



# Descriptions of Scientific Literacy Skills of 9<sup>th</sup> Grade at Secondary School Students on Human Excretory System

Siti Darmi Amir<sup>1</sup>, Sitti Rahma Yunus<sup>\*2</sup>, Hasanuddin<sup>3</sup>, Ramlawati<sup>4</sup>, Sitti Saenab<sup>5</sup>

Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Indonesia

This study is a quantitative descriptive survey research that aims to describe the level of scientific literacy skills of ninth-grade of secondary school students' in Angkona sub-district accredited A and B for 2021/2022 academic year in terms of context, knowledge, and scientific competence on human excretory system topics. Population of this study were all ninth grade of secondary school students accredited A and B throughout in Angkona sub-district with 252 students, namely SMPN A which was accredited A; and SMPN B, C, and D were accredited B. Samples were selected using saturated sample technique so that the samples in this research were 252 students. The instrument of this research was 20 multiple choice questions on human excretory system topics. The data collection technique was by giving tests directly at school and/or giving online test for students who did not come to school via Google Form and/or WhatsApp. The data were analyzed using analysis of quantitative descriptive. The results obtained are the scientific literacy skills of ninth-grade of secondary school students in Angkona sub-district: (1) in the context of science is in "medium", (2) knowledge of science is in the "medium", and (3) competence of science is in the "low" category.

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\*Correspondence

Sitti Rahma Yunus

sitti.rahma.yunus@unm.ac.id

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Penelitian ini adalah penelitian survei bersifat deskriptif kuantitatif yang bertujuan untuk mendeskripsikan tingkat kemampuan literasi sains peserta didik kelas IX SMPN se-Kecamatan Angkona yang terakreditasi A dan B tahun pelajaran 2021/2022 pada aspek konteks, pengetahuan, dan kompetensi sains pada materi pokok sistem ekskresi manusia. Populasi pada penelitian ini terdiri dari seluruh peserta didik kelas IX SMPN terakreditasi A dan B se-Kecamatan Angkona yang berjumlah 252 orang, yaitu SMPN A yang terakreditasi A, serta SMPN B, C, dan D yang terakreditasi B. Sampel dipilih dengan teknik sampel jenuh sehingga sampel yang digunakan dalam penelitian ini terdiri dari 252 peserta didik. Instrumen penelitian yang digunakan berupa 20 butir soal pilihan ganda pada materi pokok sistem ekskresi manusia. Teknik pengumpulan data yaitu dengan pemberian tes secara langsung di sekolah serta pemberian tes secara daring bagi peserta didik yang tidak datang ke sekolah menggunakan *Google Form* dan/atau *WhatsApp*. Data penelitian kemudian dianalisis menggunakan analisis deskriptif kuantitatif. Hasil penelitian yang diperoleh adalah kemampuan literasi sains peserta didik kelas IX SMPN se-Kecamatan Angkona: (1) pada aspek konteks sains berada dalam kategori "sedang", (2) pada aspek pengetahuan sains

berada dalam kategori “sedang”, dan (3) pada aspek kompetensi sains berada dalam kategori “rendah”

**Kata Kunci: Literasi Sains; Aspek Konteks; Pengetahuan; Kompetensi Sains**

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## INTRODUCTION

(Mudyahardjo, 2016) defines education broadly, namely all learning experiences that take place in all environments and throughout life that can influence individual growth. Whereas in a narrow sense, education is taught in schools as formal education. Education in Indonesia still has limitations related to the quality of education. The Ministry of Education and Culture presents a graph of the average 2019 National Examination (UN) results through the website. The average of the National Examination for secondary school was 52 points of 100 points (Kemdikbud, 2019). Especially for science subject was 48 points, in the “less” category because the average (Pendidikan, 2020). The results of the National Examination for Science subjects interpret the abilities of students at secondary school throughout Indonesia.

The science skills of students are also measured globally known as scientific literacy through the PISA (Program for International Student Assessment) test conducted by the OECD (Organization for Economic Co-operation and Development). This is clarified by (Puspendik Kemendikbud, 2019), which states that the National Examination is a process of evaluating student learning outcomes nationally. Meanwhile, PISA complements various existing national and international systems and assessments. Drawing on the findings of the PISA 2018 study released by the OECD for Indonesia, the scientific literacy proficiencies of students achieved an average of 389 of 489 scores of the OECD average score (Kemendikbud, 2019).

