

CHEMICAL LITERACY ABILITY IN GENDER PERSPECTIVE ON ACID-BASE MATERIAL

Erlinda Novriani Saputri, Pandu Jati Laksono*, Indah Wigati

Chemistry Education Study Program Faculty of Tarbiyah and Teacher Training Universitas Islam Negeri Raden Fatah Palembang, Indonesia.

Abstract: Research on chemical literacy skills from a gender perspective on acid-base materials has been conducted at SMA Y in Lahat District. This study aimed to determine students' chemical literacy skills from a gender perspective in acid-base material. This type of research is descriptive research with a qualitative approach. The subjects of this study were 28 students of class XI MIPA 1 at SMA Y in Lahat Regency, with 14 male and 14 female students. The instruments in this study were chemical literacy test questions in the form of descriptions and interview guidelines. The results of this study indicate that the chemical literacy ability of SMA Y students in the Lahat Regency is, on average, 56% in the low category. The difference in chemical literacy based on gender for male students is 54%, and for female students is 59%. The chemical literacy of female students is better than male students, with a difference of 5%, and is included in the low category. Female students were better able to answer questions that explained the concept of acids and bases, while male students were better able to answer questions on acid-base calculations.

Keywords: Acid Base, Chemical Literacy, Gender

INTRODUCTION

Scientific literacy is one of the abilities that must be mastered by students, especially now in the 21st century. Scientific literacy is an individual's ability to involve literacy skills in solving a problem (Asyhari & Hartati, 2015). According to Zuhara et al. (2019), one of the keys to progress in facing the difficulties of the 21st century is to master scientific literacy skills, with scientifically literate people expected to have the option to utilize their scientific information to deal with a problem in everyday life and

produce useful scientific products. Program for International Student Assessment (PISA) Scientific literacy has interrelated characteristics, namely aspects of context, competence, knowledge, and attitudes (OECD, 2016).

Chemical literacy is a part of scientific literacy that cannot be distinguished. Chemistry is included in science, so chemical literacy is also part of scientific literacy. The importance of chemical literacy relates to how students can appreciate nature by utilizing the science and technology they have mastered

* Correspondence address: Jl. Pangeran Ratu, Jakabaring, Palembang, South Sumatera, Indonesia

e-mail: pandujati_uin@radenfatah.ac.id

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(Nisa et al., 2015). Several previous studies have shown that scientific literacy skills in Indonesia still need to improve. The results of the PISA study from 2012 to 2018 show that students' scientific literacy skills in Indonesia could be more optimal. This can be seen in table 1 below.

Table 1. Results of the Ability PISA Study Science Literacy of Indonesian Students

Years	Indonesia Average score	Average Score PISA	Rating	Participating Countries
2012	375	500	64	65
2015	403	500	62	70
2018	396	500	70	78

Source : (Sutrisna, 2021)

Based on a gender comparison, the results of the 2012 to 2018 PISA scientific literacy test show that the results of students' scientific literacy skills in Indonesia the scores obtained are still low and are consistently ranked at the bottom. Regarding gender differences in scientific literacy abilities, male students show better results than female students. Research by Zuhara et al., (2019) offers that male students get a score of 399 while female students get a score of 387. Furthermore, the results of the 2015 PISA test (OECD, 2016) stated that of the 33 participating countries, the average scientific literacy score for male students was higher than for female students. In Finland, female

students have higher scores than male students.

Research in Indonesia shows test results Indonesia National Assessment Program (INAP) in 2012 in two regions, namely Yogyakarta and East Kalimantan. The results of this study indicate that in Yogyakarta, the gain score in the science field of female students (533.08) is better than male students (527.58). In contrast, East Kalimantan's acquisition score of female students (502.39) is lower than that of male students. Male (506.96). So based on gender comparisons using the INAP test, the average student with scientific literacy skills in Indonesia shows more varied results (Zuhara et al., 2019).

The results of interviews with chemistry teachers at SMA Y in Lahat District show that chemistry lessons often relate learning material to everyday life, including acid-base material. However, in acid-base materials, the link between the material and daily life could be more optimal in practice. The evaluation or examination of the chemistry subject at SMA Y in Lahat Regency has never assessed students' chemical literacy abilities. In addition, there are differences in the acquisition of daily chemistry test scores between male and female students. Students' chemical literacy abilities need to

be measured using chemical literacy-oriented assessments to determine students' chemical literacy abilities (Purwandini, 2018)

The results of previous research conducted by Nurisa (2019) regarding the chemical literacy-oriented assessment instrument that produces a chemical literacy assessment sheet on acid-base material states that the assessment sheet has the characteristics of the dimensions of chemical literacy, namely content, context, process, and attitude. The importance of chemical literacy skills that students must possess made researchers interested in using this assessment sheet to measure the chemical literacy abilities of students at SMA Y in Lahat Regency on acids and bases. The acid-base material was chosen because it complied with the PISA principles. The topic of acids and bases has concepts related to everyday life. Acid-base material does not only contain concepts but also process skills. Cigdemoglu et al (2017) suggested that the concepts in acid-base material occupy a large part of chemistry learning from the elementary, middle and high levels. The concept of acids and bases has a broad scope in everyday life, especially in household chemicals, newspapers such as the occurrence of acid rain, and industries where all of these

concepts are known by students and are worthy of research. Differences in chemical literacy in acid-base materials from a gender perspective must be seen.

