Electrochemistry Textbooks for Senior High School Students: Need Analysis

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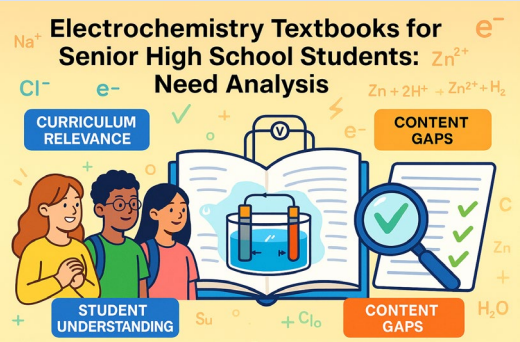
Abstract

This study aims to determine the learning resources, methods, and media teachers commonly use for chemistry instruction. It also seeks to assess students' utilisation of textbooks and teaching materials, how they obtain learning resources, the electrochemistry topics that students find challenging, and the characteristics of textbooks they desire. Data regarding students' scientific literacy skills were gathered using the TOSLS instrument, and student responses were collected through a questionnaire administered via Google Forms, which included 12 questions. The scientific literacy skills assessment results yielded a score of 55.28, placing it in the low category. The findings from the questionnaire revealed: 1) Teachers prefer using resources from the internet; 2) Teachers more frequently utilise lecture and assignment methods; 3) Teachers more often employ blackboard media; 4) Students do not fully utilise textbooks and teaching books; 5) Students primarily acquire textbooks and teaching materials by borrowing from the library; 6) Students face difficulties when studying chemistry books, particularly with electrochemistry topics and voltaic cell materials; and 7) Students desire textbooks that feature chemical representation characters.

Graphical Abstract



Keywords:

Chemical literacy; Science literacy; Chemical representation; Chemistry learning; Learning material

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Introduction

Of the various learning resources available, students most often use textbooks. Textbooks are instructional media that play a dominant role in the learning process, facilitating the learning process so that student competence can be achieved as expected (Ulumudin, 2017).

Meanwhile, textbooks are subject matter materials arranged systematically and show the competencies that students will master during learning activities. A textbook assists teachers in delivering learning materials so that learning objectives can be achieved (Suwarni, 2015). From this definition, it can be concluded that both play an important role in the learning process to attain essential competencies, especially students' science literacy skills.

Merdeka Curriculum is a flexible curriculum based on character and competence at the same time, which was determined by the government starting in 2022/2023 at the primary and secondary education levels (Mulyasa, 2023). In this curriculum, the terms Core Competencies (CC) and Basic Competencies (BC) are replaced with a new term, namely Learning Outcomes (LO), so that the position of the LO in the era of the independent curriculum has an equal position with the CC and BC in the 2013 curriculum era. The learning outcomes consist of a series of knowledge, skills, and attitudes as a unity that must be achieved through the learning process in building complete competence for students. Therefore, the assessment developed by teachers must cover the learning outcomes that have been determined previously.

High school chemistry lessons are contained in phases E and F of the learning outcomes. Phase F learning outcomes for high school chemistry lessons are that at the end of phase F, learners can understand chemical calculations, properties, structures, and particle interactions in forming various compounds, including processing and their application in everyday life; understand the concepts of reaction rates and chemical reaction equilibrium; understand the concept of solutions in everyday life; understand the concepts of thermochemistry and electrochemistry; understand organic chemistry including its application in everyday life. These concepts enable learners to apply and develop their science inquiry skills, which are further divided into science understanding and science skills.

One of the measurable chemistry learning outcomes related to science understanding and skills is grasping the concept of electrochemistry and its application in everyday life. Electrochemistry explores the relationship between chemical compounds and electricity, demonstrating how chemical reactions can generate electrical voltage or how electricity can drive chemical reactions (Setianto & Wardani, 2021). Electrochemical sub-materials, namely voltaic cells, study chemical reactions that create electric voltage. Conversely, electrochemical sub-materials, such as electrolysis cells, examine electricity that can induce chemical reactions. At the same time, electrochemical sub-materials like redox reactions, oxidation numbers, balancing of redox reactions, and electrolyte and non-electrolyte solutions relate to both voltaic and electrolysis cells. The conceptual electrochemical sub-materials of redox reactions, oxidation numbers, balancing of redox reactions, and electrolyte and non-electrolyte solutions are interconnected.

In contrast, the electrochemical topics of voltaic and electrolysis cells are applications. The concepts of electrolyte and non-electrolyte solutions in electrochemistry form a foundational understanding of electrochemical materials. In this area, students are encouraged to observe various solutions to grasp the characteristics of electric current transmission. These solutions are categorised into electrolyte and non-electrolyte based on their electrical conductivity.

