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Analysis of Students' Scientific Literacy Ability in Terms of Learning Styles on Acid-Base Material

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ABSTRACT: This study aims to determine students' science literacy abilities, to know students' science literacy abilities based on learning styles, and to determine differences in students' science literacy based on learning styles in acid-base materials. This research is a non-experimental causal-comparative quantitative study with a sample of 62 students from 11th grade Science (MIPA) at MAN 1 Jombang, specifically classes XI-H and XI-I. The sample was selected using a purposive sampling techniques. The research instruments used were interviews for the preliminary study, a test consisting of 19 questions covering all literacy indicators with a test reliability score of 0.697, which is considered high, and a questionnaire to determine students' learning styles using the *AkuPintar* website. The interview results indicate that the school has implemented the independent curriculum, but the application of science literacy in learning is still limited to providing introductory readings before explaining the material and during practice exercises, and has not fully integrated the aspects of science literacy. The research results show that students' science literacy skills on acid-base materials fall into the medium category. Based on science literacy indicators, the high category is found in the indicators of researching, evaluating, and using scientific information for decision-making and action; the medium category is found in the indicator of explaining phenomena scientifically; and the high category is found in the indicators of designing and evaluating designs for scientific investigations and critically interpreting scientific data and evidence. Based on learning styles, students with a visual learning style have higher science literacy skills, followed by students with an auditory learning style and students with a kinesthetic learning style. Although there are differences in mean scores between learning styles, statistically no significant difference was found in students' science literacy abilities based on learning style. This indicates that efforts to improve science literacy should focus on enhancing the quality of teaching, student engagement, and strengthening scientific thinking skills, rather than solely on adapting teaching methods to specific learning styles.

Keywords: science literacy, learning styles, acids and bases, multiple representations

INTRODUCTION

One of the 21st-century competencies that everyone should possess is scientific literacy. The Program for International Student Assessment (PISA) 2022 defines science literacy as a person's ability to engage with scientific issues. Science literacy provides direct experience thru observation activities such as identification, decision-making, and reasoning related to science, as well as social interaction [1]. From research data conducted by PISA (Programme for International Student Assessment), it is known that Indonesia's science literacy scores have not shown significant improvement over the past ten years. PISA states that in 2018, Indonesia's literacy skills score ranked 70th out of 79 participating countries with a score of 396 [1]. This science literacy score continued to decline in 2022 to 383 [2]. This score reflects that most Indonesian students still lack science literacy skills. Low scientific literacy skills can be caused by several factors, including non-contextual learning, misconceptions, textbook selection, an unconducive learning environment and climate, low reading ability, and a teaching and learning process that does not adequately support students in developing scientific literacy skills [3].

One of the subjects that requires literacy is chemistry. This is because chemistry is very closely related to everyday life. Chemistry learning not only emphasizes understanding concepts, but students are also required to be able to apply scientific concepts to solve science-related problems in daily life. A deep understanding of chemical concepts and their application in daily life can be achieved if students possess abilities that encompass both aspects, namely chemical literacy skills [4]. According to PISA, chemical science literacy includes concepts and theories of chemical matter (scientific knowledge), the relationship of chemistry with global issues and its application in daily life (scientific context), and the ability to explain phenomena scientifically and interpret evidence scientifically (scientific competence) [5]. One of the chemistry topics that requires a high level of scientific literacy is acids and bases. Acid-base chemistry is a very complex topic when considering its characteristics [6]. Therefore, acid-base material is considered difficult by some students. Many students have difficulty analyzing the acidic or basic nature of solutions based on Arrhenius, Bronsted-Lowry, and Lewis acid-base theories; calculating the pH or pOH of solutions with known concentrations; and relating the degree of acidity (pH) to the degree of ionization (α), and the acid equilibrium constant (Ka) or base equilibrium constant (Kb) [7]. Beside their complex nature, acids and bases have practical applications, allowing them to be linked to phenomena in everyday life. Due to its practical nature, acid-base chemistry requires scientific literacy skills for students to gain a better learning experience [8].

