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Chemical Teachers Perception about Chemical Literacy, Cognitive Learning Strategies and Self-Efficacy in High School Students

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Abstract. This study aims to provide information related to chemical teachers' perceptions of chemical literacy, cognitive learning strategies, and self-efficacy in high school students in East Lombok. The research sample was five chemistry teachers (four female, one male). The sampling technique was done by purposive sampling. Data were collected using face-to-face open interviews (one-on-one), and participants were given 15 questions and collected in the form of video and voice recordings. The study results found that the terms chemical literacy and self-efficacy were still foreign to some teachers. They revealed that students' chemical literacy was still low. The student's chemical literacy ability was still in the content and context domain. The teaching and cognitive learning strategies most often applied by teachers and students in the classroom were rehearsal and discussions. More teachers reported that the rehearsal strategy was the most effective cognitive learning strategy to improve students' chemical literacy. The teacher also revealed that mastery experience, vicarious experience, and verbal persuasion were the most influential sources of self-efficacy to increase students' self-efficacy in learning chemistry. They revealed that chemical literacy, cognitive learning strategies, and self-efficacy influence each other, where cognitive learning strategies can improve students' self-efficacy and chemical literacy. Considering these results, teachers must improve their understanding of chemical literacy, cognitive learning strategies, and self-efficacy to help students improve their chemical literacy, learning strategies, and self-efficacy.

INTRODUCTION

Chemistry learning in high school is intended to equip students in chemical literacy, namely basic knowledge of chemistry that is useful in life, namely understanding how nature functions chemically [1], to produce students who are literate with chemistry, become more knowledgeable citizens, understand chemical reports, discuss chemistry, and better understand environmental problems related to chemistry [2]. Teaching chemistry contributes to chemical literacy in particular and scientific literacy in general [3]. An understanding of chemistry is essential because chemical explanations have practical applications in everyday life and help people take part in public debates about chemistry, understanding their daily life and environment [1].

Scientific literacy, including chemical literacy, is the main goal in learning. The assessment of scientific literacy becomes an essential component in learning activities. The research topics that are most researched are related to scientific literacy, which usually focuses on developing and validating students' content knowledge assessments, evaluating student performance, evaluating reading, writing, reasoning abilities, and measuring students' abilities related to science and their attitudes towards science [3].

Chemical literacy is defined as a person's ability to understand and apply knowledge of chemistry in everyday life in terms of three main aspects: knowledge, awareness, and application of chemistry in daily life appropriately and effectively [4]. Improving students' chemical literacy is the focus of teaching chemistry in basic sciences which includes various targets (domains), namely intellectual, personal, and social domains. So that teachers also have an

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important role in the development of the chemical literacy of students [5]. Chemical literacy is defined in 4 domains: content, context, high-level learning skills, and attitudes [3, 6].

The ability of students to understand chemistry learning cannot be separated from the teaching strategies applied by the teacher in teaching and how the learning strategies used by students in retrieving information. Educational psychology has researched the most effective learning strategies in long-term learning. As a result, delivering learning over time and self-testing (practice) are the two most valuable forms of learning strategies [7].

The majority of research empirically defines student learning strategies as a measurement of individual performance on tests or students' ability to remember information well [7]. Learning that has in-depth strategies, including elaboration learning strategies, metacognitive control strategies, critical thinking strategies, and organizational strategies, can support students to understand important information in learning [8, 9]. Cognitive strategies include learning strategies used by students in processing information from texts and lectures. The basic cognitive strategy subscale is the use of rehearsal by students (e.g., repeating words to themselves to remember information). Then the use of more complex strategies is measured by sub-scales of using elaboration strategies (e.g., paraphrasing, summarizing) and organizing strategies (e.g., describing, making tables). In addition, the sub-scale on critical thinking is included to assess the use of learning strategies learners to apply previous knowledge to new situations or make a critical evaluation of the ideas [10].