Research on literacy and gender has been done before to see the influence of gender differences. Factors that influence scientific literacy skills in gender are the factors that classify female students as higher than male students (Srikandi et al., 2017). Analytical thinking skills and students' chemical literacy on gender differences did not significantly differ (Ad'hiya et al., 2019). The research is expected to provide an overview of the level of students' chemical literacy ability in acid-base material from a gender perspective using the Gender Analysis Pathway (GAP) to determine the factors that cause differences in chemical literacy abilities. This is beneficial so that in the future there will be no gender gap between male and female students. Chemical literacy, especially in acid-base material and from a gender perspective.

RESEARCH METHODS

The approach used in this study is a qualitative approach using descriptive analysis methods. The targets in this study were 28 students in class XI MIPA 1. This research was conducted at SMA Y in Lahat

Regency in the even semester of the 2021/2022 academic year. The instruments used in this study were chemical literacy texts, which consisted of 24 essay questions and questionnaires, which consisted of statements adapted from the research results by Nurisa, (2019), as well as interview guide sheets with teachers and students.

Table 2. Criteria for Students' Chemical Literacy Ability

Literacy Ability Level	Predicate	Category
86-100%	Very good	High
76-85%	Good	
60-75%	Passably	Moderate
55-59%	Less good	Low
≤ 54%	Not good	

Data collection techniques in this study were by administering chemical literacy test questions, administering questionnaires, and conducting interviews with teachers and students. The data obtained were then separated between male and female students and then analyzed to calculate their presentation using Microsoft office excel. Data from the research results were also reduced to draw a more precise result. Data in the form of numbers is shown in the form of the results of this

presentation and then interpreted according to Table 2.

The results of research data between male and female students were then analyzed using Gender Analysis Pathway (GAP) to determine the factors causing differences in the chemical literacy abilities of male and female students.

RESULTS AND DISCUSSION

This research was conducted at SMA Y in Lahat District class XI MIPA 1. This study aimed to analyze the chemical literacy abilities of male and female students in acid-base material. This study describes or explains the literacy skills of class XI MIPA 1 SMA Y in the Lahat District. The ability of students' chemical literacy is known by using instruments in the form of questions taken and validated by previous researchers. This question instrument followed the PISA 2018 structure in the context, content and competency sections, which were adapted to acid-base material. The instrument of this question consists of description questions with six discourses which are presented in the form of a story and followed by problem-solving questions which can be seen in Table 3

Table 3. PISA Chemical Literacy 2018

Unit	Context	Knowledge	Competency
Apple trees	Environment personal	Content	Explain phenomena scientifically
		Procedural	Compose a scientific inquiry.
		Epistemic	Evaluating scientific inquiry
		Epistemic	Interpret data and facts scientifically.
Gastric pains	Health personal	Procedural	Explain phenomena scientifically
		Content	Explain the effects of excess stomach acid based on the nature of the acid.
		Procedural	Explain the concept of neutralization of a strong acid by a strong base.
Bee sting	Health personal	Content	Explain the principle and mechanism of the neutralization reaction of a strong acid by a strong base.
		Epistemic	Analyze acids and bases contained in food.
		Content	Explain phenomena scientifically
		Epistemic	Explain phenomena scientifically
Acid rain	Global Hazards and the environment	Epistemic	Interpret data and facts scientifically.
		Content	Explain phenomena scientifically
		Procedural	Compose a scientific inquiry.
		Procedural	Evaluating and compiling scientific inquiry
Industrial waste	National Environment	Content	Interpret data and facts scientifically.
		Epistemic	Evaluating scientific inquiry
		Procedural	Compose a scientific inquiry
Shampoo and conditioner	Health personal	Content	Explain phenomena scientifically
		Content	Explain phenomena scientifically
		Content	Explain phenomena scientifically
		Epistemic	Interpret data and facts scientifically.

Table 3, shows the part in chemical literacy, namely the aspects of context, content and competence. The problem cases displayed in the problem instrument are events that occur in the environment around students and have a scientific basis that will affect the existence of individuals in the surrounding environment. The discourse raised in this problem represents each acid-base sub-material: apple trees represent indicators of acids and bases, stomach ulcers

represent strong acids, bee stings represent the concept of neutralizing acid by the base, acid rain represents strong acids and strong bases, and industrial waste. Represents calculating the pH value and the strong alkaline properties of shampoos and conditioners. Based on the results of the chemical literacy test Based on the results of the chemical literacy test, it was found that the discourse on industrial waste in calculating the pH value was the lowest result.