PISA is an international survey that assesses students aged 15 years and is carried out every three years (Eiverset al., 2008) PISA is a continual initiative aimed at tracking patterns in the level of expertise and capabilities that learners worldwide have. There are three domains assessed in the PISA that emphasize functional knowledge and skills that enable an individual to fully take part in community. The three domains are reading, scientific, and mathematical literacy. Scientific literacy is one's abilities to be involved in science-related problems. PISA scientific literacy is determined by three competencies, namely: (1) explaining phenomena scientifically, (2) evaluating and designing scientific inquiry, and (3) interpreting data and evidence scientifically (OECD, 2019).

Multiple studies conducted on scientific literacy had yielded inadequate outcomes. According to the findings of the study conducted by (Nofiana, 2017), the scientific literacy profile of pupils in Purwokerto was observed to be comparatively low. The three aspects measured were content, process, and context aspects with a successive percentage of 53.80%; 44.038%; 35.088%. The present study aligns with the research carried out by (Purwani et al., 2018), which indicated a deficiency in the scientific literacy of pupils on the dimensions of competence and science attitudes were low. These are caused by several factors, including: students are not used to and do not understand the problem, as well as a lack of interest in reading.

In the field of science, the minimum level of competence is the skill level which states that students can demonstrate

knowledge of the content and basic science procedures to interpret data, identify questions posed in a simple experiment, or identify whether a conclusion is valid according to available data (Puspendik Kemdikbud, 2019). The most importance in the development of students' scientific literacy skills are scientific knowledge, scientific processes, the development of attitudes towards science, and the students understanding of science. This allows students to not only know about scientific concepts, but also apply their scientific skills. Ability to solve various problems and make decisions based on scientific evidence (Harlen, 2004 as cited in (Yuyu, 2017).

(Nofiana, 2017) pointed out the need for efforts to improve science learning in schools. Endeavors to regenerate learning quality in schools need to be supported by accurate information on students' achievement of scientific literacy, especially secondary school students who are 9 years of compulsory school age. In line with the insignificant PISA results, (Pratiwi, 2019) Pexpressed his opinion that Indonesia needs to reform the curriculum to meet market demands by the PISA assessment.

A proficient level of scientific literacy holds significant importance for all Indonesian students, owing to scientific literacy plays a role in determining a nation's progress. The evaluation of global scientific literacy reveals a significantly deficient positioning for Indonesia, indicative of the current Indonesian education system works. The reading ability of students is still very low. Reading culture is related to the willingness to “force themselves” to buy books and the willingness to take the time to read is still low. Whereas students' scientific literacy will not grow if every student does not have the ability and awareness to read (Nofiana, 2017).

One of the teachers' tasks in the learning process is to provide student learning experiences that contain scientific literacy, so students' learning outcomes about scientific information can be applied in real life. But, in learning, teachers lack about the application of scientific literacy, such as in the learning process of excretory system material, learning evaluations that contain scientific literacy have been not applied, so that students' scientific literacy skills are not yet visible in learning outcomes, especially in excretory system learning (Ratnasari & Sumini, 2019) By knowing students' profile on excretory system will make teachers to find out the best strategy to improve students' ability in scientific literacy. The topic used in this research was the human excretory system. The topic was chosen because it was abstract and closely related to everyday life (relevant to real life) and material that was in the context of science in the health and disease group.

Research related to scientific literacy in excretory system material has been carried out by (Nisa, 2016) As a result, the project based learning learning model can improve students' scientific literacy with an N-gain value of 56.4 which is in the medium category. Problem-based research was also carried out by (Subaidah et al., 2019) to measure aspects of the context and knowledge of students' scientific literacy. The result is that students' scientific literacy abilities in the context aspect are 58% and are in the less category, while in the knowledge aspect 71% are in the sufficient category.

Previous research discussed the influence of problem-based learning models in improving scientific literacy skills. In contrast to this study, which only measured the level of students' scientific literacy skills along with their descriptions that teachers could use as a reference in developing learning strategies in class.

**METHODOLOGY**

**a. Type of the Research**

The type of research used was a survey research method. This research was directed to determine the scientific literacy ability of students in human excretory system material.

**b. Time and Place of the Research**

This research was conducted in the Odd Semester of the 2021/2022 Academic Year at four secondary schools (SMPN) accredited A and B in the Angkona sub-district.