Science literacy skills are crucial for addressing the challenges of the 21st century, as many everyday problems are closely linked to science (Basam, 2022). When viewed through its definition, scientific literacy is the ability to utilise scientific knowledge, formulate questions, draw conclusions, and make inferences to comprehend the universe and make informed decisions about how human activities impact the world (Pujiyanti et al, 2022). Science literacy encompasses various aspects, including knowledge, processing, disposition (behaviour and attitude), and its relationship with environmental facts (Hakim, 2024). Therefore, adequate learning resources are necessary to support the implementation of the Merdeka curriculum, particularly in assessing phase F learning outcomes, especially in the area of science literacy skills concerning electrochemical materials. Learning resources encompass sources such as information, people, materials, tools, techniques, and backgrounds that students utilise to engage in learning activities and that can enhance the quality of their educational experience (Supriyadi, 2015).

The use of learning resources must be linked to the learning outcomes established in the learning process. In other words, learning resources are selected and utilised during the learning process when they are appropriate and support the achievement of basic competencies, specifically students' science literacy skills in electrochemistry. As facilitators in learning, teachers need strategies to enhance students' science literacy skills, particularly concerning electrochemical materials. These strategies involve using tools, methods, or learning models that promote the development of students' science literacy skills. One essential resource in this process is textbooks. A textbook is a unit of learning that includes information, discussions, and evaluations systematically arranged to help students grasp the material and support the achievement of learning objectives (Ningrum et al, 2019). On the other hand, textbooks used must meet standards, namely material standards, presentation standards, design standards, and graphic standards.

Previous research has identified the effectiveness of textbooks in the chemistry learning process at the high school level. It has been found that textbooks play an important role in enhancing cognitive learning outcomes, problem-solving skills, critical thinking abilities, concept understanding, attitudes, and student interest in chemistry. However, the study found no positive impact of textbooks on improving science literacy skills, particularly in electrochemistry. Therefore, it is necessary to develop electrochemical textbooks designed to enhance science literacy skills.

On the other hand, the availability of textbooks, especially chemistry textbooks for class XII in the independent curriculum era, is notably limited, particularly concerning electrochemical material, making them challenging to find in the market or school libraries. A search on the National Library website yielded only thirty-eight monograph books titled Electrochemistry. In general, school textbooks provide knowledge for specific fields of science or subjects. They are intended for students at particular educational levels or serve as teaching handbooks for teachers, either as primary resources or supplementary materials. They cover various topics using various learning methods and models, sometimes making it difficult for students to learn effectively.

Therefore, developing a textbook on electrochemistry is essential based on this description. However, before the book is created, it is important to analyse the necessity of textbooks on electrochemical materials that can later be used to enhance students' science literacy skills. The needs analysis for this textbook is described through two research focuses: 1) students' initial science skills in electrochemistry before utilising textbooks and 2) analysing the requirements of XII grade high school students for electrochemistry textbooks based on the results of questionnaires distributed to students.

Method

The purpose of this study was to determine the initial science literacy skills of students before using teaching books and to explore how students utilise textbooks, acquire learning resources, identify difficult sub-materials in electrochemistry, and express the characteristics of textbooks they desire to support their chemistry learning in electrochemistry. Teachers often employ various learning resources, methods, and media during chemistry instruction. Additionally, this research examines the commonly used learning resources, methods, and media teachers use in the chemistry classroom.

Observation data is in the form of students' science literacy skills, and the results of interviews are questionnaire data related to the needs of textbooks and the learning process in the classroom. This study used the Test of Scientific Literacy Skills (TOSLS) instrument to measure science literacy skills. Science literacy skills are calculated based on two aspects, namely a) developing a comprehensive approach to understanding the methods of inquiry that lead to scientific knowledge, and b) Organising, analysing, and interpreting quantitative data and scientific information (Gormally et al, 2012). Each of these aspects is grouped into nine indicators, namely: (1) identifying valid scientific arguments, (2) evaluating the validity of scientific arguments, (3) evaluating the use and misuse of scientific information, (4) understanding the elements of research design, (5) making graphical representations of data, (6) reading and interpreting graphical representations of data, (7) solving problems using quantitative skills, including probability and statistics, (8) understanding and interpreting basic statistics, and (9) justifying conclusions, predictions, and conclusions based on quantitative data. Science literacy in electrochemical materials is the ability of students measured based on two aspects, namely a) developing a comprehensive approach to understanding the methods of inquiry that lead to scientific knowledge, and b) organising, analysing, and interpreting quantitative data and scientific information on electrochemical concepts such as electrolyte-nonelectrolyte solutions, redox reactions, voltaic cells, and electrolysis cells. The respondents were the class XII students of SMAN 1 Pronojiwo, with 105 students engaging in chemistry learning.