In this study, the instruments in the test items contained aspects of chemical literacy according to PISA, namely aspects of context, content, and competence. In addition, a questionnaire totaling 14 items was used to analyze aspects of student attitudes. The results of student answers are given a score of zero to four based on the student's ability to answer according to the answer key. The student's score is then accumulated, and a percentage is made, categorized as chemical literacy ability, whether in the high, medium or low categories. After obtaining the percentage results in data on students' chemical literacy abilities, the researchers interviewed chemistry teachers and students who took the chemical literacy test to strengthen the research data.

1. Chemical Literacy Students in General

Chemical Literacy which is an essential part of scientific literacy in 21st-century skills that links various aspects of competence, attitudes and skills in science, especially chemistry (Sulistina et al., 2021)

The results showed that overall the chemical literacy skills of students at SMA Y in Lahat Regency were in a low category, reaching 57%. In the graph

above, students' chemical literacy is generally shown not to be separated based on the gender of male and female students.

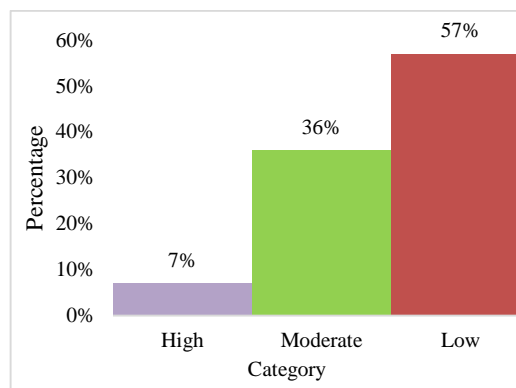


Figure 1. Results of students' Chemical Literacy

The low chemical literacy ability of SMA Y students in Lahat Regency is caused by several factors, including students' lack of interest in reading. Students' low scientific literacy includes textbook selection, misconceptions, non-contextual learning, and student reading skills (Fuadi et al., 2020). Students often need to be more active in reading and repeat the lessons given by the teacher. A strong positive relationship was demonstrated between SMA students' reading habits and scientific literacy (Ayu et al., 2018). Based on the results of the interviews, some of the students repeated material obtained at school. Even though repeating the lesson will make it easier for us to understand the material.

The students view chemistry is a complex subject, so most students prefer to avoid chemistry lessons, especially in material related to calculations. Students experience difficulties in solving questions whose completion requires high levels of metacognition and mathematical chemistry strategies (Fitrandi & Muntholib, 2020). Students' interest in learning chemistry is low, students' motivation to learn chemistry is low, understanding of prerequisite concepts is low, understanding of concepts is low, and students' mathematical abilities are weak (Sariati et al., 2020). Analysis of the results of the tests and interviews, it is known that most of the students have yet to be able to answer the calculation questions.

Students have never been trained to solve chemical literacy questions related to chemistry learning. Inquiry-oriented learning the application of an ethnoscience-laden inquiry-learning model to teach scientific literacy skills can be applied to the concept of chemistry, because chemistry is part of science (Zuhro & Nawangati, 2017; Imansari et al., 2018). From the results of the interview the teacher said that carrying out a special literacy test had

never been done, but during the test, several questions led to literacy questions

The results of research conducted by Imansari et al. (2018) showed that the chemical literacy skills of class XI IPA students at SMA Negeri Banyumas were in the sufficient category. The same thing was found by Khusmawardani et al. (2021) that the average chemical literacy achievement of Nggoro 1 Public High School students was 57.77% in the medium category. Laksono (2018) also concluded that the chemical literacy ability of students of the chemistry education study program at UIN Raden Fatah Palembang in waste management material was 73.33% in the moderate category.

2. Gender Perspective Chemical Literacy Ability

Chemical literacy abilities are distinguished by gender. In his perspective, gender is a social construction to show the differences in functions, roles, and obligations between men and women (Prasetyawati, 2018). Differences in chemical literacy abilities based on gender can be seen in Figure 2.

The results in Figure 2. show that female students' chemical literacy ability is higher than male students. There is a difference of 5% between women and

men. Based on the results of the study, it can be seen that there are differences in chemical literacy abilities between male and female students who have better chemical literacy abilities than male students. However, the difference is insignificant.