**c. Research subject**

The population in this research were all students of the ninth grade of a secondary school accredited A and B throughout in Angkona sub-district for the 2021/2022 academic year as many as 252 students spread over ten classes in four schools. Sampling was carried out using a saturated sample technique, where all members of the population were selected as sample members. So, the number of samples used in this study was 252 students. Students' scientific literacy skills are the value gained by pupils after taking test of scientific literacy skills.

**d. Data Collection and Research Instruments**

Data collection techniques in this study were carried out through thorough tests. The tests used 20 scientific literacy questions adapted from PISA questions that have previously been tested for validity. The grid of scientific literacy question indicators can be shown at Table 1.

[\[Table 1 about here.\]](#)

Each item had 4 answer choices. The correct answer was 1, the wrong answer or not filled in/blank was 0. The tests were given directly at school and given online via WhatsApp and Google Form for students who didn't present/come to school. To calculate the scientific literacy skills value of students, the following formula can be used:

$$NP = \frac{R}{SM} \times 100 \dots\dots\dots(1)$$

Information:

- NP = Value of scientific literacy skills
- R = Number of questions answered correctly
- SM = Maximum score of the test

The interpretation of students' scientific literacy achievement scores is interpreted descriptively based on categories according to (Ridho et al., 2018) in Table 2.

[\[Table 2 about here.\]](#)

**RESULT AND DISCUSSION**

The results of the descriptive analysis provide a general description of ninth-grade secondary students' literacy skills in the Angkona sub-district. Students' values are based on descriptive analysis which are maximum value, minimum value, average value, standard deviation, and variance can be seen in Table 3.

[\[Table 3 about here.\]](#)

Through the results of the scientific literacy test, information is obtained about the students' scientific literacy skills which can be seen in Table 4.

[\[Table 4 about here.\]](#)

Table 4 shows the average value of students' scientific literacy skills. In context, personal and local/national indicators are in the medium category, and global indicator is in the high category. Science context average value is 54.10 in the medium category. In the aspect of knowledge: content, procedural, and epistemic indicators are in the medium category. Science knowledge average values is 53.29 in the medium category. In the aspect of competence: explaining phenomena scientifically indicator is in a low category, interpreting data & evidence scientifically indicator is in the medium category. The average value of science competence is 33.48 in a low category. The average value of scientific literacy of students in content, context, and scientific competence aspects are shown in the form of a bar chart as Figure 1.

[\[Figure 1 about here.\]](#)

Based on Table 4, the average value of students' scientific literacy in the aspect of the science context indicators can be visualize in the form of a bar chart as Figure 2.

[\[Figure 2 about here.\]](#)

Students' scientific literacy average value in the scientific knowledge aspect indicators can be shown in the form of a bar chart as Figure 3.

[\[Figure 3 about here.\]](#)

The average value of scientific literacy of students in scientific competence aspect indicators can be presented in the form of a bar chart as Figure 4.

[\[Figure 4 about here.\]](#)

Obtaining data of research related to skills of scientific literacy in the context, knowledge, and competence of science aspects were gained by counting the average score of test results achievement per indicator in each aspect of scientific literacy. This average score was obtained by comparing the number of

students who answered the questions correctly with the total number of students who worked on the questions, then looking for the average value of the achievement of skills of scientific literacy on aspects of context, content, and competence of science. The average value of the achievement of scientific literacy skills in the aspect of scientific competence indicators are shown in Table 4.

#### ***Descriptions of Scientific Literacy Skills in Context Aspect***

Based on Table 4, information is obtained that the aspects of the science context on the personal context indicators are spread out at numbers 16, 17, and 19. The average student scores on numbers 16, 17, and 19 respectively are 30.16; 63.49; and 73.02. The average value of students at number 16 is 30.16 and is included in the "low" category. This is because students have difficulty connecting the context of science with everyday life. This results of research is in line with Utami (Subaidah et al., 2019) which states that the low scientific literacy of students is caused by the ability of students who are only limited to remember and recognize scientific knowledge, without relating scientific topics to everyday life. The scientific context aspect of the personal context indicator at numbers 17 and 19 shows an average value of 63.49 and 73.02 and is included in the "high" category because it is in the 61-80 value interval. In general, the personal context indicator is in the "medium" category with an average value of 55.56.

Aspects of the context of science in local/national context indicators are spread out at numbers 14 and 20. The average score of students at number 14 is only 28.97 and is in the "low" category. While students' average value at number 20 is 62.23 and is in the "high" category. In general, students' average achievement on the indicators of the local/national aspect falls into the "medium" category with a value of 45.64. The scientific context aspect of the global indicator is at number 8. The average value of students at number 8 is 61.11 and is included in the "high" category.