The research data includes information on students' science literacy skills and their textbook needs. Data regarding students' science literacy skills can be gathered using the TOSLS instrument, which comprises 25 items on electrochemical material. The skills data obtained from students were subsequently analysed to establish the criteria for their science literacy skills. The technique for collecting data on textbook needs and learning processes is through

questionnaires distributed in the form of Google Forms. The questionnaire instrument contains 12 closed questions directed at students regarding textbooks and the learning process concerning electrochemistry material.

Results & Discussion

Table 1 shows the results of observations of the science literacy skills of XII-grade high school students on electrochemical materials with electrolyte and non-electrolyte solutions, redox reactions, voltaic cells, and electrolysis cells.

Table 1. Science literacy test results using TOSLS

No	Science Literacy Indicators	topic	Correct answers (%)
1	Identify valid scientific arguments	Electrolyte and non-electrolyte solutions	68,6
2		Redox Reactions	52,4
3		Voltaic Cell and Electrolysis Cell	70,5
4	Evaluate the validity of Scientific arguments	Electrolyte and non-electrolyte solutions	41,0
5		Redox Reactions	46,7
6	Evaluating the Use and Misuse of Scientific Information	Electrolyte and non-electrolyte solutions	31,4
7		Redox Reactions	64,8
8		Electrolysis Cell	35,2
9		Voltaic Cell	55,2
10	Understanding Elements of Research Design & How They Affect Scientific Findings/Conclusions	Electrolyte and non-electrolyte solutions	54,3
11		Redox Reactions	60,0
12		Electrolysis Cell	74,3
13		Voltaic Cell	49,5
14	Creating Graphical Representations of Data	Redox Reactions	70,5
15			48,6
16	Reading and Interpreting Graphical Representations of Data	Electrolyte and non-electrolyte solutions	32,4
17		Redox reactions	71,4
18	Solve problems using quantitative skills, including probability and statistics	Voltaic Cell	73,3
19		Electrolyte and non-electrolyte solutions	75,2
20	Understanding and Interpreting Basic Statistics	Electrolysis cell	54,3
21		Redox reactions	81,0
22	Justifying Conclusions and Predicting Based on Quantitative Data	Electrolysis cell	11,4
23		Redox reaction	61,0
24		Voltaic Cell	42,9
25		Voltaic Cell	56,2
Average			55,28

Students' science literacy scores on electrochemical materials, including electrolyte and non-electrolyte solution sub-materials, redox reactions, voltaic cells, and electrolysis cells, range from the lowest score of 11.4% to the highest of 81.0%. The lowest percentage score indicates difficulties in justifying conclusions and making predictions based on quantitative data related to the electrolysis cell sub-material. In contrast, the highest score reflects an understanding and interpretation of basic statistics in the redox reaction sub-material.

Generally, science literacy skills are categorised using interval score criteria: very good (80% - 100%), good (66% - 79%), sufficient (56% - 65%), low (40%- 55%), and very low (30% - 39%)(Arikunto, 2013). From this data, the science literacy skills of students in class XII SMAN 1 Pronojiwo regarding the topic of electrolyte and non-electrolyte solutions, as well as redox reactions, are categorised as low, with an average percentage value of 55.28%.

To gather insights from students regarding the necessity of textbooks, researchers include the following questions in the questionnaire: 1) What learning materials or resources does your chemistry teacher frequently use in class?; 2) How do teachers present the subject matter in class?; 3) What types of learning media do teachers commonly incorporate during lessons?; 4) Have you ever utilised a textbook while studying chemistry?; 5) How frequently do you refer to a textbook when studying chemistry?; 6) Where do you obtain textbooks for chemistry studies?; 7) Do you find it challenging to comprehend the content when reading the textbook?; 8) Does the textbook you read include explanations of electrochemistry material?; 9) Is there a need for an electrochemistry textbook within the chemistry curriculum?; 10) What type of textbook would you prefer?; 11) Do you face challenges in understanding chemistry lessons, particularly concerning electrochemistry?; and 12) Which electrochemistry subtopics do you find difficult to grasp? The data from the students' responses to these questions will be analysed qualitatively.

Answer to question 1

The learning process is a communication process that involves three main components: the message sender (teacher), the message receiver (student), and the message itself, which usually includes subject matter. In this process, communication failures often occur; specifically, the subject matter may not be optimally absorbed by students as message recipients. Therefore, teachers, as message senders, need to develop learning strategies by utilising varied resources so that students can absorb the material effectively.