However, in practice, students still face difficulties in implementing science literacy in acid-base material. The difficulties students encounter in learning acid-base material are caused by several factors, including a lack of interest in learning and a learning process that is considered boring by students [9]. In addition, the learning process is considered inadequate in training students to enhance their thinking and critical reasoning skills. This is evidenced by students who are not accustomed to working on science literacy-based test questions, even though such practice can help students develop their thinking skills [10]. With the evidence presented above, a thorough diagnosis is needed to identify the factors that influence a person's science literacy [11]. In previous research, one of the factors affecting science literacy ability is learning style [12]. Learning style is the consistent way a student captures stimuli or information, remembers, thinks, and solves problems during the learning process [13]. Accommodating the individual learning styles of students before delivering lessons, thereby making it easier for them to understand the material being taught. Learning styles have three types, namely visual learning style, auditory learning style, and kinesthetic learning style. Generally, everyone has a tendency to learn or understand something in various ways, which can be referred to as a mixed learning style [14].

Visual learning style is a learning style that more often utilizes the sense of sight [15]. Next, the auditory learning style is a learning style that utilizes the sense of hearing to acquire information or knowledge [15]. Meanwhile, the kinesthetic learning style is a learning style that more easily absorbs information or knowledge by engaging in physical activities such as moving, doing, or creating something that provides specific information to be remembered [15]. In chemistry learning, visual learning styles have higher academic achievement than other learning styles [16]. This indicates that students with visual learning styles are more successful in understanding chemical concepts when using media such as diagrams, graphs, and videos. They can remember information better and relate abstract concepts to visual representations. Learning styles, if maximally utilized by students, will also result in high literacy skills. Learning styles, when forced and not aligned with the student, can result in a slow reception of the information obtained [17].

In previous research, an analysis of scientific literacy skills has already been conducted. Analysis of junior high school students' science literacy skills on the topic of global warming [18]. Research on the analysis of eleventh-grade students' scientific literacy skills on the topic of reaction rates [19]. Another research on the analyzed science literacy skills based on school favorites [20]. Research that analyzed science literacy skills based on reading habits, learning motivation, and academic achievement [21]. However, research conducted specifically on chemical science literacy has not extensively examined it from the perspective of students' learning styles. Yet, one of the factors influencing science literacy is students' learning styles [12]. Additionally, to date, no analysis of students' scientific literacy abilities has been conducted, specifically considering learning styles, particularly at MAN 1 Jombang. In fact, every school has different student characteristics. By analyzing science literacy skills based on learning styles, we can gain information about students' science literacy abilities and learning styles. This analysis can also serve as a foundation for improving the quality of science instruction and encouraging teachers to further enhance science literacy.

Acids and bases are one of the chemistry topics studied by students in the eleventh grade, and they are very complex and involve calculations. It is very important for students to study and understand acid-base chemistry because it is practical and widely used to study scientific fields in other areas [22]. Additionally, there hasn't been much research analyzing literacy abilities from the perspective of learning styles, and in this study, the science literacy test instrument uses multiple representation questions, designed to measure students' understanding from various aspects and improve their ability to apply science concepts more comprehensively. Based on the above description, the idea emerged to delve deeper into students' science literacy abilities, considering their learning styles, particularly in the context of acid-base material.

RESEARCH METHODS

Causal-comparative research is a study that aims to find a cause-and-effect relationship between two or more variables without directly administering treatment or manipulating the independent variable. The independent variable in this study has already occurred naturally, and its influence or differences on the dependent variable are then investigated [23]. This study, using a causal-comparative method, aims to investigate differences in students' scientific literacy abilities based on their learning styles. The purpose of this study is to determine students' scientific literacy abilities, students' scientific literacy abilities based on their learning styles, and to determine the differences in students' scientific literacy abilities based on their learning styles.

Population and Sample of the Study

The population is the general or specific unit that exhibits the characteristics determined by the researcher for study and conclusion [23]. The population in this study is the students of class XI MAN 1 Jombang. A sample is a small part of the population [24]. The research sample for this study is the students of class XI MIPA at MAN 1 Jombang, namely classes XI-I and XI-H, with a total of 62 students. The sample selection used a purposive sampling technique, considering that both classes had diverse cognitive ability levels based on information from the subject teachers, thus representing the variation in student abilities. The sample criteria include students in the 11th grade MIPA program who have studied acid-base materials.