Self-efficacy is defined as students' beliefs about the extent to which they are able to complete their tasks [11, 12]. According to Bandura [13], self-efficacy has been found to be a strong predictor of influencing academic achievement, course selection, and career decisions across domains and age levels.

Students both at the school and university level consider chemistry a difficult and scary subject. This causes them to have levels of self-efficacy (confidence) low in chemistry learning so that students choose to avoid chemistry lessons [14]. On the other hand, the research found that students with high self-efficacy chemistry have the perseverance and effort to complete their tasks and improve their achievement [15, 16]. Learners will gain related to their level of self-efficacy through 4 sources, namely mastery experience, vicarious experience, verbal persuasion, and emotional/ physiological states [13].

Mastery experience refers to how successful students are in completing their assignments. The success obtained repeatedly can increase the self-efficacy of students and not reduce their self-efficacy. Vicarious experience refers to how a person experiences after seeing other people do something (observation of other people's behavior). Verbal persuasion refers to that a person can do their job if they get persuasion from a trusted person such as their class teacher. The physiological state refers to how students feel before, during, and after engaging in completing their tasks. Students will evaluate the physiological and emotional reactions they feel in completing tasks such as fast heart rate, shaking, and sweating. Physiological or emotional circumstances such as anxiety, stress, and fatigue also contribute to self-efficacy [11]. Based on the introduction, this study aims to provide information related to chemical teachers' perceptions of chemical literacy, cognitive learning strategies, and self-efficacy in high school students in East Lombok.

METHOD

This study used a descriptive qualitative approach to determine teachers' perceptions of chemical literacy, cognitive learning strategies, and self-efficacy in high school students. The population in this study were chemistry teachers in East Lombok. The participants in this study were five chemistry teachers from 3 public high schools from 3 sub-districts in East Lombok Regency (4 female, 1 male). The sampling technique used was purposive sampling with the following criteria: chemistry teacher with teaching experience of more than 10 years and teaching in accredited schools A. The instrument used was an interview protocol form designed by the author, containing 15 questions to then asked participants during the interview process. Interviews were conducted in each school where the participants taught. The following are the items of interview questions that were asked to the interviewees (Table 1):

TABLE 1. List of interview question items

Aspect	Interview Question Items
Knowledge related to chemical literacy, cognitive learning strategies, and self-efficacy	1. Have you ever heard of chemical literacy, cognitive learning strategies, and self-efficacy? 2. What do you know about chemical literacy, cognitive learning strategies, and self-efficacy?

Aspect	Interview Question Items
	3. Can you tell me in more detail about the students' chemical literacy skills that you have observed while teaching?
Knowledge related to 4 domains of chemical literacy and students' chemical literacy conditions	4. Based on theory, chemical literacy skills can be seen in 4 domains, namely content, context, high-level learning and chemical attitudes. Do you know the explanation of these 4 domains before?
	5. Among the 4 domains, which one is the most prominent, or do you find the students most often? In your opinion, why did this happen?
Knowledge related to 4 cognitive learning strategies and cognitive learning strategies applied by teachers and students	6. Can you tell me in more detail about your learning strategies while teaching chemistry and students' learning strategies in learning chemistry?
	7. Based on the theory, there are 4 cognitive chemistry learning strategies for students, namely rehearsal, elaboration, organizing and critical thinking. Do you know the explanation of these 4 learning strategies before?
	8. Based on your observations during teaching, which of the cognitive learning strategies have been applied and which are most often used by students in learning? And which strategies do you often apply in teaching?
Knowledge related to 4 sources of self-efficacy and self-efficacy in students	9. Can you tell me in more detail about the self-efficacy of students in learning chemistry?
	10. Based on the theory, students' self-efficacy can be obtained from 4 sources, namely mastery experience, vicarious experience, verbal persuasion, and emotional/physiological states. Do you know the explanation of these 4 sources of self-efficacy before?
	11. Based on your observations during teaching chemistry, can you explain which of the 4 sources of self-efficacy has the most influence on increasing students' self-efficacy in learning chemistry?
Knowledge related to the relationship and influence of chemical literacy, cognitive learning strategies, and self-efficacy	12. From the three questions I asked, according to you, is there a relationship between chemical literacy, cognitive learning strategies and self-efficacy? Can you explain how the relationship and influence between the three?
	13. In your opinion, can learning strategies affect students' chemical literacy and self-efficacy?
	14. In your opinion, can self-efficacy affect students' learning strategies and chemical literacy?
	15. In your opinion, can chemical literacy affect students' learning strategies and self-efficacy?

