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Enhancing Science Learning: Exploring Literacy and Analytical Thinking Skills (A Literature Review)

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Abstract: This study aims to provide empirical evidence on literacy and analytical thinking skills obtained through a comprehensive literature study. The approach involves searching, evaluating and synthesizing relevant literature to find problems and solutions in journals. Analysis of the literature involved understanding and identifying themes and patterns that emerged from the selected literature. Relevant information was collected and organized to produce a comprehensive understanding of literacy and analytical skills in science learning. Based on the findings of this study, it was found that the importance of developing analytical thinking skills and science literacy in learning. The development of students' analytical thinking skills and science literacy needs to be a focus in classroom learning. With the right approach, the use of relevant technology, and effective assessment instruments, it is expected that students can develop better analytical thinking skills and be able to apply science knowledge in everyday life.

Keywords: Literacy; analytic skills; science learning.

Introduction

21st century competencies are skills that are essential for students to compete and succeed in real life in this knowledge age. In the context of education, quality educational preparation is essential to improve the skills of the younger generation to face global challenges (Aryani, Susilowati, & Utami, 2022). Technological developments pose new challenges in terms of literacy and analytical thinking. For example, the ability to access information quickly and easily through the internet may affect students' ability to filter valid information and develop critical thinking skills in evaluating the information. Based on the results of the 2018 Programme for International Student Assessment (PISA) assessment, Indonesia was found to have an average reading literacy score of 371, mathematics literacy score of 379, and science literacy score of 396. In the overall ranking, Indonesia was ranked 70th out of a total of 78 countries that participated in Programme for International Student Assessment (PISA) (OECD, 2019).

Science literacy is a primary objective of science education since it is seen as a means of preparing the current generation. Science literacy comprises concepts, processes, and scientific attitudes that are applicable in people's everyday lives, demonstrating the effectiveness of each country's science education. However, this is not fully developed through the science learning process in Indonesia (Dewi, Erna, Martini, Haris, & Kundera, 2021). Literacy development is a crucial component of students' chemistry education since chemical literacy necessitates vital critical thinking skills (Setyorini, Yamtinah, Mahardiani, & Saputro, 2021). Bacanak & Gökdere (2009) define science literacy as the capacity to comprehend and evaluate nature and its alterations resulting from human activity by means of scientific knowledge, by raising inquiries and making judgments founded on evidence.

Analytical thinking skills refer to the capability

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of identifying the genuine intention and inferential relationships among various forms of expression, such as statements, questions, concepts, descriptions, or opinions. These skills are essential for facing the challenges of the present century (Prawita, Prayitno, & Sugiyarto, 2019). Analytical thinking encompasses further inquiry and situations with less defined parameters and outcomes. It is crucial when facing ambiguous scenarios that necessitate students to recognize or develop problems to be solved (Robbins, 2011)

Literacy and analytical thinking are two aspects that are important in education and everyday life. Literacy involves one's ability to read, write and understand information, while analytical thinking involves one's ability to analyze, solve problems and make decisions logically. Both play a crucial role in developing understanding, critical and reflective responses to a complex world. However, in the context of education, there are challenges that need to be addressed in relation to literacy and analytical thinking. Some of the relevant issues include high levels of illiteracy, lack of analytical thinking skills needed to deal with complex situations, and lack of integration of literacy and analytical thinking in the education curriculum. Therefore, this article aims to analyze the problems of literacy and analytical thinking and the solutions provided in education.

Science problems in everyday life can be solved if students can understand and apply analytical, creative thinking and problem solving. To gain understanding and analytical thinking in decision making, a strong foundation is needed such as seeking information from various literatures, being able to make hypotheses and being able to draw conclusions based on the results of interpretation and investigation by increasing literacy(P, Suryanda, & W, 2018).Problem-based learning is useful for improving analytical thinking skills (Syawaly & Hayun, 2020). This shows that analytical thinking and science literacy have a close relationship in problem solving.

According to James Rutherford (2011), scientific literacy includes literacy about anything related to science, while scientific literacy includes literacy about all branches of knowledge, such as science, language and social sciences. To improve students' abilities, literacy skills must be carried out effectively, according to Shwartz, Ben-Zvi, & Hofstein, (2006) Students' ability to integrate analytical thinking skills and chemical literacy in the concept of hydrolysis is reasonable with a percentage of 56.76%. This shows that learning activities in class have not fully improved students' literacy and thinking (Prastiwi & Laksono, 2018)

This study aims to provide empirical evidence obtained through a comprehensive literature study on literacy and analytical thinking. By analyzing various relevant literature sources, this study aims to gain an in-depth understanding of problems and solutions related to literacy and analytical thinking. Its main aim is to inform practical implementation in an educational context, by providing a solid knowledge base and recommendations based on the findings of the literature.

