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Literacy Level of Students in Chemistry Education Department on Thermochemistry

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ABSTRACT

This study aims to identify the chemical literacy level of students on Physical Chemistry course, especially in Thermochemisty. Chemical literacy is a major goal in chemistry education recently. The measuring of chemical literacy level in this study used a chemical literacy instrument developed based on Shwartz, et.al framework. The instrument measure students' chemical literacy skills at each level. There are 4 levels of literacy that are measured, namely nominal literacy (level 1), functional literacy (level 2), structural literacy (level 3) and multi-dimensional literacy (level 4). The objects in this study were 14 first year students of Billfath University who took Physical Chemistry course. The data were collected after student got the Thermochemistry subject. The measurement results show that 14.29% of students reach level 3, 71.42% of students reach level 2 and 14.29% of students reach level 1. These results indicate that there is no student that able to reach the highest level 4. Overall, the chemical literacy level of first year students in the Physical Chemistry course is classified as low level. These results allow further development in learning to increase students' chemical literacy level.

Keywords: *chemistry; chemical literacy; education; thermochemistry*

INTRODUCTION

Indonesia is in the process of improving the quality of existing human resources in order to achieve the goals set by the central government in various sectors, one of which is education. State development can be pursued through education in responding to challenges that arise in the era of globalization, one of which is through the literacy movement. The National Literacy Movement states that Indonesian people should be sensitive and master basic literacy, namely language literacy, numeracy literacy, scientific literacy, digital literacy, financial literacy, and cultural literacy (Kemendikbud, 2017). Scientific literacy is the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen (OECD, 2019a). A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

Scientific literacy is developed through science education that is both broad and applied (OECD, 2019b). Eduvation that aims to improve scientific literacy skills certainly requires information about the mastery level of scientific literacy by students. Scientific literacy is a requirement for every student to master when in social life (OECD, 2017). The scientific literacy is one of the main goals in science learning in the 21st century. This also applies to learning chemistry which makes chemical literacy the main goal in chemistry learning. Chemical literacy is a part of scientific literacy (Mozeika & Bilbokaite, 2010). It characterizes the activation of knowledge, skills, acquirements, and other elements retained.

Chemical literacy covers four aspects, i.e chemical content knowledge, chemical in context, higher order learning skills, and affective (Jarman & McClune, 2010). The assessment for chemical literacy level is needed to determine the learning model that will be used in classroom. By knowing the student's literacy level, the lecturer will be able to choose a suitable learning model and approach to improve students' understanding of concepts and levels of chemical literacy. Therefore, the assessment of chemical literacy needs to be carried out on first-year students at Billfath University as the basis for making further learning plans.

Assessment for chemical literacy level can be done using instrument based on Program for International Students Assessment. Right now, officially, the OECD scientific literacy framework is used in 36 countries participating in the PISA (Muntholib et al., 2020). This study used OECD's scientific literacy framework in which the content knowledge of the

framework was replaced from scientific knowledge to chemical knowledge.

The main aspects of the PISA framework (OECD, 2019b) are described in a cognitive framework that aims to assess and report on student ability levels, as follows:

1. Low Level (Low, L), students can carry out a one-step procedure, for example remembering facts, terms, principles or concepts or finding a point of information from a graph or table.
2. Moderate level (Moderate, M), students can use and apply conceptual knowledge to describe or explain phenomena; choosing an appropriate procedure that involves two or more steps; organize or display data; interpret or use simple data sets or charts.
3. High Level (High, H), students can analyze complex information or data; synthesizing or evaluating evidence; justifying reasons; considering multiple sources; draw up a plan or sequence of steps to solve a problem.

Rahayu (2017) states that students with less developed literacy skills can solve problems in simple and frequent situations, while those with more developed literacy skills are able to solve new problems in complex situations. PISA 2018 results on the component of scientific literacy in Indonesia scientific literacy is in the lowest 10 level, which is ranked 70 out of 78 participating countries. The low level of scientific (chemical) literacy in Indonesia can be improved by improving the quality of education. This is part of the foundation of hope for improving the quality of Indonesia's human resources.

The subject matter that used is thermochemistry. Based on previous research, it is known that the understanding of Chemistry Education students at Billfath University towards thermochemistry material is still low (Priyasmika & Yuliana, 2019). One of the low learning outcomes is the students' lack of overall understanding about thermochemistry. This lack of overall understanding makes the lecturer use the inquiry learning model application. After the learning has been carried out, it is necessary to assess the students' chemical literacy skills to see the effect of the learning that has been done.

Thus, continuing research is needed to describe or see the profile (description) of the ability and development of chemical literacy of students in Chemistry Education students at Billfath University towards thermochemistry material after learning using inquiry model. This research is expected to be an initial description of the ability of chemical literacy in making decisions regarding the learning program later and to know the the influence of the

inquiry model on chemical literacy skills.

METHOD

This research process uses descriptive methods and surveys using a structured questionnaire. Survey research has characteristics, namely that the information collected comes from a sample with the aim of obtaining an overview of certain aspects or characteristics of the population from which the sample originates. In this study, the researcher did not give special treatment to the sample used so that it did not require a control class or an experimental class. This research was conducted on a sample of students majoring in Chemistry Education who took the Physical Chemistry 1 course and consisted of 14 students. Result data were prepared for statistical analysis.

The category of students' chemical literacy skills according to PISA (2018) consists of 3 levels, namely: low level (Low, L); moderate level (Moderate, M); and high level (High, H). Which are described in values as in Table 1.