In general, students' scientific literacy skills in aspects of the science context which include indicators of personal, local/national, and global contexts are in "medium" category. The average score is 54.10. This means that students still need to improve their ability to apply theory in everyday life (Subaidah et al., 2019). This is in line with (Irwandi, 2018) who states that students' low scientific literacy skills result in them having difficulty connecting the concepts they acquire to the subject matter by applying them in everyday life to solving the problems they face.

#### ***Descriptions of Scientific Literacy Skills in Knowledge Aspect***

Based on Table 4, information is obtained that aspects of scientific knowledge on content knowledge indicators are spread at numbers 4, 7, and 12. The average value of students in numbers 4, 7, and 12 respectively is 55.95; 30.56; and 40.87. The average value of students at number 4 is 55.95 and is in the "medium" category. While the students' average score in numbers 7 and 12 is in the "low" category since it is in the 21-40 interval. In general, students' scientific literacy skills on content knowledge indicators fall into the "medium" category with an average value of 42.46. (Nofiana & Julianto, 2017) state that the students' low abilities in aspects of science

content are caused by the low proficiency of students' science concepts. This is due to the request for the completion of teaching materials by teachers based on the curriculum target, forcing pupils to acknowledge science concepts which will not be completely caught on. This makes numerous science concepts understood incorrectly (misinterpretations) or just memorized which in the end the concept is difficult to recall.

Scientific knowledge on epistemic knowledge indicators is spread at numbers 5, 9, and 15. The average value of students is at numbers 5, 9, and 15, respectively, namely: 45.63; 71.83; and 63.89. The average value of students at number 5 is 45.63 and is in the "medium" category. While the students' average value in numbers 9 and 15 is included in the "high" category because it is in the 61-80 interval. In general, the average score of students is 60.45 on the epistemic knowledge indicator and is in the "medium" category.

Scientific knowledge aspect on procedural knowledge indicators are spread at numbers 3 and 18. The average value of students at number 3 is 50.00. While the average value at number 18 is 63.89. The average value of students at number 3 of 50.00 is in the "medium" category. While students' average value at number 18 is 63.89 and is in the "high" category. In general, students' average score is 56.95 on the procedural knowledge indicator and is included in the "medium" category.

Generally, scientific literacy skills of students in science knowledge aspect are in the "medium" category. The average score is 53.29. This means that students have not fully understood the indicators contained in aspects of scientific knowledge. One of the reasons is that students are not familiar with scientific literacy questions. In addition, another cause is that pupils are not accustomed to working on problems that using the lecture method (Permatasari & Fitriza, 2019). In line with (Saraswati et al., 2021) teachers need to familiarize and develop students' abilities both in the context of competence, cognitive, knowledge, and scientific literacy by providing access to learning resources from various sources, one of which is looking for information on the internet. This is in line with (Adnan et al., 2021) suggested that teachers used to use constructivist learning methods, such as the inquiry method which is equipped with innovative media and learning resources to improve students' scientific literacy skills.

#### ***Description of Scientific Literacy Skills in Competence Aspect***

Based on Table 4, information is obtained that the aspect of scientific competence in the indicators explaining phenomena scientifically is spread out at numbers 6 and 13. The average value of students at number 6 is only 23.41 while at number 13 it is 25.00. The average value of students on questions number 6 and 13 is in the "low" category because it is in the 21-40 interval. This figures out that pupils still do not know the topic related to the excretory system completely and thoroughly. In addition, students have not been able to apply their scientific knowledge and deduce based on the prove carried out on nature through human activities (Yalvema, 2017).

Aspects of scientific competence on indicators of interpreting data and evidence scientifically are spread at numbers 1, 2, 10, and 11. The average value of students who answered correctly was at numbers 1, 2, 10, and 11,





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**TABLE 1** / Grid of Scientific Literacy Question Indicators

<b>No.</b>	<b>Scientific Literacy Aspects</b>	<b>Scientific Literacy Indicators</b>	<b>Question Number</b>	<b>Number of Questions</b>
1.	Context	Personal	16, 17, 19	3
		Local/National	14, 20	2
		Global	8	1
2.	Knowledge	Content	4, 7, 12	3
		Procedural	3, 18	2
		Epistemic	5, 9, 15,	3
3.	Competence	Explaining phenomena scientifically	6, 13	2
		Interpreting data and evidence scientifically	1, 2, 10, 11	4