The data collection techniques used face-to-face open interviews (one-on-one). Collect data was in the form of an interview sheet containing interview questions and used audiovisual materials in voice and video recordings. Before the data analysis process, the things that were done were organizing and transcribing the data. Organizing data was done by collecting and storing voice and video recordings of interviews. The voice and video recordings were transcribed in the form of text data typed in Microsoft Word. The transcripts of the data obtained were analyzed manually. Analysis of the data carried out was exploring and coding the data. In the data exploration stage, the author read the transcript of the data as a whole and repeatedly then grouped it into several parts. In the data coding stage, 15 discussion topics (interview questions) were coded and narrowed down to several discussion topics according to the aspects of the interview questions. The last stage was the author drawing conclusions from each topic of discussion that can be informed to others. This study uses descriptive data analysis, which provides an overview of an object of research through the data collected and then draws conclusions that apply in general. The accuracy and validity of the research results were carried out by member checking and external auditing procedures. The data has been analyzed and concluded, then validated by confirming to the respondent or rechecking by the respondent and asking others to read and provide suggestions. A summary of the research procedure can be seen in Fig. 1:

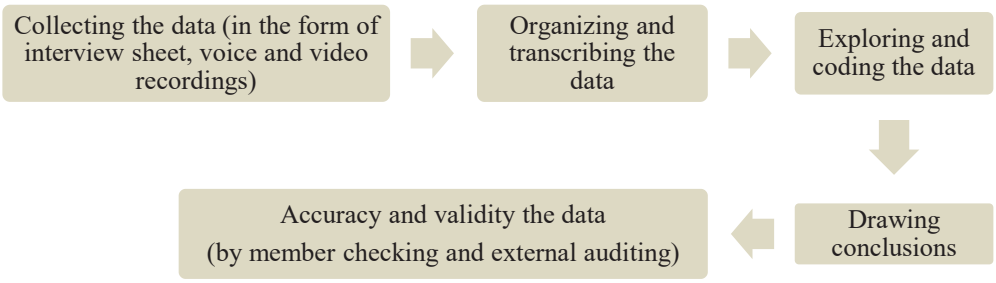

FIGURE 1. Research procedure

RESULTS AND DISCUSSION

Research has been conducted to find out how teachers perceive chemical literacy, cognitive learning strategies, and self-efficacy in high school students. Participants were given 15 questions. The first question asked whether they had previously heard chemical literacy, cognitive learning strategies, and self-efficacy. From the interviews obtained information that the average teacher was not familiar with the term chemical literacy. The learning strategies are very familiar to them. While the term self-efficacy, all participants answered on average that they had never heard of the term. Furthermore, they were then asked to explain how chemical literacy they understood and the condition of the chemical literacy of the students they teach. Based on the responses from the participants, the average teacher understands that chemical literacy is chemistry learning resources, such as books, the internet, and other supporting learning media define. Chemical literacy as a person's ability to understand science and apply their understanding in everyday life [4]. Participants revealed that chemical literacy ability of students cannot be generalized. They have sufficient abilities and tend to be good. Students' chemical literacy is very diverse; some are good, and some are ordinary. Most are normal. There are also difficult ones. Overall, it can be said that the chemical literacy abilities of students are good, and many students have low chemical literacy skills.

Next, the researcher explained to the participants the definition of chemical literacy according to the previous research [3, 6] can be seen in Table 2.