Figure 1. Learning materials are often used by chemistry teachers

In question number 1, which pertains to the learning materials and resources frequently used by your chemistry teacher in class, 54 students responded with the internet, 51 with modules or textbooks provided by the teacher, 29 with textbooks, and 4 with LKS. These responses indicate that the teacher employs multiple learning resources during instruction. For example, the teacher prompts students to open their textbooks at the start of a lesson. When students encounter difficulties with the textbook, the teacher encourages them to seek additional resources such as LKS, the internet, and teacher-provided textbooks. Generally, students noted that the teacher often utilises online learning resources.

Answer to question 2

Question 2 relates to how the teacher delivered the subject matter in class. In other words, this question asks students to identify teachers' teaching methods. The teacher utilises the teaching method to realise the learning strategy by establishing relationships with students during the teaching process (Sudjana, 2019).

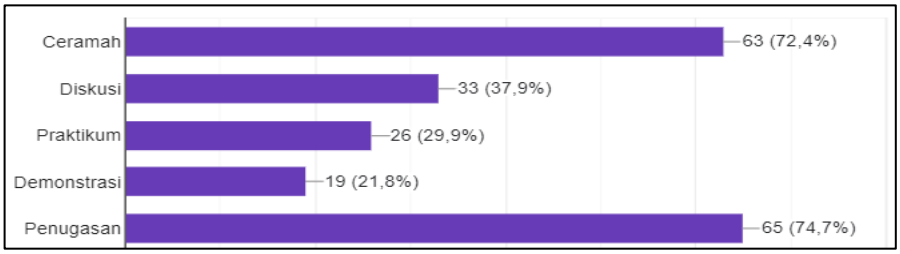

Figure 2. How teachers deliver the subject matter in class

From this question, 65 students completed the assignment, 63 attended the lecture, 33 participated in the discussion, 26 participated in the practicum, and 19 engaged with the demonstration. The students responded because they observed the teacher delivering the material over several meetings. For example, at the beginning of the lesson, the teacher presented the material in a lecture and assigned tasks to students at the end. At the next meeting, the teacher conducted a practicum that began with a discussion and a demonstration in front of the students. This combination of methods aims to assist students in executing the practicum correctly. Although various teaching methods exist, none function independently in practice. The teacher must select the appropriate method to foster an effective learning process.

Answer to question 3

Edgar Dale's cone of proximal development describes the acquisition of students' abstract knowledge that is only conveyed verbally (Susilana & Riyana, 2007). This means that students may know words without fully understanding their meanings, which can lead to misperceptions about their comprehension of the subject matter. Therefore, teachers must utilise various learning media to minimise students' misconceptions when engaging with the content, especially in electrochemical studies. In question number 3, which pertained to the types of learning media used by teachers, 87 students indicated the blackboard, 34 indicated pictures, 17 indicated textbooks or learning modules, 7 indicated learning videos, and 7 indicated additional textbooks.

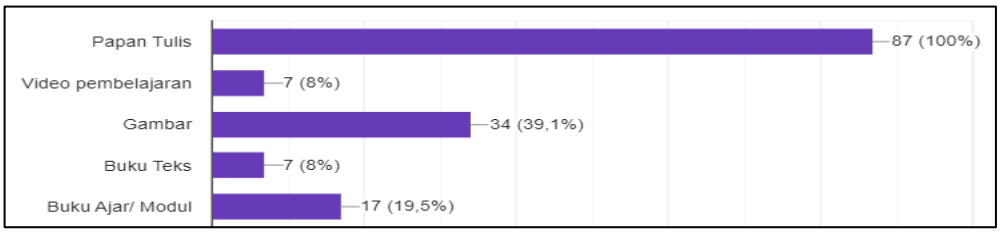

Figure 3. Learning media that teachers often use

The students' responses reflect their observations of the teacher's delivery of the material during lessons. For instance, the teacher presented a learning video at the beginning of the lesson. Furthermore, the teacher instructs students to seek information in textbooks or other sources. After that, the teacher explains concepts using two-dimensional images on the blackboard to help students better understand the material presented. Similar to various learning methods, using diverse media or resources is expected to enhance the quality of classroom learning and ensure that learning outcomes are achieved.

Answer to question number 4

The results of previous studies in Table 1 show that textbooks play an essential role in achieving learning objectives, especially in chemistry subjects. In question number 4, regarding whether you have used textbooks while studying chemistry, 75.9% of students answered no, and 24.1% answered yes. The students' responses were based on their experiences during the learning process from several meetings, specifically that a small proportion of teachers used textbooks or teaching books, while most teachers did not. In other words, most teachers are reluctant to use textbooks or teaching books because the availability of these resources is limited and the content is often less relevant. This irrelevance arises because the existing textbooks or teaching books still adhere to the old curriculum, and the latest textbooks are limited in number.