Materials and Methods

This research uses the literature study method to investigate literacy and analytical thinking skills. this approach involves searching, evaluating and synthesizing relevant literature to find problems and solutions in journals. relevant databases and information sources were used to search for literature related to the concepts of literacy, literacy in science, and analytical thinking. afterwards, literature that met the inclusion criteria was reviewed in depth. analysis of the literature involved understanding and identifying themes and patterns that emerged from the selected literature. relevant information was collected and organized to produce a comprehensive understanding. the findings of the literature were then interpreted and linked to the research objectives.

Results and Discussion

Analytical thinking is the process of breaking down material into smaller components, taking into account a number of factors such as reasoning, degree of correlation, interpretation of diagrams, differences, focus, principles, and relevance to life

contexts (Montaku, Kaittikomol, & Tiranathanakul, 2012). according to drew, C. (2023) Analytical thinking skills are crucial in dealing with the complexity of an increasingly modern world. This process involves breaking down complex subjects into simpler components, Organising information in a structured and cohesive manner, and utilising tools such as graphs and statistics to illustrate relationships between key factors. By doing so, we can identify cause and effect and formulate solutions to overcome challenges. In addition, assessing the effectiveness of solutions and estimating their impact is also an important element of analytical thinking. Therefore, further development of analytical thinking skills is a major focus in education, so that individuals can be prepared for various professions in the modern era.

According to Anderson et al. (2015), analysis is the process of breaking down material into smaller components and establishing relationships to the overall structure. Analytical thinking involves three main processes:

1. Distinguishing: The process of sorting out relevant and important information from a structure.
2. Organising: The recognition of elements in a communication or situation and the establishment of coherent relationships between them.
3. Attributing: The process of deconstruction to determine the purpose of the elements that make up the structure.

Science analytical thinking is inseparable from science literacy. Science literacy is an understanding of science and scientific processes that enable decision-making and engagement in social and economic aspects, including specialised skills (Widyatingtyas, 2006)According to PISA in (Aqil, 2017) there are five aspects in assessing science literacy, which include recognition of scientific questions, identification of evidence needed, drawing conclusions, communication of results, and application of science concepts.

Based on the above, analytical thinking and science literacy are interrelated and support each other. The ability to think analytically, which includes breaking down material into smaller components and considering important factors, is an important basis for the development of science literacy. Science literacy, on the other hand, involves understanding science concepts and the ability to make decisions based on that knowledge. Analytical thinking helps individuals to parse and understand scientific information, identify cause-and-effect relationships and formulate effective solutions in the context of science. Developing analytical thinking skills is therefore a priority in education to prepare individuals for the challenges of the modern era, especially to improve the increasingly important science literacy.

Based on research by Marthinu & Nadiroh (2017)students' analytical thinking skills at SMA Negeri 3 ternate are known to be low, especially in the context of environmental problems. This is due to the use of learning systems and approaches that do not encourage serious and deep student involvement, and do not pay attention to students' perspectives and analytical thinking skills in understanding natural problems. To enhance students' analytical thinking skills concerning environmental matters, the study suggests employing experiential learning techniques with an outdoor perspective. This approach enables students to obtain hands-on knowledge and use their senses to comprehend ecological phenomena. Subsequently, students can acquire inspiration, concepts and an enhanced understanding of managing environmental problems. The findings indicated that implementing experiential learning strategies, both indoors and outdoors, enhanced students' analytical thinking skills. The findings indicated that implementing experiential learning strategies, both indoors and outdoors, enhanced students' analytical thinking skills. Although both indoor and outdoor strategies proved beneficial, the latter proved more advantageous. The findings indicated that implementing experiential learning strategies, both indoors and outdoors, enhanced students' analytical thinking skills. Significantly, students possessing keen insight into sustainable development realized significantly higher gains when utilizing experiential learning strategies outdoors.

Research by Wiyarsi, Fachriyah, Supriadi, & Bin Muhamad Damanhuri (2019) identified challenges

in developing students' analytical thinking skills in chemistry learning. These challenges include the lack of emphasis on developing analytical thinking skills, students' difficulties in solving problems analytically, students' difficulties in representing chemical phenomena at the sub-microscopic level, the lack of emphasis on chemical representations at various levels, and the lack of use of tests that include chemical representations at various levels. To overcome these challenges, changes in chemistry learning approaches and the development of tests that include chemical representations at multiple levels are needed. This research recommends the development of an assessment instrument to measure students' analytical thinking and chemical representation skills in the topic "Rate of Reaction" by ensuring the validity, reliability, and suitability of the assessment instrument through assumption test and item suitability analysis.

