect, the two dimensions were chosen based on conformity with the dimensions of a core disciplinary (content) in the form of material from the 2013 curriculum, namely the interaction of living things with the environment. The K-12 Framework emphasizes the integration of all three dimensions in the NGSS standard [6]. Integrating the NGSS dimension can describe the competencies that must be achieved by students in the learning process [8].

The initial ability of students in data literacy is also measured by the NGSS dimension. The first dimension used is the Analyzing and Interpreting Data skill which shows the ability of students to analyze data to draw an explanation, solution or conclusion [15], [6]. The second dimension is that

students are able to relate understanding related to a causative relationship due to a matter in the form of mechanism and explanation [22]. Indicators of NGSS dimension-based data literacy capabilities are measured using questions in the form of essays. The initial test results of students are presented in table 1.

### 3.1 Data Literacy

**Table 2.** Percentage of student literacy data capabilities.

No.	Indicator	Percentage (%)	Category
1.	Evaluate decisions based on data	22.83	Low
2.	Decision making based on data	34.93	Low
3.	Identify problems using data	28.61	Low
4.	Data conversion	27.25	Low
5.	Data discovery and collection	27.70	Low



**Figure 1.** Percentage diagram of students' literacy data capability.

The test instrument used to measure the students' initial literacy abilities consisted of 10 essay test items. Table 2 shows that there were no students who obtained very high, high, and average data literacy abilities in each achievement indicator. In the first indicator of discovery and data collection, the percentage of students' abilities is 27.70% which is in the low category. Learners show weakness in understanding information in obtaining the required data. This indicator is a basic ability that must be mastered by students in facing the challenges of the 21st century, technological developments have the effect of spreading information very quickly and uncontrollably so that the indicator of finding and collecting data is expected to make students able to select every information according to their needs and know the accuracy of information or data.

The second indicator of data conversion is used to determine the ability of students to process and change data so that it is easier to understand. The analysis showed that the percentage of data conversion capability was 27.25% which was included in the low category, not much different from the indicators of data collection and discovery. The third indicator identifies problems using data whose results show the ability category of low learners with a percentage of abilities of 28.61%. Learners show weakness in information literacy to identify problems based on data to ask and answer meaningful questions [13]. This indicator also makes students more active, the thought process becomes critical and innovation in solving problems [11].

The fourth indicator of decision making based on data shows the percentage of 34.93% which of the five indicators of data literacy, this indicator shows the largest percentage even though it is still in the

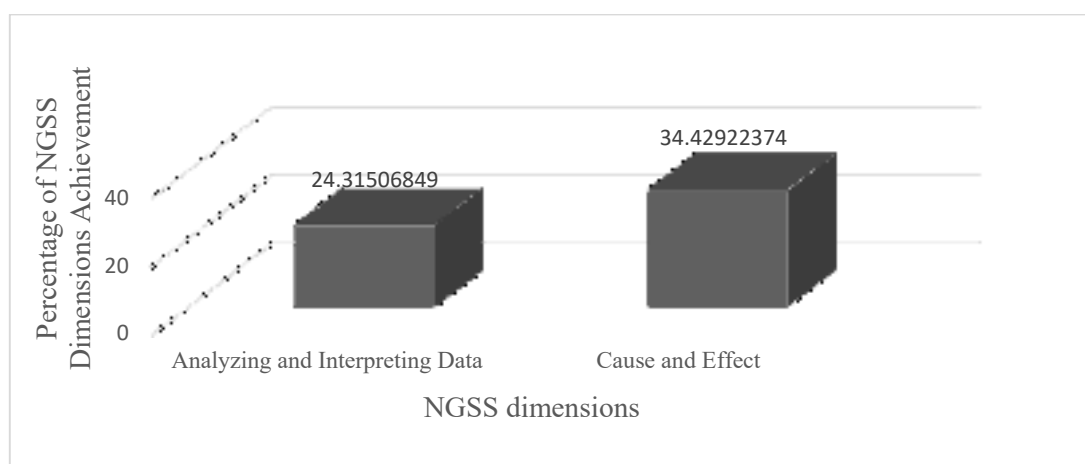
low category. This indicator allows students in the future to identify information [14] and always rely on data in making decisions [11]. The fifth indicator evaluating decisions based on data shows the results of the analysis included in the low category of 22.83%. This indicator shows the lowest results compared to other indicators of data literacy ability. Overall, the results of the analysis of the data literacy ability test show that the ability of VIII grade junior high school students on the material interaction of living things with the environment is still in the low category as seen from the answers of the students in the essay test.

