A Profile of Scientific Literacy of Senior High School Students on Physics Learning

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Abstract. In physics learning, students need to know the extent to which scientific concepts have been studied. Scientific literacy is the ability to make decisions based on scientific considerations, solve problems and apply the knowledge gained in everyday life. This study aims to scientifically analyse the scientific literacy ability of senior high school students on the kinetic theory of gases. The sample of this research is 90 high school students. Data analysis used descriptive qualitative. The results study show that high school students’ ability was very low, many students did not have scientific literacy ability on physics learning. The implications of this study can be used as empirical evidence that the scientific literacy of senior high school students on physics learning still needs to be improved.

1. Introduction
In the 21st century education is more based on learning by learning to think logically and rationally oriented to knowledge, learning to behave oriented to how to solve problems [1]. In the 21st century students are required to have scientific literacy ability (SLA) [2]. The SLA achievement of high school students can be seen from the results of an international survey, namely PISA. According to PISA, SLA is divided into four aspects, namely knowledge, context, attitudes, and indicators. PISA results show that Indonesian students' SLA are low, including using scientific facts, identifying scientific problems, and understanding life. Attitudes are aspects of SL that support to analyze how students are interested in science, support science and students' motivation to be responsible for natural resources and the surrounding environment. The results of PISA 2018 showed that Indonesian high school students have low level of SLA. Indonesia's average SLA score is ranked 75th out of 80 participating countries. Indonesia's score is below the international average value [3] in science subjects from 2000 to 2018. This means that the SLA of students in Indonesia is still low [4].

SLA are very important to face development and changing times. SLA does not only train students to read, but students must learn to understand the content of to explore current scientific issues, and students must be active in the learning process. SL is an obligation for every individual. Research on students' SLA on an international scale is organized by the Organization for Economic Co-Operation and Development (OECD) through PISA. SLA are used to identify questions, use scientific knowledge, make decisions about nature through human activities by drawing conclusions based on the available evidence [5]. SLA is a person's ability to use and apply scientific concepts in everyday life, describe and explain scientific phenomena based on data and scientific evidence [6]. Literacy is related to the competence to think and process information. So, it's not just reading or spelling skills.
Someone with a high level of literacy has the ability to reason and solve problems in various fields, including science, numeracy, and finance. To find out the extent of students' literacy of the science concepts that have been studied, it is very important to measure SLA [7]. Therefore, as individuals and as social beings, they must master SLA to solve problems in the world and interact in the environment and society [8]. Students can easily solve real today and in the future and meet the needs of life through understanding positive attitudes towards science and SLA [9]. Aspects of SLA indicators are aspects that students achieve to have SLA. Aspects of SLA consist of several indicators that become a benchmark for students to have SLA. There are three indicators must be considered in physics literacy according to PISA [3]. These indicators include being able to: (1) explain scientific phenomena means being able to explain scientific phenomena, which means students can recognize, identify and predict and explain phenomena scientifically and their uses (2) evaluating and designing scientific investigations means being able to evaluate and design scientific investigations, which means students are able to explain and interpret scientific investigations and propose ways to deal with scientific questions (3) interpret scientific data and evidence means being able to interpret scientific data and evidence, which means students are able to analyze, transform and evaluate scientific data, claim in various presentations of scientific phenomena to draw conclusions.

In learning physics, students need to develop SLA. If students have high SLA, then these students can master the concept of the material. Thus, physics learning must be carried out optimally. One of the materials in physics that is considered difficult by students is the kinetic theory of gases. The basic competence 3.6 explains the kinetic theory of gases and their characteristics in a closed space and 4.6 presents works related to the kinetic theory of gases and their physical meaning. These competences require students to have SLA. SLA is useful to be applied in real situations and problems related to science. The things that are central to students' SLA are knowledge of science, scientific students' understanding, scientific processes, and the development of scientific attitudes towards science, so that students are expected to make decisions based on scientific considerations and apply science skills in solving problems in life. In addition, students are expected to be able to apply the knowledge gained in everyday life. So that students can understand the meaning of the subject matter they are studying.