Research Instrument

The instrument used in this study was an interview guide used to conduct a preliminary study on the implementation of the curriculum used and the application of science literacy in the learning and assessment process. Then, a learning style questionnaire was used to gather information about students' learning styles, and finally, a science literacy test instrument in the form of multiple-choice and essay questions was created based on the XI grade material, including a scoring rubric and cognitive aspects. The test instruments used were developed by the researcher and have been validated by experts and empirically tested before being used. The results of content validation by 2 experts, namely chemistry lecturers and teachers, were 97.7% with the criteria being suitable, and empirical testing showed 19 valid questions with a question reliability using Cronbach Alpha resulting in a value of 0.697. Reliability is considered good if the Cronbach's Alpha value is > 0.60, so this instrument can be categorized as reliable [25].

To measure students' scientific literacy skills, a Likert scale was used. The assessment of the test instrument was done by providing a scoring rubric from 6 to 1. Here are the ways to assess students' science literacy skills:

$$\text{Value} = \frac{\text{Score Earned by The Student}}{\text{Total Score}} \times 100$$

The criteria for assessing science literacy skills are stated in the Table 1.

TABLE.1 Criteria for Assessing Science Literacy Skills

Score Value	Category
Value > 67	High
34 < Value > 66	Medium
Value < 33	Low

Data Analysis

The data analysis techniques used in this research are divided into two stages: descriptive analysis and inferential analysis. Descriptive analysis is used to describe and categorize the data obtained from the questionnaire. Inferential analysis is divided into two stages: prerequisite tests and hypothesis tests. Inferential tests are used to see if there are differences in science literacy skills based on students' learning styles. In the normality test, there is one data point that is not normally distributed, so the test that will be used in the hypothesis test is a non-parametric test. The non-parametric test used is Kruskall-Wallis.

RESULT AND DISCUSSION

A. The Level of Students' Science Literacy Skills on Acid-Base Material

The research began with students working on a test consisting of 19 essay questions completed within 90 minutes, as well as the AkuPintar website, which contains 30 statements with 3 answer choices for each statement to measure students' learning styles. The data from the students' science literacy test on acid-base material involved 62 students. Each student's score was totaled and then grouped based on their level of science literacy. Based on the research data, it was found that the maximum score obtained by students on the science literacy test was 74, and the lowest was 22. The average score from the science literacy test on acid-base material for the 11th-grade students of MAN 1 Jombang was 41.77, categorized as moderate.

1. Results of the Analysis of Students' Science Literacy Skills on Acid-Base Material

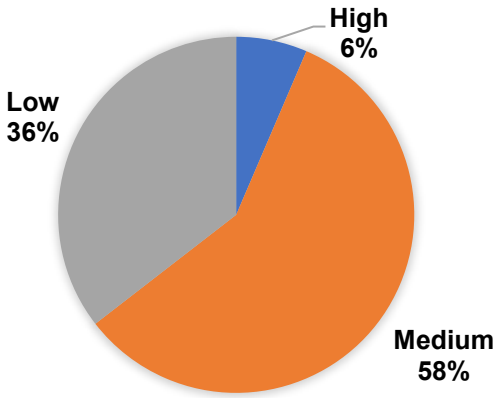

FIGURE 1. The Level of Science Literacy Ability of Class XI Students at MAN 1 Jombang on Acid-Base Material

The science literacy skills of students on acid-base materials were assessed based on their answers to questions prepared by the researcher. The results of the data analysis of students' science literacy skills can be seen in Figure 1. Based on the diagram of science literacy skills analysis results, there are 4 students with high science literacy skills, 37 students with medium science literacy skills, and 21 students with low science literacy skills. This indicates that the average science literacy skills of class XI students at MAN 1 Jombang fall into the medium category with an average score of 41.77. The results of the analysis of science literacy skills of class XI students at MAN 1 Jombang are consistent with the interview findings, which show that the school has implemented a science literacy program in the form of providing students with introductory readings before explaining the material and when doing practice questions. However, it has not fully integrated the existing aspects of science literacy. The results of this study are consistent with research conducted in 2022, which found that the scientific literacy skills of 11th-grade students at public high schools in Yogyakarta City fell into the medium category [20]. Similar findings were also observed in research at SMA Negeri 1 Kota Agung, which showed that students' scientific literacy achievement was 56% [8].