**TABLE 2 /** Interpretation Criteria for Students' Science Literacy Values

<b>Value</b>	<b>Criteria</b>
81 – 100	Very high
61 – 80	High
41 – 60	Medium
21 – 40	Low
0 – 20	Very low

**TABLE 3 /** Statistic of Scientific Literacy Skills of Secondary School Students in Angkona

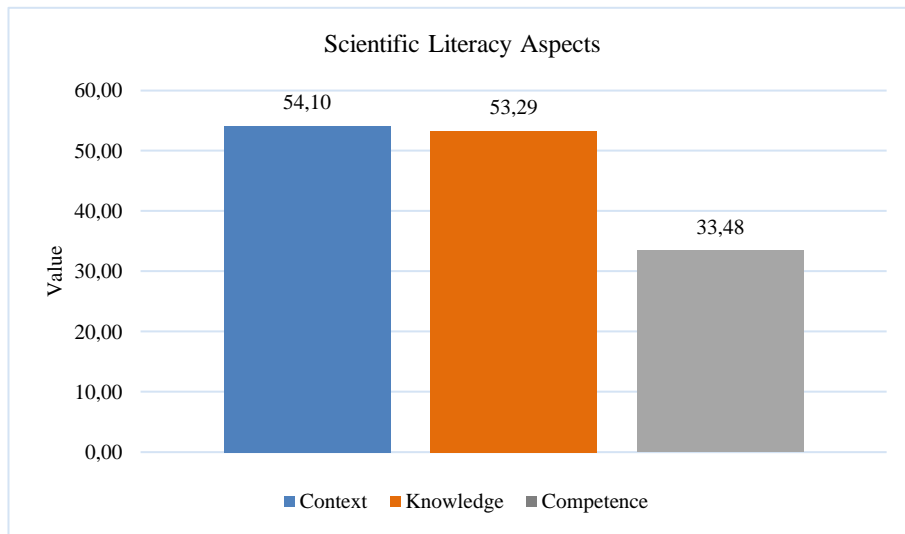
<b>Descriptive Statistics</b>	<b>Scientific Literacy Skills</b>
Number of Samples	252
Maximum Ideal Value	100
Minimum Ideal Value	0
Maximum Value	85
Minimum Value	10
Average Value	48.056
Standard Deviation	16.68
Variance	279.27

**TABLE 4 /** Results of Grouping Ninth Grade Students' Values in Scientific Literacy Skills

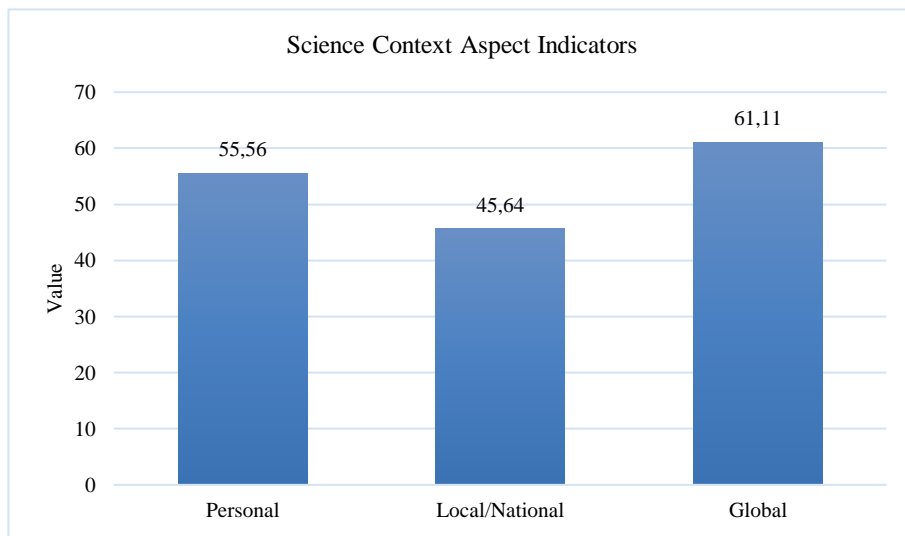
Scientific Literacy Aspects	Scientific Literacy Indicator	Question Number	Cognitive Level	Value	Average	Category
Context	Personal	16	C2	30.16	55.56	Medium
		17	C2	63.49		
		19	C3	73.02		
	Local/National	14	C2	28.97	45.64	Medium
		20	C2	62.30		
Global	8	C3	61.11	61.11	High	
Knowledge	Content	4	C2	55.95	42.46	Medium
		7	C2	30.56		
		12	C1	40.87		
	Procedural	3	C2	50.00	56.95	Medium
		18	C3	63.89		
		5	C2	45.63		
Epistemic	9	C1	71.83	60.45	Medium	
	15	C2	63.89			
Competence	Explaining Phenomena Scientifically	6	C2	23.41	24.21	Low
		13	C4	25.00		
	Interpreting Data & Evidence Scientifically	1	C2	33.33	42.76	Medium
		2	C2	32.14		
		10	C2	43.25		
		11	C2	62.30		