In order to analyze of SLA for senior high school students, so there is a need for research that focuses on looking at the profile of scientific literacy of senior high school students', especially in the kinetic theory of gases. The next study is needed as an alternative solution of SLA that is very low category. It is hoped that the research results can be empirical evidence of SLA in the development of physics learning research.

2. Method
2.1. Background
The purpose of this research is to analyze the profile of SLA of senior high school students on physics learning. This research is pre-experimental research.

2.2. Sample
The subjects in this study were senior high school students consisting of 90 students of class XI high school, this study using purposive sampling in determining sample.

2.3. Procedure
The procedure of this research consists of: (1) researchers conduct a literature study related to SLA (2) researchers focused on finding assessments and indicators of SLA (3) the researcher developed a SLA test instrument to determine the profile of the SLA of senior high school students on gas kinetic theory material (4) the researcher conducted a limited trial (5) the researcher revised the test results (6) the researcher used a SLA test instrument to measure 90 students in determining the profile of senior high school students' SLA on the kinetic theory of gases (7) researchers conduct conclusions and analysis based on the results of the test instruments.
2.4. Instruments of Research
This study uses a SLA test instrument to determine the SLA profile of senior high school students on physics learning which consists of three indicators: explain scientific phenomena, evaluate and design scientific investigations, interpret data and scientific evidence. This instrument has been declared reliable based on the Cronbach’s alpha reliability test using SPSS. Validation results of scientific literacy instrument in Table 1.

| Components               | The validity of Scientific Literacy Ability Instruments | Content Validity |
|--------------------------|--------------------------------------------------------|-----------------|
|                          | Construct Validity | Reliability  | V    | α    | Reliability |
| Scientific Literacy Ability | ICC = 0.17 Valid | 0.67 Reliable | 0.17 Valid | 0.67 Reliable |

Conclusion: The scientific literacy instrument that has been developed is valid. It can take as an instrument to measure determine scientific literacy ability of students on physics learning.

Note = ICC: Interclass Correlation Coefficient, α: Cronbach’s Alpha, V: Validity, R: Reliability

The test instruments of scientific literacy ability to determine a profile of scientific literacy of senior high school students on physics learning by statistic analyse with Cronbach’s alpha. This instrument valid (ICC = 0.17) and Reliable (α = 0.67).

2.5. Data Analysis
A profile of SLA of senior high school students on physics learning was analysed using qualitative descriptive. To determine the scientific literacy ability measured by the average percentage score on each indicator according to the criteria of 86-100 very good, 76-85 good, 60–75 enough, 55-59 low and ≤ 54 very low [10]. The results of the analysis of this study are used to obtain an initial preliminary data on the SLA of high school on the kinetic theory of gases so that it can be used as evidence in the development of research in the field of education. Then next, we will use the profile as a recommendation in learning science, especially physics.

3. Result and Discussion
A pre-test on 90 high school students shows that the kinetic theory of gases test instruments is valid and reliable. The results obtained from the SLA of senior high school students on the kinetic theory of gases are presented in Table 2.

Based on Table 2, it can be seen that students' SLA on the kinetic theory of gases are included in the very low category in all classes. A total of 90 students did not have a score above 54. It can be seen that all students have not achieved completeness on the indicators of SLA in the kinetic theory of gases. The results of the average pre-test score show that students' SLA in the aspects of knowledge and competence in the three classes are in the very low category. The SLA test instrument consists of three indicators: explain scientific phenomena, evaluating and designing scientific investigations, interpret scientific data and evidence. All indicators are still in the low category which can be seen in the percentage shown in Figure 1.