2. Results of the Analysis of Students' Science Literacy Ability Levels on Each Indicator in Acid-Base Material

Based on the results of the research that has been conducted, the following is an explanation of the analysis of students' science literacy skills from each indicator:

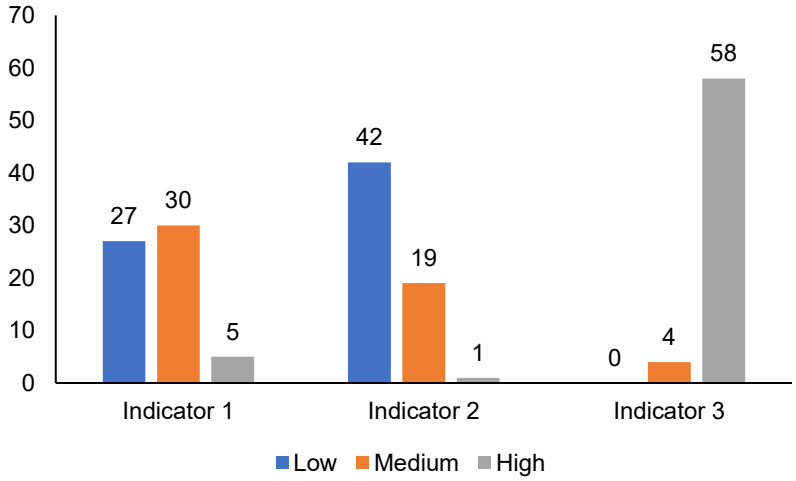

FIGURE 2. The Level of Students' Science Literacy Skills on Each Indicator in Acid-Base Material

a) Explaining phenomena scientifically (Indicator 1)

The first indicator of science literacy is explaining phenomena scientifically. On this indicator, students must be able to recall scientific knowledge concepts related to specific conditions and apply them to explain the occurring phenomena scientifically [26]. Based on Figure 2, there are 5 students with high science literacy skills, accounting for 8%, 30 students with moderate science literacy skills, accounting for 48%, and 27 students with low science literacy skills, accounting for 44%.

This indicates that the average science literacy ability of students in the first indicator, which is explaining phenomena scientifically, in the 11th grade at MAN 1 Jombang falls into the moderate category with an average score of 42.30. This research aligns with the findings of a study conducted at one of the public junior high schools in Bandung City during the 2014/2015 academic year. This indicator explains a scientific phenomenon with a percentage of 66.45%, categorized as "sufficient," as demonstrated by students' ability to apply their understanding to solve science literacy problems [27].

The low level of science literacy in the indicator of explaining phenomena scientifically is caused by students' lack of understanding of the material concepts, which results in their suboptimal application of the knowledge they possess to the phenomena occurring around them [27]. Another study reveals that the low level of students' science literacy in the competency aspect, particularly in the indicator of explaining phenomena scientifically, is due to students' tendency to memorize the material being studied, making them unable to connect it with phenomena in everyday life [26].

b) Construct and evaluate designs for scientific enquiry and interpret scientific data and evidence critically (Indicator 2)

The second indicator of science literacy is to construct and evaluate designs for scientific enquiry and interpret scientific data and evidence critically. Based on Figure 2, there are students with high science literacy skills, totaling 1 student with a percentage of 1%, students with moderate science literacy skills, totaling 19 students with a percentage of 31%, and students with low science literacy skills, totaling 42 students with a percentage of 68%.

This indicates that the average science literacy ability of students in the second indicator, which involves designing and evaluating scientific investigations and critically interpreting scientific data and evidence, in the 11th grade at MAN 1 Jombang falls into the low category with an average score of 27.49. This indicates that there is a need for reinforcement and learning that can enhance multiple representation abilities, especially at the submicroscopic level. The results of this study are consistent with research conducted at SMP Negeri 2 Gorontalo in 2023 on the indicator of interpreting data and evidence scientifically, which had a percentage of 28.23% with a low category. The low literacy ability in the competency aspect, particularly in the second indicator, indicates that students' ability to interpret scientific evidence and draw conclusions by interpreting the data presented in the images within the science literacy test instrument used in this study is still low [28].

c) Research, evaluate and use scientific information for decision making and action (Indicator 3)

The third indicator of science literacy research, evaluate and use scientific information for decision making and action. Based on Figure 2, there are 58 students with high science literacy skills, accounting for 94%, 4 students with moderate science literacy skills, accounting for 6%, and no students with low science literacy skills.