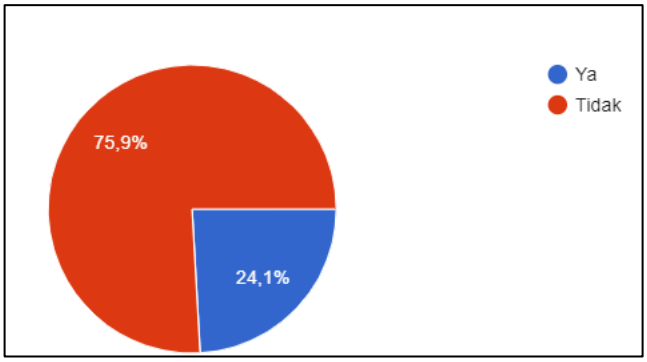

Figure 4. Percentage of the use of textbooks/teaching books when learning chemistry

Answer to question 5

In question number 5, related to how often students use textbooks while studying chemistry, 57.5% of respondents indicated that they never use textbooks, 28.7% stated that they rarely use textbooks, and 13.8% reported that they only use textbooks during chemistry lessons. The students' answers are based on their experiences learning chemistry in several sessions, where they rarely or never utilise textbooks. Furthermore, students seldom use textbooks because they are accustomed to accessing information on subject matter as learning enrichment material through internet media on the devices they carry. However, teachers must also pay attention to various factors related to students' use of internet technology, namely: 1) evaluating which topics need to be understood, 2) considering the expected learning objectives, 3) noting how students develop their level of understanding while using internet technology, 4) contemplating how to evaluate it, and 5) fostering collaboration

between teachers and students during learning that involves internet technology (Santrock, 2016).

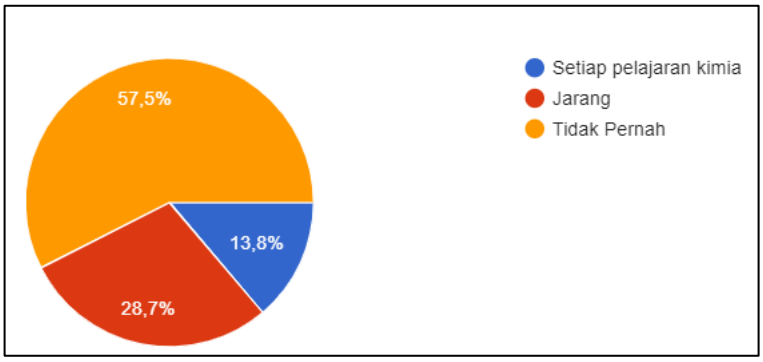

Figure 5. Percentage of the intensity of using textbooks when learning chemistry

Answer to question number 6

In question number 6, related to how students obtain textbooks or teaching books when studying chemistry, 34.5% reported obtaining them from the library, 32.2% from the internet, 21.8% from the teacher, and the remaining 11.5% provided other responses. These other responses stemmed from students not needing to search for textbooks because they had sufficient information from the teacher's explanation on the blackboard, and their classmates already possessed textbooks from the library.

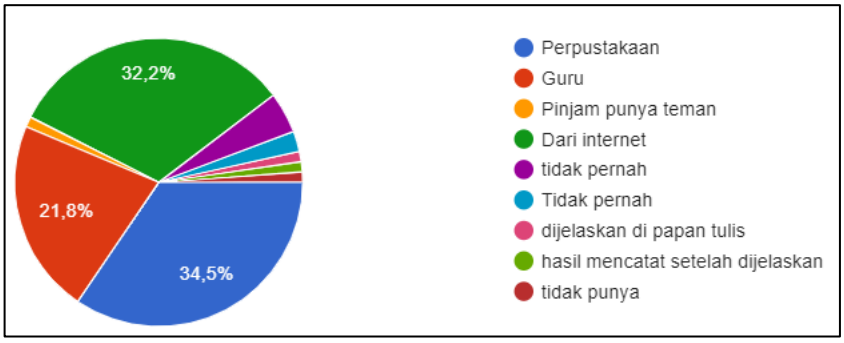

Figure 6. The percentage of students who get textbooks when learning chemistry

Answer to question number 7

In question number 7, which was related to students' difficulties in understanding the content of the textbook or teaching book, 56.3% of students experienced challenges, while 43.7% did not face any difficulties. In other words, most students struggle to grasp the textbook or teaching book material. The factors causing students trouble understanding lessons, particularly in chemistry, can be categorised as internal and external. Internal factors affecting students' comprehension include their ability to understand the chemistry content and their low memory capacity. In contrast, external factors encompass the school environment, teaching methods employed by instructors, and insufficient learning time during the day. Additional reasons for students' difficulties in understanding chemistry involve physiological factors (related to physical or sensory organs), psychological aspects,

social influences, along with facilities, infrastructure, learning approaches, and teachers (Ristiyani & Bahriah, 2016).