Some students' answers clearly show that students are less able to analyze and understand questions correctly. Most students experience errors in answering questions because the basic concept of the material is still wrong and unable to connect the concept of material to answer a question. Examples of basic concepts that are related to the grouping of biotic and abiotic components, there are still many students who are wrong in the concept of living things and not living so that some questions produce incorrect answers. To be able to minimize the weaknesses of students in analyzing and understanding a question, it is necessary to have a habit in the learning process by directing students to always be able to think in a high level domain, one of which is the ability of data literacy that can be applied in class to be able to familiarize students in solving a problem using data with further analysis process. Requirements must be owned by students in improving data literacy capabilities, namely 1) knowing when the data is needed, 2) understanding the appropriate data sources, 3) critically selecting data, data sources and the impact of data, 4) making decisions and problem-solving skills [13]. This is still not understood by students so that in the process of answering questions and existing problems, students tend to answer incorrectly.

### 3.2. Next Generation Science Standards

**Table 3.** Percentage of achievement of student NGSS dimensions.

No.	Indicator	Percentage (%)	Category
1.	Analyzing and Interpreting Data	24.31	Low
2.	Cause and Effect	34.42	Low



**Figure 2.** Diagram of percentage of achievement of NGSS dimensions

Table 3 results of the analysis of NGSS-based data literacy abilities were also analyzed based on students' answers in the essay test which showed that data on the dimension of analyzing and interpreting the data obtained a percentage of skills of 21.31% which were in the low category. Indirectly this dimension also supports data literacy capabilities so that the results obtained are in line with the percentage of data literacy capabilities that are in the low category. The dimensions of science and engineering practices are intended to train students in conducting activities in accordance with scientists

in the form of investigation and design activities [6]. One aspect of the skills that students want to know about is analyzing and interpreting data. Learners show difficulties in the process of understanding the data provided so as to achieve the stages of analyzing data and information and interpreting data students are in the stage of being less able.

The cause and effect dimension shows the results which are not much different from other dimensions which are in the low category with a percentage of 34.42%. The dimension of Crosscutting concepts facilitates the interconnection and relationship of various disciplinary content so as to produce students' understanding that is complete and coherent [6]. In this dimension, students seem less able to explain a phenomenon based on existing cause and effect relationships and relate it to the material, so students have difficulty in answering questions.

Based on the results of the percentage of NGSS-based literacy ability tests that have been given shows that the ability of VIII grade junior high school students in Takalar Regency on the material interaction of living things with the environment is in the low category seen based on the ability of students in answering essay questions. This illustrates that the data literacy ability of students is still less developed by educators in schools. There are various possibilities behind the low ability of students' data literacy. The first possibility is that educators do not develop data literacy skills, even though data literacy skills are very much needed in learning and also the era of globalization which results in students lacking mastery of data literacy abilities. Another possibility is that educators have trained students' data literacy skills, but lacked orientation to different patterns as a basis for ability development. One of them is a monotonous learning process without following the evolving learning standards, such as the application of NGSS in learning that can support a variety of skills, and students' understanding by combining these three dimensions that can be an alternative in responding to challenges in the globalization era.

This can be a benchmark for researchers and educators to further study learning that can improve the ability of data literacy with the help of NGSS so that it can support students in facing global challenges. Research conducted by Macmillan explains that developing student data literacy competencies provides the benefits of student involvement and the alignment of abilities needed for the future [24]. The ability of data literacy can be through approaches to diverse and creative learning environments, educators must provide learners a conducive learning environment. The use of formal and informal teaching methods in learning, by developing skills outside the classroom. Some of these teaching approaches can improve students' understanding and ability to use data [10].

#### 4. Conclusion

The results of the research that have been carried out show that the literacy ability of students in Takalar Regency junior high school is in the low category in each achievement indicator. Students lack data literacy capability which is a new capability needed in the 21st century. This is also shown from the results of data processing performance expectation NGSS which both dimensions show less categories. Educators are expected to design a learning activity that relates to the needs of students in the 21st century including NGSS-based learning.

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The results of the research that have been carried out show that the data literacy ability of students in a number of Takalar Regency Junior High Schools is in the low category for each achievement indicator. Students lack data literacy ability which is a new capability needed in the 21st century. This is also shown from the results of data processing in NGSS performance expectation, both dimensions show a low category. Educators are expected to design a learning activity that relates the needs of students in the 21st century including NGSS-based learning.



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