This shows that the average science literacy ability of students in the third indicator, which is research, evaluate and use scientific information for decision making and action in the 11th grade of MAN 1 Jombang, falls into the high criteria with an average score of 87.63. This indicates that the majority of students understand the questions and readings provided in the science literacy instrument used in this study. In addition, students are also aware of environmental issues and the scientific and social complexities underlying environmentally friendly actions and concern for the environment [29].

Based on the science literacy abilities on each indicator, it can be seen that the highest science literacy ability was obtained on the third indicator, which is research, evaluate and use scientific information for decision making and action with an average score of 87.63. This shows that students are able to utilize scientific information in the context of decision-making, reflecting their engagement with science-related issues relevant to everyday life [29]. Then, in the sufficient category, the indicator of explaining phenomena scientifically was obtained with an average score of 42.30. This indicates that students have a limited understanding in linking scientific concepts with phenomena occurring around them, which may be caused by a learning approach that emphasizes memorization rather than conceptual understanding [29]. In the low category of science literacy skills, the second indicator, which is to construct and evaluate designs for scientific enquiry and interpret scientific data and evidence critically, received an average score of 27.4. This low achievement shows that students have difficulty in constructing and evaluating designs for scientific enquiry and interpreting scientific data and evidence critically. This may be caused by a lack of deep understanding of scientific methods and critical thinking skills required in the scientific investigation process [29].

B. The Level of Students' Science Literacy Ability in Terms of Learning Styles on Acid-Base Material

The determination of students' learning styles was conducted online using the AkuPintar website by selecting one of the 3 answer options provided in 30 statements that correspond to the students' conditions. Based on the tests conducted, it was found that 28 students have a tendency towards visual learning styles, 11 students have a tendency towards auditory learning styles, and 23 students have a tendency towards kinesthetic learning styles. Thus, it can be concluded that the most prevalent learning style among the 11th-grade students of MAN 1 Jombang is the visual learning style.

The results of this study are consistent with research conducted in 2021, which showed that visual learning styles are more dominant. The results obtained in that study included visual learning styles with a percentage of 55%, followed by kinesthetic learning styles with a percentage of 34%, and auditory learning styles at 11% [14]. Another study showing dominant results for visual learning styles was conducted at SMA Negeri 1 Godong, with the following findings: 43 students (63.2%) had a visual learning style, 13 (11.1%) had an auditory learning style, and the remaining 12 (17.6%) had a kinesthetic learning style [30].

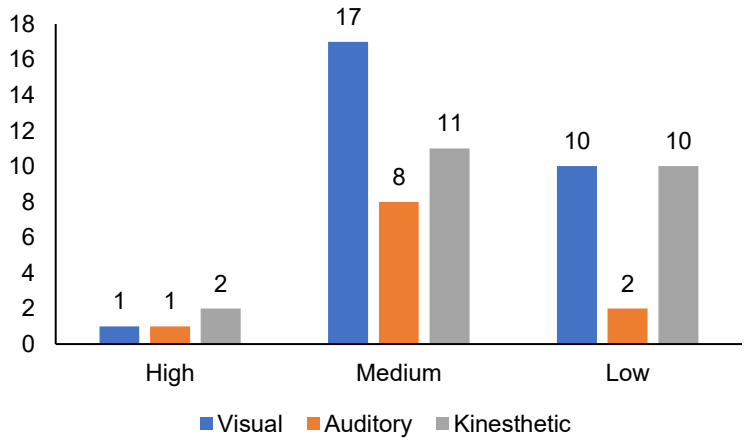

FIGURE 3. Results of Students' Science Literacy Ability Levels Viewed from Learning Styles

Based on the results of the research that has been conducted, the following is an explanation of the analysis of students' science literacy abilities from each learning style:

a. The Level of Science Literacy Skills in Visual Learning Styles

Visual learning style is a process of receiving information related to the sense of sight (eyes). Because for someone with a visual learning style, they will understand better when learning if they can see it directly, or they will remember the learning better if they see interesting pictures, or with striking colors [14].