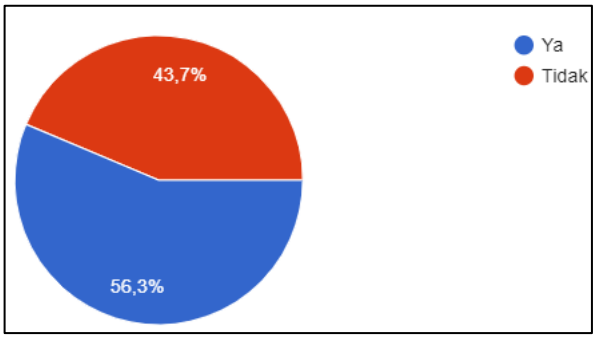

Figure 7. Percentage of students' difficulties in understanding the textbook

Answer to question number 8

In question number 8, regarding whether the textbook you read explains electrochemical material, 63.2% of students answered yes, while 36.8% answered no. Electrochemistry encompasses the concepts of electrolyte and non-electrolyte solutions, redox reactions, voltaic cells, and electrolysis cells. The explanation of electrochemistry in question refers to the concepts of electrolyte and non-electrolyte solutions, redox reactions, voltaic cells, and electrolysis cells. 36.8% of students answered "no" due to misconceptions about electrochemical sub-materials, which were confused when reading and understanding textbooks. A misconception is an error that occurs when students grasp concepts that are not scientifically appropriate (Nisa & Fitriza, 2021) .

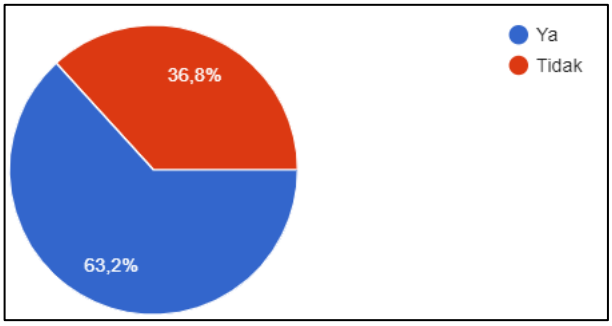

Figure 8. Percentage of electrochemistry material in textbooks

Answer to question number 9

Textbooks are educational resources designed to enhance creativity, motivation, and student engagement. Students can independently comprehend learning materials to improve their quality (Rahmawati, 2015). Question 9 concerns the need for or electrochemistry textbooks during the chemistry learning process in class: 69% of students require textbooks, 29.9% need textbooks, and the remaining 1.1% do not. The textbooks that students refer to are alternative ones, distinct from the existing textbooks. In contrast, 1.1% of students do not need alternative textbooks because they find the teacher's explanations and the provided textbooks sufficiently clear.

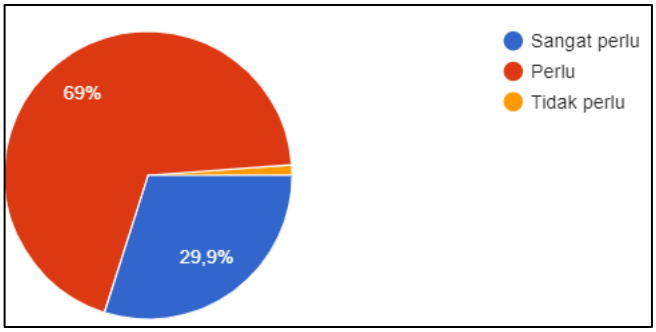

Figure 9. The percentage of the need for textbooks in the learning process

Answer to question number 10

In question number 10, regarding the kind of coursebook students prefer, 75 students want coursebooks that explain concepts and formulas, 66 students prefer coursebooks that include interesting pictures, 63 students desire coursebooks that connect material to everyday life, 46 students want coursebooks with exercises, and 55 students seek coursebooks featuring practical activities. Researchers can develop the coursebook emphasising chemical representation based on students' responses.

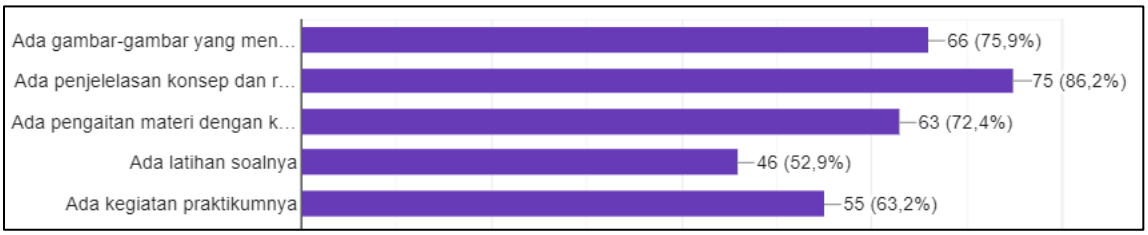

Figure 10. Characteristics of textbooks desired by students

Chemical representation studies chemical phenomena at three levels: macroscopic, symbolic, and submicroscopic, with all three being directly interrelated (Treagust et al, 2010). Students in practicum gain a macroscopic understanding and the application of chemistry in real life, while the symbolic level arises from symbols of chemical elements, such as reaction equations. In contrast, the submicroscopic level is derived from explaining reactions by describing the characteristics and behaviour of atoms and molecules, using symbolic representations to create a visual image of a reaction.