Furthermore, Muhsin & Laksono (2023) conducted research highlighting the lack of focus on developing students' analytical thinking skills in education, particularly in chemistry learning, and a mismatch between the demands of the 21st century and the quality of education in Indonesia. Furthermore, Muhsin & Laksono (2023) conducted research highlighting the lack of focus on developing students' analytical thinking skills in education, particularly in chemistry learning, and a mismatch between the demands of the 21st century and the quality of education in Indonesia. One of the main issues is teachers' insufficient understanding of scientific attitudes.

In an attempt to address these issues, researchers have created an integrated assessment tool that aims to measure students' analytical thinking skills and scientific attitudes in relation to chemical balance materials. The validity and applicability of this tool has been scrutinised and its results indicate that the tool satisfies the required standards of validity, practicality, and substantiality. Thus, this comprehensive assessment tool can be utilised effectively to evaluate students' analytical thinking skills and scientific attitudes towards chemical equilibrium materials.

In the article titled "The Differences of Analytical Thinking Skills on Biodiversity Material in Guided Inquiry Model with Conventional Class" by Cahyati & Subali, (2022) the significance of analytical thinking skills in education is highlighted. Nevertheless, classroom education currently prioritises acquiring knowledge, resulting in students lacking practical abilities. Despite the adoption of Curriculum 2013 with a thematic and scientific approach, the analytical thinking skills of students remain suboptimal. Factors that impact students' limited analytical thinking abilities encompass daily habits, insufficient comprehension of the material, and difficulty in analysing and drawing conclusions. Contributing to this are internal factors, such as genetics, in addition to external factors, such as the social environment, culture, economy, and educational facilities.

The recommended solution is to implement a guided inquiry-based learning model in two schools. This model involves students actively in discovering and understanding concepts through structured inquiry activities guided by the teacher. Innovative class discussion methods and technology integration are also important in developing students' analytical thinking skills. Periodic formative assessments are needed to monitor student progress and provide constructive feedback.

In the journal "Exploring and Comparing Content Validity and Assumptions of Modern Theory of an Integrated Assessment: Critical Thinking-Chemical Literacy Studies" by Sadhu, Ad'hiya, & Laksono (2019)problems related to science literacy and analytical thinking in chemistry learning were also revealed. The lack of development of students' critical thinking skills and integrated chemical science literacy is one of the main problems. There is a gap between chemical science literacy and chemistry learning that is relevant to students' daily lives. In the study, the integrated assessment instrument in the field of chemical equilibrium has passed the content validity test and fulfils the assumptions in modern theory. A learning model that connects chemical concepts with real-world situations and the use of relevant technology is also suggested to improve

students' analytical thinking skills in solving chemical problems.

Overall, these studies show that the development of students' analytical thinking skills and chemical science literacy needs greater attention in chemistry learning. Through the right learning approach, the use of relevant technology, and effective assessment instruments, it is hoped that students can develop better analytical thinking skills and be able to apply chemical knowledge in everyday life.

Research conducted by Setyorini et al., (2021)identified problems with students' science literacy and analytical thinking in the context of chemical reaction rates. The lack of comprehensive assessment development and limited assessments that include chemical literacy are the problems found. This research recommends the development of assessment instruments that cover various aspects of chemical literacy. In addition, it is important to develop accurate and in-depth test result analysis tools to improve students' understanding in chemical literacy and analytical thinking skills in the context of science. This research makes an important contribution to the development of more effective and relevant chemical literacy assessments for students.

In the journal "Using HOTS-Based Chemistry National Exam Questions to Map the Analytical Abilities of Senior High School Students" by Harta, Rasuh, & Seriang, (2020), it is emphasised that implementing the concept of Higher Order Thinking Skills (HOTS) in the chemistry national exam has its own challenges. There are obstacles in developing students' analytical thinking skills in solving HOTS chemistry problems. The role of chemistry teachers in training students and the difficulty in implementing lessons that guide students in analysing and initiating analytical thinking processes are very important.

Several steps are recommended to overcome this problem. First, the development of valid and reliable research instruments needs to be done. The instrument must go through a validation process by experts and chemistry teachers. The instrument is tested on students and the results are analysed using the Rasch model. Learning strategies can be developed based on student ability analysis to improve students' science literacy and analytical thinking skills. Collaboration between teachers and experts is also considered important in developing research instruments and learning strategies. It is expected that students' ability to solve HOTS questions can be significantly improved through the implementation of this solution.

In the journal "Effectiveness of a Generative Learning-Based Biology Module to Improve Analytical Thinking Skills of Students with High and Low Reading Motivation" by Prawita et al., (2019)discussed the low level of analytical thinking skills and science literacy among students. Conventional learning methods that rely on teacher explanations are ineffective, especially for students with low academic levels. Students' reading motivation has a significant influence on analytical thinking skills.