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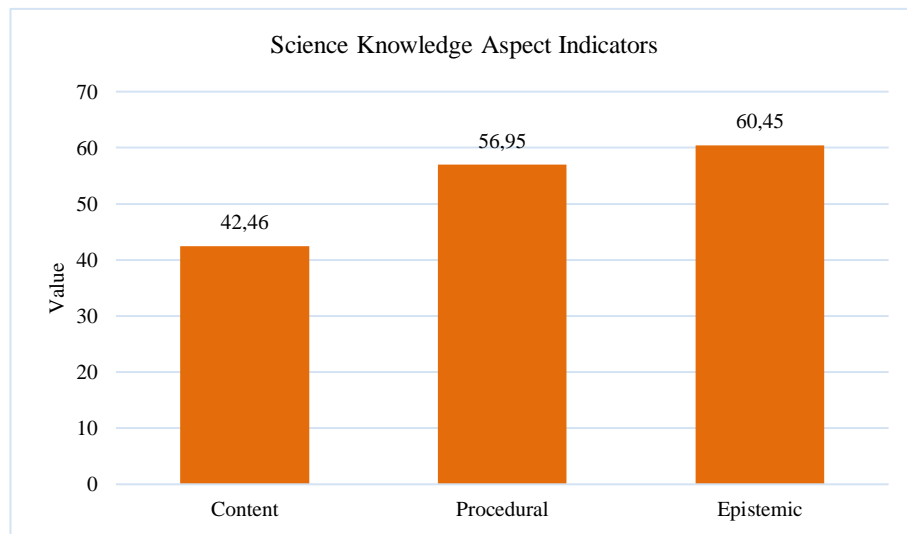


**FIGURE 1** / Students' Average Scientific Literacy Value on the Aspects of Context, Knowledge, and Science Competence

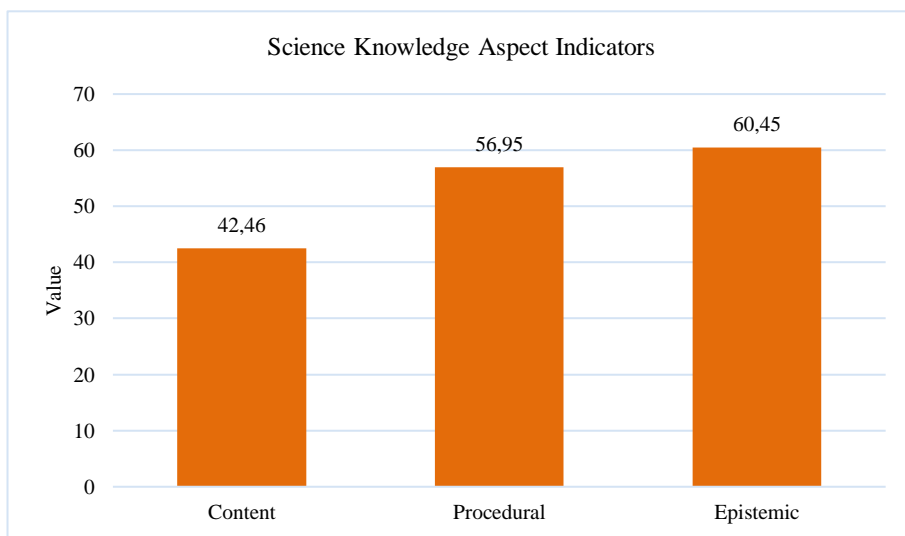


**FIGURE 2 /** Students' Average Scientific Literacy Value on Personal, Local/National, and Global Indicators





**FIGURE 3** / Students' Average Scientific Literacy Value on Content, Procedural, and Epistemic Knowledge Indicators



**FIGURE 4** / Students' Average Scientific Literacy Value on Indicators Explaining Phenomena Scientifically and Interpreting Data & Evidence Scientifically