TABLE 2. The definition of chemical literacy through 4 domains, namely content, context, skills, and attitudes [3, 6]

Domain of chemical literacy	Definition
Chemical science content knowledge	1. A person who is literate in chemistry will have an understanding of: • Scientific ideas in general. • Chemistry is an experimental discipline. A chemist is able to carry out scientific investigations, make generalizations of findings, and suggest theories to explain natural knowledge. • Chemistry provides knowledge that connects chemistry with other sciences, such as explaining phenomena in the earth sciences and life sciences. 2. Chemical characteristics • Chemistry describes macroscopic phenomena in the microscopic structure of matter. • Chemistry investigates chemical processes and reactions. • Chemistry investigates energy changes in chemical reactions. • Chemistry aims to understand and explain the structures of chemical molecules in life. • Chemists use a certain scientific language. People who are literate in chemistry do not have to use the language but must know the use of the language for the development of the discipline of chemistry.
Chemistry in context	A person who is chemistry literate is able to: • It knows the importance of chemical knowledge in explaining everyday phenomena.

Domain of chemical literacy	Definition
	• Use their understanding of chemistry in everyday life as consumers of new products and technologies, in decision making, and participate in social debates related to chemistry issues. • Understand the relationship between chemical innovation and sociological processes.
High-level learning skills	It is the ability to ask questions, investigate relevant information when needed, and evaluate the pros and cons of debates in chemistry.
Affective Aspect	It is the ability of students to have a fair and rational chemical perspective related to chemistry and its applications. In addition, students must show an interest in chemistry topics and problems, especially in non-formal frameworks or environments such as mass media/television programs.

Participants were asked whether they had previously heard an explanation related to the four domains and how students' literacy ability was when viewed from the four domains. Some teachers revealed that the term 4 domains were still foreign because it was not used in the teacher's habituation environment. However, 2 of the participants said that they had never heard of this explanation. They also informed that the average student has chemical literacy skills in the content domain. Some of the students have achieved more understanding of chemistry in the context and high-level learning. From the teacher's explanation, it can be concluded that students' chemical literacy skills are generally still in the content and context domain. The study [3], revealed that knowledge of chemical content is considered necessary in scientific literacy. So this is most often assessed by teachers to measure the scientific memory of students [17].

After the discussion related to chemical literacy, participants were asked what they understood about learning strategies, what teaching strategies they often applied, and what students' learning strategies they observed in class. Most of the participants defined learning strategies as the way they used to deliver material in the class. Each participant also explained the teaching strategies they used most often. On average, the participants answered that the strategies they used in learning were sometimes different, depending on the class conditions. Like the answer that student's study at different times, in different classes, in different class conditions, the teaching strategies used are also different. Although the learning implementation plan has been prepared in such a way as to how the teaching methods and techniques are used, in the field, only 50% of the implementation is in accordance with the learning implementation plan because the teaching implementation is adjusted to class conditions. Some reveal the learning strategy they use is to provide problems to students, then ask them to complete the solutions and present the results. One teacher also explained in detail the teaching strategies she used, namely playing videos, observe real-life events, asking questions to students, and then asking them to discuss the answers. As for the learning strategies students use in the class based on observations from several participants is a discussion strategy. Students will quickly understand the lesson when they discuss, and through discussion, students become more active, especially those with a high literacy level. However, some learners prefer to hear (lecture) in learning. Discussion strategies carried out by students in learning can regulate their way of thinking. The discussion is a very important strategy in teaching. Many students participating in the discussion requires not only good questions but good management frameworks, and teaching strategies [18].

