



Literature Review: Improving Science Literacy Skills Through Chemistry Learning Media

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ABSTRAK

Penelitian ini merupakan tinjauan literatur yang bertujuan untuk mengetahui efektivitas berbagai media pembelajaran kimia dalam meningkatkan literasi sains. Literasi sains melibatkan kemampuan untuk memahami konsep-konsep sains, berpikir kritis, dan berpartisipasi dalam isu-isu sains dan teknologi. Literatur yang dianalisis meliputi artikel-artikel ilmiah yang diterbitkan antara tahun 2021 hingga 2024. Media pembelajaran yang diteliti meliputi modul pembelajaran berbasis *problem-based learning* (PBL) berorientasi *green chemistry*, e-modul, media interaktif berbasis etnosains, komik kimia, dan aplikasi Android. Hasil kajian menunjukkan bahwa penggunaan media pembelajaran inovatif dapat meningkatkan pemahaman konsep kimia, motivasi belajar, dan keterampilan literasi sains siswa. Modul PBL berorientasi *Green Chemistry* dan media interaktif berbasis etnosains terbukti efektif dalam meningkatkan literasi sains. E-modul, komik kimia, dan aplikasi Android juga memberikan kontribusi penting dalam meningkatkan pemahaman konsep dan keterampilan literasi sains siswa. Secara keseluruhan, media pembelajaran inovatif dan interaktif berpotensi besar untuk meningkatkan literasi sains siswa, menjembatani teori dan praktik, serta memberikan pengalaman belajar yang lebih menarik dan efektif.

ABSTRACT

This study is a literature review that aims to identify the effectiveness of various chemistry learning media in improving science literacy skills. Science literacy includes the ability to understand science concepts, think critically, and participate in science and technology issues. The literature analyzed includes scientific articles published between 2021 and 2024. The learning media studied includes Green Chemistry-oriented Problem-Based Learning (PBL) modules, e-modules, ethnoscience-based interactive media, chemistry comics, and Android applications. The results of the study show that the use of innovative learning media can improve students' understanding of chemistry concepts, learning motivation, and science literacy skills. The Green Chemistry-oriented PBL module and ethnoscience-based interactive media have proven to be effective in improving science literacy. E-modules, chemistry comics, and Android apps also make a significant contribution in improving students' concept understanding and science literacy skills. Overall, innovative and interactive learning media has great potential to improve students' science literacy, bridge theory and practice, and provide a more engaging and effective learning experience.

1. INTRODUCTION

In the modern era full of scientific and technological advances, science literacy is becoming increasingly important for every individual. Science literacy isn't as it were constrained to the capacity to memorize scientific formulas or facts, but a broader ability, namely, understanding science concepts and applying them in daily life, reading and interpreting scientific information critically, identifying and solving problems using scientific thinking methods, and actively participating in issues related to science and technology (Yuliati et al., 2019). Science literacy is essential for understanding complex and diverse scientific information. According to (OECD, 2023), science literacy is capacity to lock in with science-

related issues and with science thoughts as a intelligent citizen. Science literacy not only helps individuals in understanding scientific concepts, but also in developing critical and analytical thinking skills that are needed in today's world of work (Irsan, 2021).

The young generation who are literate in science will become future leaders who are able to make decisions based on scientific evidence, adapt to technological changes, and contribute to the advancement of science and the welfare of society. Science literacy equips them with the capacity to get it and assess logical data, which is fundamental for making educated choices in a variety of fields, including health, the environment, and technology. According to (OECD, 2023), effective science literacy education can improve students' ability to think critically and analytically, as well as prepare them to actively and responsibly participate in a science-based society.

Although science literacy is very important, the fact is that many students still have difficulty understanding science concepts in school. One example in high school chemistry subjects, chemical materials are frequently considered abstract and complex by students, which causes challenges in understanding related concepts. This is reinforced by recent research showing that many students experience obstacles in understanding the chemical reactions that occur in the hydrolysis process as well as the underlying concepts of pH and chemical equilibrium (Prianti et al., 2020).

Difficult to relate to daily life According to recent research, many students feel that the concepts taught in chemistry material do not have direct relevance to their daily experiences, making it difficult to understand and apply them (Ristanti & Sumarti, 2024) as well as Traditional learning methods that emphasize memorization and formulas can make this material feel boring. As a result, students fail to understand the concept of chemistry in depth, which leads to their low science literacy (Habiddin et al., 2023).