Based on Figure 1 it can be seen that the percentage of students' SLA is still very low on each indicator. In class 1 indicator 1 of 56.51% and indicator 2 of 54.23% in low category, indicator 3 of 26.44% in very low category. In class 2 indicator 1 of 71.95% and indicator 2 of 62.74% in low category, indicator 3 of 53.64% in very low category. In class 3 indicators 1 of 73.69%, indicator 2 of 59.54% in low category, indicator 3 of 51.14% in very low category. The average percentage of SLA on indicators explaining scientific phenomena is 45.73%, on indicators evaluating and designing scientific investigations is 62.77%, on indicators of interpret scientific data and evidence is 61.46%. These results indicate that the profile SLA of senior high school students on gas kinetic theory is low. SLA in this case students only have scientific knowledge to explain the context or make conclusions...
based on simple investigations. However, students are less able to explain scientific components in various complex life situations and evaluate scientific evidence that is correct to respond to situations.

### Table 2. Scientific literacy ability of students on the kinetic theory of gases

| Student | Initial | Class 1 | Class 2 | Class 3 |
|---------|---------|---------|---------|---------|
|         | Score   | Category| Score   | Category| Score   | Category|
| U1      | 15      | VL      | 22      | VL      | 40      | VL      |
| U2      | 33      | VL      | 30      | VL      | 27      | VL      |
| U3      | 22      | VL      | 28      | VL      | 34      | VL      |
| U4      | 23      | VL      | 29      | VL      | 30      | VL      |
| U5      | 13      | VL      | 28      | VL      | 40      | VL      |
| U6      | 20      | VL      | 37      | VL      | 48      | VL      |
| U7      | 15      | VL      | 37      | VL      | 30      | VL      |
| U8      | 15      | VL      | 44      | VL      | 50      | VL      |
| U9      | 27      | VL      | 32      | VL      | 20      | VL      |
| U10     | 10      | VL      | 25      | VL      | 25      | VL      |
| U11     | 25      | VL      | 37      | VL      | 25      | VL      |
| U12     | 21      | VL      | 35      | VL      | 44      | VL      |
| U13     | 22      | VL      | 24      | VL      | 33      | VL      |
| U14     | 23      | VL      | 30      | VL      | 23      | VL      |
| U15     | 22      | VL      | 35      | VL      | 30      | VL      |
| U16     | 12      | VL      | 20      | VL      | 30      | VL      |
| U17     | 35      | VL      | 44      | VL      | 45      | VL      |
| U18     | 20      | VL      | 22      | VL      | 50      | VL      |
| U19     | 10      | VL      | 38      | VL      | 35      | VL      |
| U20     | 22      | VL      | 20      | VL      | 46      | VL      |
| U21     | 20      | VL      | 27      | VL      | 50      | VL      |
| U22     | 22      | VL      | 39      | VL      | 29      | VL      |
| U23     | 10      | VL      | 25      | VL      | 23      | VL      |
| U24     | 24      | VL      | 20      | VL      | 50      | VL      |
| U25     | 28      | VL      | 23      | VL      | 20      | VL      |
| U26     | 13      | VL      | 28      | VL      | 37      | VL      |
| U27     | 20      | VL      | 49      | VL      | 40      | VL      |
| U28     | 20      | VL      | 20      | VL      | 50      | VL      |
| U29     | 24      | VL      | 20      | VL      | 35      | VL      |
| U30     | 23      | VL      | 32      | VL      | 40      | VL      |
| Average | 20.3    | VL      | 30      | VL      | 36.3    | VL      |