Based on Figure 3, there are 28 students with a visual learning style, and the analysis of the science literacy skills of students with a visual learning style shows that there is 1 student with high science literacy skills, 17 students with moderate science literacy skills, and 10 students with low science literacy skills. This indicates that the average science literacy skills of students with a visual learning style in the 11th grade of MAN 1 Jombang fall into the moderate category with an average score of 44. Here is one of the answers from a student with a visual learning style:

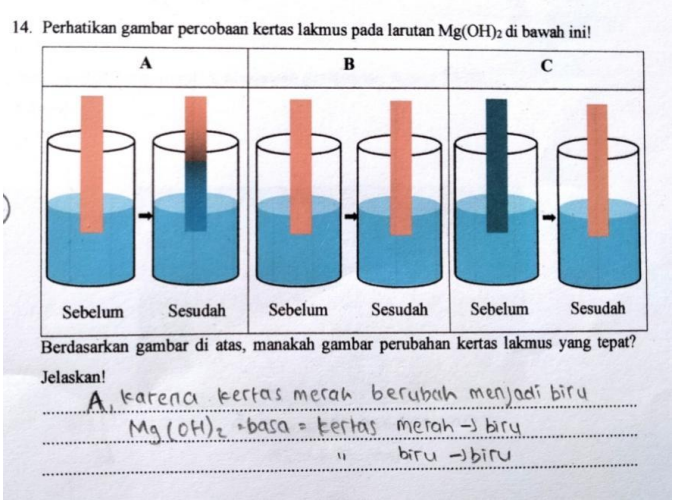

FIGURE 4. Student's Answer with a Visual Learning Style

In Figure 4, it can be seen that students with a visual learning style answered question number 14 with neat handwriting and their answers were written in an organized manner. Additionally, the student's answer was not explained in detail using words but with arrows. The use of arrows in explaining the answer suggests that the student is more comfortable using symbols or visual representations than long descriptions with words. This aligns with the theory that one of the characteristics of students with a visual learning style is that they are neat and organized, and students with a visual learning style often know what to say or write, but are not good at choosing words [31]. In addition, characteristics of someone with a visual learning style include speaking quickly, usually not being distracted by noise, remembering what they see rather than what they hear, preferring to read rather than be read to, being fast and diligent readers, remembering visual associations, having difficulty remembering verbal instructions unless they are written, often asking people to repeat them, and being meticulous about details [15].

b. The Level of Science Literacy Ability in Auditory Learning Styles

The auditory learning style is a process of receiving information closely related to the sense of hearing; someone with this learning style will easily memorize information if they listen to it. Additionally, individuals with an auditory learning style tend to be more interested in conversations, one of which can take the form of discussions with others [15].

Based on Figure 3, there are 11 students with an auditory learning style, and the analysis of the science literacy skills of students with an auditory learning style shows that there is 1 student with high science literacy skills, 8 students with moderate science literacy skills, and 2 students with low science literacy skills. This indicates that the average science literacy skills of students with an auditory learning style in the XI grade at MAN 1 Jombang fall into the moderate category with an average score of 42.5. Here is one of the answers from a student with an auditory learning style:

In Figure 5, it can be seen that students with an auditory learning style answered question number 14 at length. This indicates that students are more comfortable expressing their

understanding thru detailed verbal explanations. This aligns with the theory that one of the characteristics of students with an auditory learning style is that they enjoy talking, discussing, and explaining things at length [31]. Additionally, characteristics of someone with an auditory learning style include talking to themselves while working, being easily distracted by noise, enjoying reading aloud and listening, finding it difficult to write but being great at storytelling, and learning by listening and remembering what was discussed rather than what was seen [15].