The suggested solution is to use a Generative Learning-based biology module that encourages students to be active in learning. This module uses simple language and integrates the Generative Learning model with indicators of analytical thinking skills. In addition, increasing students' reading motivation is also important through activities that attract students' reading interest and creating a learning environment that supports active reading and student curiosity.

It is expected that by implementing these solutions, students' science literacy and analytical thinking skills can improve. Generative Learning-based biology modules provide an interactive learning experience, while increased student reading motivation provides more access to information and improves analytical thinking skills. Based on several studies cited in these journals, it is important to develop students' analytical thinking skills and science literacy in chemistry learning. The low analytical thinking skills of students are identified as one of the main challenges in chemistry education, especially related to environmental issues. The lack of emphasis on developing analytical thinking skills in education, low science literacy, and the mismatch between the demands of the 21st century and the quality of education in Indonesia are also factors that need attention.

To overcome these challenges, several solutions are recommended, including the use of experiential learning strategies with an outdoor approach, the development of assessment instruments that include chemical representations at various levels, the application of guided inquiry-based learning models, innovative classroom discussion methods, and the integration of technology in chemistry learning. Changes in chemistry learning approaches and emphasis on chemical representations that are relevant to students' daily lives are also needed. With the right approach, the use of relevant technology, and effective assessment instruments, students are expected to develop better analytical thinking skills and be able to apply science knowledge in everyday life.

In addition, studies have also highlighted issues related to science literacy and analytical thinking in chemistry learning. The lack of development of students' critical thinking skills and integrated chemical science literacy, as well as the gap between chemical science literacy and chemical learning relevant to students' daily lives, are also of concern. Therefore, the development of assessment instruments that cover various aspects of chemical literacy, the use of learning models that connect chemical concepts with real-world situations, and the application of relevant technologies are recommended to improve students' analytical thinking skills in solving chemical problems.

Discussion

Various analytical studies highlight the problems surrounding analytical thinking skills and science literacy in the context of chemistry learning. The identification of these problems includes several main points, such as the low ability of analytical thinking among students, the lack of application of analytical thinking skills in the educational process, and the gap between the educational demands needed in the 21st century era and the quality of education in indonesia.

The solutions offered include several strategies, such as using an experimental learning approach with an outdoor approach. In this case, direct experience through activities outside the classroom is considered to enrich students' understanding of chemical phenomena in everyday life. In addition, there are recommendations for developing assessment tools that include chemical representations at various levels of understanding, implementing guided inquiry-based learning models that allow students to actively discover and understand concepts, and utilizing technology as a tool in chemistry learning.

However, there is still a need for more in-depth work on aspects of science literacy and analytical thinking skills in chemistry learning. There is a gap between students' critical thinking skills and integrated chemical literacy. It is necessary to develop assessment tools that cover various aspects of chemical literacy and apply learning models that link chemical concepts with real-world situations so that students can develop analytical thinking skills in solving chemical problems.

The importance of focusing on developing students' analytical thinking skills and chemical literacy is a major highlight in the context of classroom learning. It is expected that with the right learning approach, the application of relevant technology, and the use of effective assessment tools, students can develop better analytical thinking skills and be able to apply chemical knowledge in everyday life. There is also an emphasis on the role of teachers in training students and actively involving them in the analytical thinking process, as well as the importance of increasing students' reading motivation in the context of chemical science literacy. All of these need to be considered as part of efforts to improve students' understanding of chemistry.

Based on the above explanation in the context of science learning, there are problems related to the low ability of analytical thinking and science literacy among students. Although several solutions have been proposed such as the use of experimental learning approaches, the development of assessment tools, and the application of inquiry-based learning models, more in-depth efforts are still needed. The focus on developing students' analytical thinking skills and chemical science literacy is important, with the need for appropriate learning approaches, the application of relevant technology, the active role of teachers, and increasing students' reading

motivation. These things need to be considered in an effort to improve students' understanding of science.

Conclusions

The conclusion from the various studies cited in this journal is the importance of developing analytical thinking skills and science literacy in science learning. Some of the challenges faced in developing these two competencies include the low analytical thinking ability of students, the lack of emphasis on developing analytical thinking skills in education, low science literacy, and the mismatch between the demands of the 21st century and the quality of education in Indonesia.

To overcome these challenges, several solutions are recommended, including the use of experiential learning strategies with an outdoor approach in improving students' analytical thinking skills related to environmental issues, the development of assessment instruments that include chemical representations at various levels, the application of guided inquiry-based learning models, innovative classroom discussion methods, and the integration of technology in chemistry learning. In addition, changes in chemistry learning approaches and emphasis on chemical representations relevant to students' daily lives are also needed.

Overall, the development of students' analytical thinking skills and science literacy needs to be the focus of classroom learning. With the right approach, the use of relevant technology, and effective assessment instruments, it is expected that students can develop better analytical thinking skills and be able to apply science knowledge in everyday life.

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