Note = VL: Very Low

In maintaining, improving the quality of life, and developing public policies, PISA assessments are carried out so that students know that science has important value for society and individuals optimally achieved [11]. Literacy skills are needed by students. If students have high SLA, then these students can master the concept of the material. In addition, SLA is useful to be applied in real situations and problems related to science. Only some students who have a high of ability master indicators in explain phenomena scientific, evaluate and design scientific investigations, interpret data and evidence scientific. Not all students can achieve these indicators. Related previous studies have supported these findings. Lack of scientific attitude makes students' SLA very low so that research with a scientific approach is needed on students [12]. This is also supported by Budiarti who found that the SLA of students about the concept of motion of living things is still low in Papua [13]. In line with the reason when students do not have an android smartphone with an internet connection [14]. SLA with a scientific approach as learning requires strategies that must be achieved by students to have the ability conceptual understanding and can help students solve scientific problems, make it easier to understand the material being taught, make it easier to connect scientific concepts with everyday phenomena. Make it easier for students to evaluate and design scientific investigations, encourage collaboration in groups, increase responsibility in group learning, facilitate interpretation of
scientific data and evidence. Better learning can be created if students have high SLA [15]. The solution for students who have not achieved mastery in SLA indicators is through effective remedial learning in active learning, which means learning ability. In line with the research results of Gunel et al [16].

![Figure 1. Data Percentage Indicator of Scientific Literacy Ability](image)

Students' low SLA is influenced by several factors, namely low reading interest, evaluation tools that have not led to the development of scientific literacy, and the teacher's lack of knowledge about SLA [17]. The cause of the low SLA of Indonesian students is due to several other things, namely: teacher centered learning, the low positive attitude of students in understanding science, there are several basic competencies that are not liked by students related to process, context and content. This is caused by the material being tested has never been studied, Questions that use discourse are not used to being done by students, and students' SLA are not supported by the learning process. A learning model is needed to improve SLA. Scientific processes that are not involved in the learning process can lead to low SLA [18]. The same thing was also revealed that the SLA of high school students was still low [19]. Diana [20] concluded that the SLA of Class X SMA students is still relatively low due to differences in learning targets applied in schools with the demands of PISA. Science learning aims to assist students in developing more understanding of the nature of science and making students scientifically educated citizens, it is considered an important outcome that must be obtained from science learning [21]. Teachers need to apply effective science learning to improve students' SLA. Based on the opinions expressed by some of these experts, it can be concluded that science learning must be able to develop SLA [22].

Science learning must be balanced with the provision of evaluation questions that encourage students to develop thinking skills and develop students' reasoning in the given situation [23]. The achievement of competence in science learning leads to the formation of science attitudes. The process of forming this scientific attitude must be based on the mastery of knowledge and skills [24]. The results of Huryah's research [25] concluded that students who are not accustomed to working on questions that require analysis are one of the factors that cause students' low SLA. The idea of SLA still requires a more in-depth study, either through discussions, seminars, or applications to make it more applicable, namely the assessment tools can be developed [26]. However, a person's SLA can develop along and that ability in a person can be very high in certain fields but can be very low in other fields [27]. Even according to Surpless, et al [28] Geology Physics students in Texas also still do not have SLA adequate.
Teachers' knowledge about integrated science learning and conceptual literacy are important assets to improve the quality of teaching and learning in the classroom [29]. This is the reason why most students find physics difficult and confusing. Teachers must be able to overcome these problems, namely by linking the kinetic theory of gases with phenomena that exist in life. So that students are expected to be able to understand physics because it will be very useful to apply and develop. The education system, curriculum, learning facilities and infrastructure, the selection of teaching models and methods by teachers, and teaching materials cause the low SLA of Indonesian students [30]. Apart from these factors, most students only memorize concepts and are less able to think deeply about the relationship of what they have learned with its application in new situations [31]. The results of the study show that the students' SLA profile is in a sufficient category [32].

4. Conclusion

In the case of this study in Indonesia, a profile of SLA of senior high school students on physics learning is generally still at a very low category. This can be seen from the results of the SLA test in the form of 10 items that have been carried out by high school students. The average percentage of indicator aspects with indicators to explain phenomena scientific, evaluate and design scientific investigations, interpret data and evidence scientific are 45.73%, 62.77%, and 61.46% respectively. SLA in this case students only have scientific knowledge to explain the context or make conclusions in various complex life situations. The implications of this study can be used as empirical evidence that the SLA of high school students on physics learning still need to be improved. The limitation of this research is that it still uses 90 senior high school students. Further research is needed to overcome the problem of high school students' SLA level on physics learning.

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