Before starting the next question, the researcher equates perceptions with participants regarding cognitive learning strategies. The researchers gave participants information related to cognitive learning strategies are 4 rehearsal, elaboration, organization, and critical thinking is the most widely discussed by previous researchers [8-10], [19, 20]. Participants were asked whether they had previously never heard related 4 cognitive learning strategies and how cognitive learning strategies are often applied to teachers in teaching and are most often applied to learners in the classroom. Response from each teacher stated that they had never heard related 4 the cognitive learning strategies. However, they indicated that learning strategies such as rehearsal, elaboration, organizing, and critical thinking are all in the learning process. Were started with practice questions, elaborating, and providing confirmation of what they had learned. The mean average response of participants revealed that the most commonly applied strategy is a rehearsal and sometimes elaboration strategy. Meanwhile, the organizing strategy is still minimal. However, the strategy most often applied by students in the classroom is the rehearsal strategy. Although the study results [19] also revealed that students considered rehearsal to be a more important strategy than other strategies. However, in learning activities, teachers are expected to be able to apply other cognitive strategies. Teaching strategies and learning strategies applied by teachers and students in schools can be seen in Table 3.

TABLE 3. Teaching strategies and learning strategies applied by teachers and students in schools

Teaching Strategies Applied by Teachers	Learning Strategies by Students
1. Adapting to class conditions. The same class but learning at different times, the learning strategies used are different. 2. Give the questions, pictures, play videos, observe real-life events. Students are given the opportunity to discuss, dig up information, and then later provide appropriate conclusions and solutions. 3. Discussions. 4. Give freedom to students looking for a solution to the problem presented and then are asked to present the results (Problem Based Learning). 5. Prepared the lesson plan (RPP), but only 50% RPP can be undertaken, and the implementation of the RPP is adjusted according to the condition of the class.	1. Rehearsal 2. Elaboration 3. Discussions

Participants were asked which cognitive learning strategies could improve students' chemical literacy skills, more of them answered that rehearsal was a learning strategy that could improve students' chemical literacy skills because rehearsal learning strategies were the most effective strategy often used. Dunlosky [21] discusses effective learning strategies to be applied in long-term learning, including rehearsal that are carried out time after time or continuously; elaboration is also effective for long-term learning but needs more research, organizing such as drawing texts is also useful in long-term learning, but more research is needed to prove it. Meanwhile, Lynch & Trujillo [19] revealed that the practice of learning strategies is not an effective learning strategy. Rehearsal is an effective learning strategy only for initial learning but less effective for complex learning targets. Meanwhile, elaboration and organization are deep learning strategies. In elaboration, learners can develop their basic knowledge through paraphrasing, summarizing, making an analogy, and general notes [19]. Through organizing, students can identify the structure of their knowledge [19]. Meanwhile, through critical thinking, students can apply previous knowledge to new situations or critically evaluate the ideas [10].

Furthermore, the researcher did not ask how the participants' understanding of self-efficacy caused the average answer from the participants is that they have never heard of the term self-efficacy. So the researcher immediately explained the definition of self-efficacy and the 4 sources of self-efficacy according to Bandura [15]. Furthermore, when asked to participants which of the 4 sources of self-efficacy, which is the most influential source in increasing students' self-efficacy in learning chemistry, most of them revealed that vicarious experience (seeing other people) is the most influential source of efficacy. This is because students will be easily motivated to complete their chemistry assignments when they see their friends are able to complete their tasks. The teacher also revealed that she chose a peer tutor strategy from student discussion groups. Students with low self-efficacy would be grouped with friends who had high self-efficacy.

The teachers revealed that students who received support from teachers and friends had a high level of self-efficacy, especially if they were asked by the teacher to come forward to work on the problem. When students are given support to come forward working on questions, they can definitely complete the task so that their self-efficacy increases. The learners who gain the support of learning from their teachers, learn from classmates, support verbally, and are supported by friendly learning environments tend to have high levels of self-efficacy higher than those who did not receive support from teachers [11]. Some teachers also revealed that mastery experience is a source of efficacy that can increase students' self-efficacy. Previous research revealed that the mastery experience also is the most influential source [15], significantly predicting science self-efficacy [22]. Teacher perceptions related to 4 sources of self-efficacy and their effect on increasing students' self-efficacy, can be seen in Table 4.