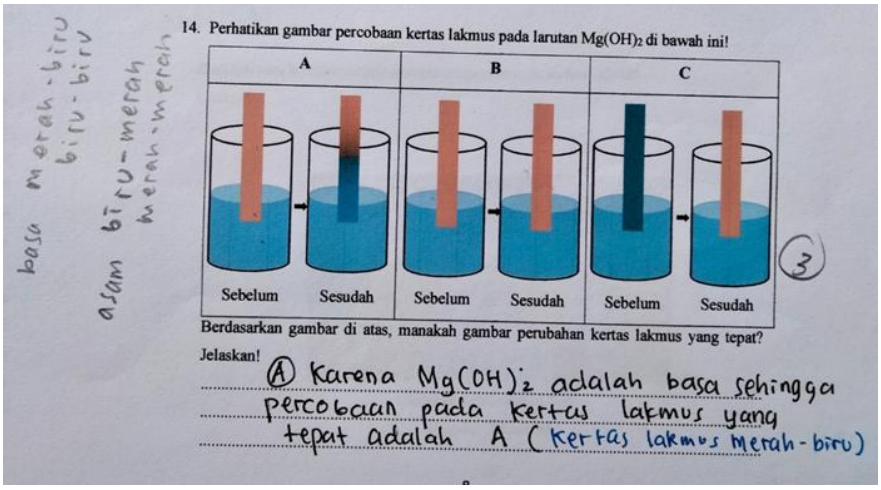

FIGURE 5. Student Responses with an Auditory Learning Style

c. The Level of Science Literacy Ability in Kinesthetic Learning Styles

Kinesthetic learning style is a method of receiving information closely related to body organs such as hands and feet; this learning style involves a deeper process of receiving information through movement, touch, and actions. Someone with a kinesthetic learning style will prioritize sensory perception and body movements to remember information [14].

Based on Figure 3, there are 23 students with a kinesthetic learning style, and the analysis of the science literacy abilities of students with a kinesthetic learning style shows that there are 2 students with high science literacy abilities, 11 students with moderate science literacy abilities, and 10 students with low science literacy abilities. This indicates that the average science literacy ability of students with a kinesthetic learning style in the 11th grade at MAN 1 Jombang falls into the moderate category with an average score of 38.7. Here is one of the answers from a student with a kinesthetic learning style:

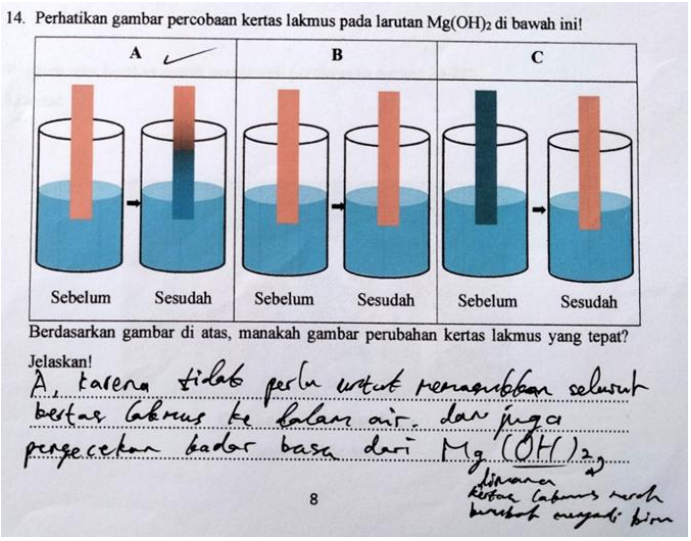

FIGURE 6. Student's Answer with a Kinesthetic Learning Style

In Figure 6, it can be seen that students with a kinesthetic learning style answered question number 14 at length, but their handwriting was less neat, making it difficult to read. This aligns with the theory that one of the characteristics of students with a kinesthetic learning style is the

possibility of having poor handwriting [31]. Additionally, someone with a kinesthetic learning style has the following characteristics: speaking slowly, difficulty remembering maps unless they have been to that place before, memorizing by walking and looking, using fingers as pointers while reading, being unable to sit still for long periods, always being physically oriented and moving a lot, and wanting to do everything. So, kinesthetic learners tend to remember information.

From this comparison, it can be concluded that learning styles influence students' patterns in delivering answers. Visual learners emphasize the aspect of visual order, auditory learners excel in lengthy verbal descriptions, while kinesthetic learners tend to be spontaneous with less neat handwriting. This difference reinforces the idea that learning styles have implications for how students express their understanding, both in terms of the form of their answers and the completeness of their explanations.

Based on the explanation of the analysis results of students' science literacy abilities for each learning style above, it is known that students with a visual learning style have a science literacy ability of 35% with an average score of 44, students with an auditory learning style have a science literacy ability of 34% with an average score of 42.5, and students with a kinesthetic learning style have a science literacy ability of 31% with an average score of 38.7. Although there is a tendency for differences between learning styles, the results do not show statistically significant differences.