Table 1

Category of Chemical Literacy Skill

Score	Category
< 56	Low (L)
56 - 75	Moderate (M)
76 - 100	High (H)

The questionnaire instrument consisted of 25 statements representing 4 aspects of chemical literacy, namely context; knowledge; competence; and attitudes (Rahayu, 2017). The scale on the questionnaire used is a Likert scale with four alternative answer points. This scale is made in the form of a statement so that it is followed by a choice of respondents indicating the level. The choice of response is point scale, namely T (True), F (False), and UD (Unable to Determine). The score for the choice of answers on the Likert scale depends on the nature of the statement, which is positive, which is T = 3; F = 2; UD = 1; and negative is the opposite, namely T= 1; F = 2; UD = 3.

RESULTS AND DISCUSSION

Description of chemical literacy skills is obtained after taking measurements using measuring instruments that have been validated by experts. This instrument is an instrument for measuring chemical literacy skills developed based on OECD shells and has been

adapted to this research. Chemical literacy skills are assessed by categorizing the scores obtained by students after filling out the instruments. The categories are High, Moderate and Low according to table 1.

Chemical literacy skills are abilities that students, especially students who have studied chemistry, must have so that students can understand and utilize the chemistry they have acquired completely and accurately. The ability of chemical literacy in this study was measured with an instrument to measure chemical literacy that has been adapted from the OECD framework to suit this research. This instrument is given to students after students learn Thermochemistry in the Physical Chemistry class 1. It aims to determine the level of chemical literacy which will later be used as a basis for determining models and approaches in subsequent learning.

Table 2

The Score Result and Chemical Literacy Category of Student

No.	Students	Score	Category
1.	Ahmad Jamaluddin Al-Anshori	64	M
2.	Titin Musayaroh	84	T
3.	Layla Muf'idah	64	M
4.	Ainur Rosidah	68	M
5.	Ah. Fathul Jadid Anshori	88	T
6.	Ahmad Abdillah Khoironi	80	T
7.	Halimatus Sa'diyah	64	M
8.	Moch. Nurakim	20	L
9.	Zumrotus Sholiha	12	L
10.	Akmal Shubhi	72	M
11.	Ivtarina	68	M
12.	Muhammad Finangkis	72	M
13.	M. Yusril Putra Zaman	64	M
14.	Nia Siska Mauliana	60	M

Student scores are obtained from the results of filling out the chemical literacy test instruments. This instrument consists of 25 statements. This statement is divided into 4 groups of phenomena. So, students fill out the statement after reading the phenomenon that is presented. After answering and being assessed, the scores obtained by each student were categorized into the high, moderate, and low categories. The used of the context-based approach is better to increase students' chemical literacy level (Cigdemoglu, 2020). There are several phenomena that we often encounter in everyday life that are closely related to

chemistry and are also related to science in formal education. In addition, it is also related to social media, such as newspapers, TV programs, the internet, and so on informally. These phenomena include environmental issues including the greenhouse effect, ozone depletion, and acid rain. There are many learning resources on social media that direct students to become more informed citizens as part of their chemical literacy skills. This is because it involves the concepts of chemistry and science concepts to other disciplines well. The percentage of each category can be observed from Figure 1.

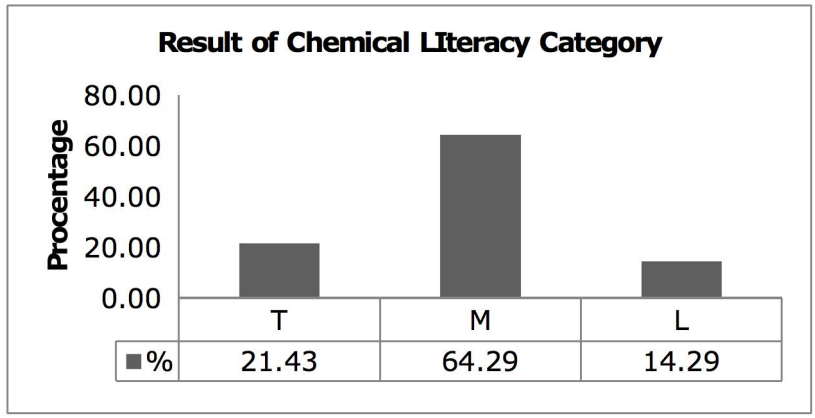

Figure 1 Result of Chemical LIteracy Category

In the table, it can be seen that most of the students were in the moderate category, which was 64.29%. In this category, students are able to explain the meaning of a concept and are able to provide examples and applications of the concept. Moderate category is the minimum level that must be achieved by senior high school students, so college level students should have been able to achieve it or even at a higher level. However, there are still two students who have just reached the low category. In the high category, students are able to connect the phenomena that exist in everyday life with the concepts in the material taught in class. In this category, students have experienced a meaningful learning process and the risk of misconceptions is very small.

The number of students who reach the moderate category is more dominant than the high category because students in this class when they are in high school rarely get learning with a learning model that emphasizes chemical literacy training. Their experience only follows one-way conventional learning from the teacher. In addition, it is possible that the students' lack of understanding of the material is due to the learning media used previously

which does not represent the three levels of representation in learning chemistry materials.

CONCLUSION

Based on the research data, it is illustrated that the chemical literacy skills of students in Thermochemistry are at a moderate level or as much as 64,29% of the entire population. A person is said to be literate when using scientific concepts and process skills when making decisions regarding other people and / or their environment, and understanding the relationship between science, technology and society, social and economic development, as well as producing useful scientific products (OECD, 2019c; Priyani et al., 2019).

The survey conducted in this study can be a basic or initial research for further researchers regarding the description; characteristics; even the process of increasing chemical literacy skills to meet learning needs entering the era of the industrial revolution 4.0.

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