TABLE 4. Teacher perceptions related to 4 sources of self-efficacy and their effect on increasing students' self-efficacy

Teacher's Statement

1.	Mastery experience and verbal persuasion are the most influential sources of efficacy in increasing students' self-efficacy. Students who get support from teachers and friends have high self-confidence. If they are at the request forward, they certainly can. Because they are given support and praise by the teacher.
2.	Mastery experience and vicarious experience and the most important verbal persuasion of the teacher is the source of efficacy that can improve the self-efficacy of students.
3.	Vicarious experience/experience from others is the most influential source of self-efficacy that can increase students' self-efficacy. When students see their friends are more capable, they will be motivated to complete their tasks.
4.	Vicarious experience/experience from others is the most influential source of self-efficacy that can increase students' self-efficacy. To improve students' low self-efficacy, peer tutoring strategies are applied. In the discussion team, students who have low self-efficacy were paired with students who have high self-efficacy.
5.	Mastery experience and vicarious experience are the most influential sources of self-efficacy that can increase students' self-efficacy. Students will be motivated to learn chemistry because they see their friends.

After discussing chemical literacy, cognitive learning strategies, and self-efficacy, the researcher tried to ask the participants whether the three were related and influenced each other. All participants stated a mutually supportive relationship between chemical literacy, cognitive learning strategies, and self-efficacy. On average, participants answered that learning strategies could increase students' self-efficacy. The teaching that increases self-efficacy affects how students' learning strategies can affect students' self-efficacy [11]. One teacher also revealed that learning strategies could also improve students' chemical literacy. This is supported by the results study [23], which showed that controlled learning strategies contribute to increasing students' mathematical literacy skills. The relationship and effect between chemical literacy, chemical cognitive learning strategies, and students' self-efficacy can be seen in Table 5.

TABLE 5. Relationship between chemical literacy, chemical cognitive learning strategies and students' self-efficacy

	Teacher's Statement
1.	All three have a relationship and support each other in forming student understanding because the strategy can increase students' literacy.
2.	All three are related. Learning strategies support how students have self-efficacy in chemistry learning.
3.	All three are very related. Literacy is part of a learning strategy. A good learning strategy can increase students' self-efficacy.
4.	All three have a relationship. These three things are in the class, although the percentages are different. These three components are always presented in class. For example, to raise students' self-efficacy, we must use learning strategies that can increase students' self-efficacy.

Finally, as an affirmation, the researcher then asked the participants whether learning strategies could affect the chemical literacy and students' self-efficacy, self-efficacy could affect students' learning strategies and chemical literacy, and chemical literacy could affect students' learning strategies and self-efficacy, almost all participants answered "Yes. “Although 1 person still answered hesitantly (possibly) on the statement "self-efficacy can affect students' learning strategies and chemical literacy".

CONCLUSION

This study aims to provide information related to chemical teachers’ perceptions of chemical literacy, cognitive learning strategies, and self-efficacy in high school students in East Lombok. From the interviews, we obtained information that the terms chemical literacy and self-efficacy were still foreign to some teachers. They revealed that students' chemical literacy was still low. The student’s chemical literacy ability was still in the content and context domain. The teaching and cognitive learning strategies that teachers and students most often applied were rehearsal and discussions. More teachers reported that rehearsal was the most influential cognitive learning strategy to improve students' chemical literacy. The average teacher also revealed that the most influential sources of self-efficacy to

improve students' self-efficacy in learning chemistry were mastery experience (achievement), vicarious experience, and verbal persuasion. The teachers also revealed that chemical literacy, cognitive learning strategies, and self-efficacy had a relationship and influence each other; cognitive learning strategies can improve students' self-efficacy and chemical literacy. Despite the limitations of the findings of this study, it is hoped that further research can examine conducting teacher interviews with different discussion topics, larger samples, different areas, and conducting more in-depth interviews. Considering these results, teachers must improve their understanding of chemical literacy, cognitive learning strategies, and self-efficacy to help students improve their chemical literacy, learning strategies, and self-efficacy.

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