A 2021 study stated that one of the factors influencing students' science literacy abilities is learning style. The ability of science literacy is influenced by students' learning styles, which is one of the psychological factors affecting academic achievement [12]. This means that as a factor that can influence academic achievement, learning styles can certainly affect science literacy skills [11]. Because learning styles are the ways students receive the knowledge provided by teachers during the learning process. The process of receiving knowledge from teachers can influence students' habits in utilizing the knowledge they possess in their lives. Thus, the knowledge they have can be applied to improve their science literacy skills. Therefore, teachers should adjust their teaching methods according to the students' learning styles so that the learning process can take place optimally.

C. Differences in Students' Science Literacy Based on Learning Styles

Based on the Kruskal-Wallis test results, the significance value obtained was 0.378. Based on the decision-making criteria, if the significance value > 0.05, then H0 is accepted and Ha is rejected. Therefore, it can be concluded that there is no difference in students' science literacy based on learning style in the acid-base material for 11th-grade students at MAN 1 Jombang. This indicates that students with visual, auditory, or kinesthetic learning styles do not show significant differences in their science literacy abilities. This research is supported by a study conducted in the Science Education Study Program, Faculty of Mathematics and Natural Sciences, Makassar State University (UNM), which involved students taking fluid mechanics courses in the 2019/2020 academic year. The study found that science literacy for all three learning styles was relatively the same, falling into the moderate category. Thus, it can be said that students' scientific literacy is not influenced by their learning style [32].

This can be influenced by several factors, including classroom learning, which most likely uses a blended learning approach that combines various learning methods. So that all types of students receive relatively balanced exposure. This approach has proven effective in accommodating diverse learning styles and reducing achievement gaps [33]. Acid-base material in science learning is both conceptual and practical, so mastering science literacy is more determined by understanding the concepts and applying them in daily life, rather than based on a specific learning style [34]. Additionally, the use of a uniform chemistry curriculum and teaching strategies across all XI MIPA classes at MAN 1 Jombang can minimize variations in achievement based on learning styles. Teachers tend to apply the same teaching methods to the entire class, in terms of media, strategies, and evaluation, so students with different learning styles receive relatively homogeneous learning stimuli.

Thus, these findings indicate that efforts to improve science literacy should focus on enhancing the quality of teaching, student engagement, and strengthening scientific thinking skills, rather than solely on adapting teaching methods to specific learning styles. A balanced, skills-based approach to science education can benefit all students, regardless of their learning style.

CONCLUSION

Based on the research findings, it can be concluded that students' science literacy skills on the topic of Acids and Bases fall into the moderate category with an average score of 41.77. Based on each

science literacy indicator, the indicator explaining phenomena scientifically scored an average of 42.30, which is also in the medium category. The indicators for designing and evaluating investigations and critically interpreting scientific data and evidence scored an average of 27.49, which falls into the low category. Meanwhile, the indicator for researching, evaluating, and using of scientific information for decision-making and action showed high results with an average score of 87.63. Based on learning styles, visual learners have a science literacy ability of 35% with an average score of 44, auditory learners have a science literacy ability of 34% with an average score of 42.5, and kinesthetic learners have a science literacy ability of 31% with an average score of 38.7. Although there are differences in mean scores between learning styles, statistically no significant difference was found in students' science literacy abilities based on learning style. This finding implies that improving science literacy is not sufficient by simply adjusting teaching methods to specific learning styles; rather, it is necessary to emphasize teaching strategies that strengthen all indicators of science literacy, particularly the ability to design investigations and interpret data. Teachers can consider using inquiry-based learning and guided experimentation approaches to evenly train scientific thinking skills across all learning styles.

RECOMMENDATION

Schools are expected to identify students' learning styles early on so that the teaching strategies implemented are more suitable for each individual's characteristics, whether thru visual media, discussion, or practical activities. Teachers are advised to present acid-base material by integrating multiple representations, particularly at the submicroscopic level, so that students gain a deeper conceptual understanding. For future researchers, an analysis of students with more than one learning style is needed so that the research can provide a more comprehensive picture and contribute to the development of science literacy in the field of chemistry education.

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