Answers to questions 11 and 12

Questions 11 and 12 are interrelated. Question 11 asks about difficulties in understanding chemistry lessons, especially electrochemistry material, and question 12 asks what sub-materials are considered problematic in electrochemistry material. In Figure 11, 69% of students experienced difficulty learning electrochemistry, and the remaining 31% did not.

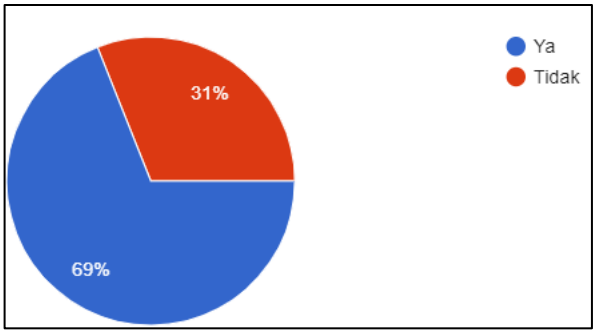

Figure 11. The percentage of students who find it challenging to study electrochemistry

Topics discussed in the electrochemical materials considered difficult in Figure 12 include 78 students who answered voltaic cells, 66 who answered electrolysis cells, 36 who answered redox reactions, and 29 who answered electrolyte-nonelectrolyte solutions. All these topics are interrelated, as electrochemistry explores the connection between chemical compounds and electricity, examining how chemical reactions can generate electric voltage and how electricity can induce chemical reactions. Therefore, students' responses can pertain to more than one topic, which is challenging. For instance, students struggling with redox reactions often face difficulties when learning about voltaic and electrolysis cells, given that the fundamental concepts of these cells are rooted in redox reactions. Common misconceptions in electrochemical materials arise when determining the flow of electric current in galvanic/voltaic cells, understanding cell potential, identifying electrodes in galvanic cells and electrolysis reactions, recognising products produced in electrolysis cells, and understanding the factors that contribute to corrosion, its prevention, and equating redox reaction equations (Nisa & Fitriza, 2021).

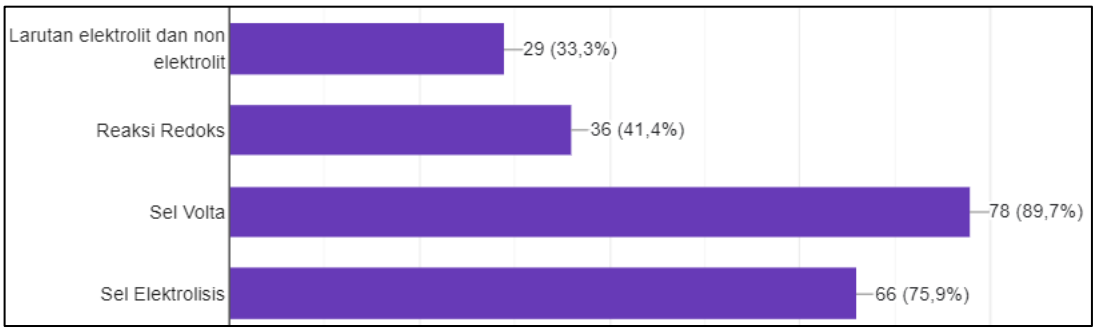

Figure 12. Percentage of electrochemical sub-materials considered difficult by students

Conclusion

The literacy skills of SMAN 1 Pronojiwo students in electrochemical material, assessed using the TOSLS instrument, were 55.28%. This percentage indicates that the science literacy skills of SMAN 1 Pronojiwo students fall into the low category. Therefore, improved methods, models, learning media, or textbooks are needed to enhance students' science literacy skills. The assessment results regarding learning methods and media teachers use in the classroom

show that teachers more frequently utilise lectures and assignments than other methods during instruction. Additionally, teachers tend to use the blackboard media more often than other media during lessons. Furthermore, while learning chemistry, students do not fully utilise textbooks or teaching books and primarily acquire these resources by borrowing from the library. Although they use textbooks, students still face challenges when studying chemistry books, particularly in electrochemistry, especially regarding voltaic cells, as they encounter misconceptions. To maximise understanding when studying chemistry, especially electrochemistry, students desire a textbook focusing on chemical representation, emphasising the study of chemical phenomena at three levels of representation: macroscopic, symbolic, and submicroscopic, where all three levels are directly interrelated.