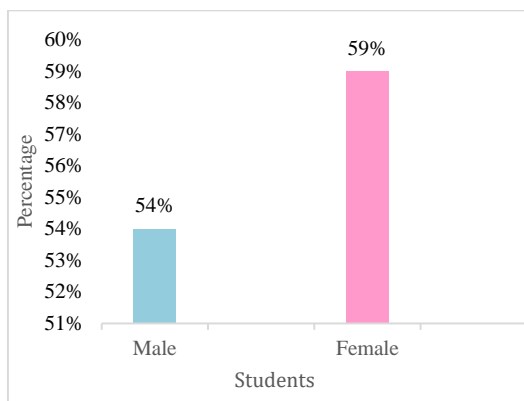


Figure 2. Chemical literacy of male and female students

From the analysis results, there are differences in chemical literacy abilities between male and female students at SMA Y in Lahat Regency due to psychological differences between males and females in interest, talent, attention, and level of intelligence between two. This is in line with Pujiati & Retariandalas (2019), who say that women have better competence than men. Differences in chemical literacy abilities between male and female students are also due to mental differences between males and females in terms of interest, thinking ability, and level of knowledge between two. (Yanti et al., 2019).

According to Ebouh, C, (2011), there is an imbalance in attitudes between men and women due to several factors, including individual character, cognitive ability, family, education, and socio-culture. Both male and female students are provided equal access to learning activities in class, but in practice, most male students still need to be more active in learning. For example, when the teacher gives examples of questions that students must answer, female students, are most active in answering questions.

The interview results also revealed that female students showed more interest in learning chemistry than male students. Female students more often read and repeat material that the teacher than male students has delivered. According to Walsh (2013), female students have superior reading and writing skills than male students. This is one of the causes of the chemical literacy ability of female students being higher than that of male students. Research conducted by Fitriani et al., (2018) said that male students get bored reading books that contain a lot of material that must be read.

Acid-base material becomes science illustration material at the even semester grade XI level. Acid-base is material that contains concepts and

calculations. The questions given to students in this study were acid-base material questions with concepts and calculations. In this study, the results were that female students were more able to answer questions that explained acid-base concepts. In contrast, male student participants could answer acid-base calculation questions more.

The students' answers showed that female students understood more than male students in answering the questions regarding the concept of chemistry. Based on perception, men can do without composing, so men only make up what is necessary. This is appropriate for National Assessment Program-Literacy and Numeracy (*NAPLAN*) which states that boys routinely outperform girls in arithmetic, and girls reliably outperform boys in reading, writing, spelling, and grammar. Safitri (2016) also said male students were better at arithmetic, science measurements, and sports. Meanwhile, female students are better at calculations related to traditional women's work, such as cooking and sewing.

Research conducted Sasser (2010) found a higher ability to remember, namely women compared to men, because women have a small part of the brain that plays a vital role in

remembering, namely the wider hippocampus. Gail et al., (2001) revealed that male students are more interested in concentrating on power, radioactivity and energy, while female students are more interested in learning about living things and welfare. Judging from the construction of the big brain, men have a parietal curve that has the ability to highlight visual-spatial capacities more than women. Hence, they prefer to recognize structures, spaces, plans, or numerical matters. (Ismail et al., 2016). Female students are better at conceptual knowledge and interpreting data (Yamtinah et al., 2017)

Ability of chemical literacy which female students more dominate, there needs to be a policy from the school that facilitates activities that support students' literacy skills. Schools have not assisted students with low literacy skills and have yet to be directed them to extra activities that can increase students' chemical literacy abilities. Science identity on the components of enjoyment of science and self-efficacy significantly differed between male and female students (Hidayat, 2022). In addition, family factors that do not support the education of male students are also a factor causing the gap in

the chemical literacy abilities of male and female students.

Several studies have shown that the achievement of student learning outcomes increases if parents take an essential role in their children's education. Harvard Family Research Project (*HFRP*) assumes parental contributions positively affect children's achievement. From these findings, it is possible to find signs of the child's progress in grades, state exam scores, or various assessments, including educator assessments. Therefore a good school is a school that facilitates a place for guardians to be involved in educating their children. Guardians involving themselves is crucial for improving children's achievement and keeping track of mental development (Wigati & Yuniar, 2018).

CONCLUSION

This viewpoint is not always valid. If women do not receive quality education, they will be unable to effectively contribute to their family's responsibilities. Additionally, Islam recognizes that mothers play a critical role in educating

children. By broadening their knowledge, women can raise and educate better children. Based on the results of a study, it is evident that female students have better literacy skills than their male counterparts. This highlights the potential that women possess, which must be harnessed to give them equal educational opportunities.

Despite the challenges, schools and parents must focus on improving the literacy skills of students who require additional support. According to the study, there are various strategies that can be adopted to close the gap between male and female students. For instance, teachers should be trained to enhance their chemical literacy and critical thinking abilities, which will also improve their students' literacy skills. Additionally, the relevant authorities should provide laboratories for practical learning, design a gender-balanced literacy-based curriculum, offer support and guidance to increase students' interest in reading, and ensure that teachers do not discriminate based on gender in their teaching practices.

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