AI-assisted technology statement

In preparing this work, the authors used Grammarly to rectify spelling errors. After employing this technique, the authors scrutinised and revised the content as necessary, assuming complete accountability for the publication's material.

References

Arikunto, S. (2013). *Dasar Evaluasi Pendidikan (Dasar-Dasar Evaluasi Pendidikan).* Bandung: Bumi Aksara.

Basam, F. (2022). *Pembelajaran Literasi Sains Tinjauan Teoritis dan Praktik.* Yogyakarta: Bintang Semesta Media.

Gormally, C., Brickman, P., & Lutz, M. (2012). Developing a Test of Scientific Literacy Skills (TOSLS): Measuring Undergraduates' Evaluation of Scientific Information and Arguments. *Life Sciences Education, 11*, 364-377. doi:10.1187/cbe.12-03-0026

Hakim, S. (2024). *Strategi Pembelajaran Di Era Kurikulum Merdeka.* Solok: PT. Mafy Media Literasi Indonesia.

Mulyasa, E. (2023). *Implementasi Kurikulum Merdeka.* Jakarta: PT. Bumi Aksara.

Ningrum, A. M., Reza, M., & Simatupang, D. N. (2019). *Pengembangan Buku Ajar Mahasiswa Pada Mata Kuliah Pendidikan Anak Dalam Keluarga.* Surabaya: Universitas Negeri Surabaya.

Nisa, N. A., & Fitriza, Z. (2021). Identifikasi Mikonsepsi Siswa Menengah Atas (SMA) Pada Pembelajaran Kimia Materi Redoks dan Elektrokimia : Studi Literatur. *Edukatif : Jurnal Ilmu Pendidikan, 3*(4), 1191-1198. doi:https://doi.org/10.31004/edukatif.v3i4.516

Pujiyanti, R., Hernawati, D., & Diella, D. (2022). Analisis Komponen Literasi Sains Pada Buku Teks Biologi Kelas XI. *Diklabio: Jurnal Pendidikan dan Pembelajaran Biologi, 6*(2), 126-135. doi:10.33369/diklabio.6.2.126-135

Rahmawati, G. (2015). Buku Teks Pelajaran Sebagai Sumber Belajar Siswa di Perpustakaan Sekolah SMAN 3 Bandung. *Edulib, 5*(5), 102-113. Retrieved from https://ejournal.upi.edu/ index.php/edulib/article/download/2307/1601

Ristiyani, E., & Bahriah, E. S. (2016). Analisis Kesulitan Belajar Kimia Siswa di SMAN X Kota Tangerang. *Jurnal Penelitian dan Pembelajaran IPA, 2*(1), 18-29. Retrieved from https://media.neliti.com/media/publications/176937-ID-analisis-kesulitan-belajar-kimia-siswa-d.pdf

Santrock, J. W. (2016). *Educational psychology: theory and application to fitness and performance, sixth edition.* New York: McGraw-Hill Education.

Setianto, R., & Wardani, T. S. (2021). *Kimia Dasar.* Bantul: Pustaka Baru Press.

Sudjana, N. (2019). *Dasar-Dasar Proses Belajar Mengajar* (Cetakan kelima belas ed.). Bandung: SBAIgensindo.

Supriyadi. (2015). Pemanfaatan Sumber Belajar Dalam Proses Pembelajaran. *Lantanida Journal, 3*(2), 127-139.

Susilana, R., & Riyana, C. (2007). *Media Pembelajaran.* Bandung: CV. Wacana Prima.

Suwarni, E. (2015). Pengembangan Buku Ajar Berbasis Lokal Materi Keanekaragaman Laba-Laba di Kota Metro Sebagai Sumber Belajar Alternatif Biologi Untuk Siswa SMA Kelas X. *Bioedukasi, 6*(2), 86-92. Retrieved from https://ojs.fkip.ummetro.ac.id/index.php/biologi/article/download/336/292

Treagust, D., Chittleborough, G., & Mamiala, T. (2010). The role of submicroscopic and symbolic representations in chemical explanations. *International Journal of Science Education, 25*(11), 1353-1368. doi:10.1080/0950069032000070306

Ulumudin, I. (2017). *Kajian Buku Teks Dan Pengayaan: Kelengkapan dan Kelayakan Buku Teks Kurikulum 2013 Serta Kebijakan Penumbuhan Minat Baca Siswa.* Jakarta: Pusat Penelitian Kebijakan Pendidikan dan Kebudayaan, Balitbang Kemendikbud.