Research in the field of science education shows that the use of appropriate and innovative learning media can be a solution to overcome these challenges. Effective learning media can, make it easier to understand concepts by presenting chemistry material in a more visual, concrete, and interesting way (Maulida Fitriya, Arry Patriasurya Azhar, 2023) and can increase learning motivation, namely creating an interactive and fun learning atmosphere (Azkia et al., 2023), developing critical thinking skills (Wulandari et al., 2023) and can also connect science with real life, namely providing examples of material application chemistry in daily life (Maulida et al., 2022a).

Thus, innovative learning media has the potential to increase students' understanding of chemistry learning materials and develop their science literacy skills as a whole. A comprehensive literature review on effective learning media to improve science literacy in chemistry is very important. This study is expected to identify the most suitable type of learning media for chemistry learning, analyze the effectiveness of each learning media in improving science literacy and provide a theoretical basis for the development of more innovative learning media in the future. Through in-depth literature review, educators and researchers can design chemistry learning that is more effective and has an impact on improving students' science literacy.

2. METHOD

The approach utilized in this study uses a type of research in the form of literature review. Literature search is the primary step in making scientific articles. Literature research is included in the style of literature research by reading several journals, books, and other publications related to the research topic with the aim of producing writing on a certain topic or topic (Marzali, 2017). The search for literature has two main objectives. First, a literature review whose purpose is to produce articles that present new research on a specific point that those who study that point got to know. Another purpose of literature research is to help the inquiry about extend itself. In this case, conducting a literature review improves our supposition on our inquiry about point, makes a difference in us defining an investigate issue, and makes a difference in us deciding the proper hypotheses and strategies for our investigation. By studying other people's investigations, able to choose whether to duplicate, duplicate, or criticize a specific investigate. We utilize other people's investigations as reference fabric for our possess investigations. By criticizing other people's composing, we at that point make something modern. In this article, we specifically discuss literature studies for the sake of one's research, especially for students who are writing a thesis (Marzali, 2017).

Based on this exposure, the researcher uses a literature review by analyzing logical articles from national journals distributed in 2021 to 2024 as a research method for the implementation of the research in question. The stages used in the literature review can be seen in the following Figure 1:

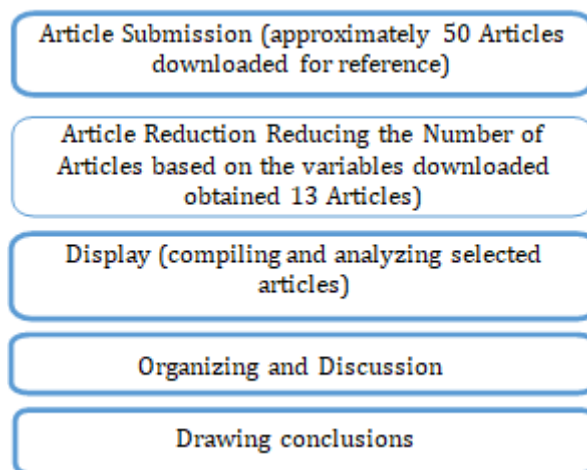


Figure 1. Stages of Literature Review (Marzali, 2017)

1) Article Submission (search and download articles)

At the arrange of collecting this article, it is done by looking and downloading articles through google researcher by writing watchwords related to the subject or title of the inquire about. In this case, the key words are chemistry learning media to move forward science literacy abilities.

2) Article Reduction (reduce the number of articles based on the variables in the title)

Article lessening implies summarizing, choosing the most things, centering on the important things, trying to find topics and designs and disposing of the superfluous. Hence, the article that has been reduced will give a clear picture and make it less demanding for analyst to gather advance information and seek for it in case fundamental.

3) Article Display (arrangement of selected articles)

Once the article has been decreased, the another organize is to show or show the article. The introduction of this article is carried out within the shape of tables, brief depictions, and connections between variables.

4) Organizing and Discussion

At this organize, organization and talk are carried out based on the sort of writing audit utilized. In this case, the writing think about chosen is within the shape of a hypothetical think about. This type of writing think about within the frame of a hypothetical think about could be a uncommon ponder in which the creator portrays a few hypotheses or concepts that are centered on a specific point and compares the hypotheses or concepts on the premise of suspicions, consistent consistency, and the scope of their information scope.

5) Drawing conclusions

Conclusions were drawn based on the comes about of organizing and examining that had been carried out already.

3. RESULT AND DISCUSSION

Science literacy is a very imperative expertise in instruction, particularly within the field of chemistry. Science literacy is the ability to get it science concepts and apply them in way of life. Improving science literacy skills is essential to prepare individuals for global challenges.

Chemistry learning media refers to tools, materials, or techniques used to convey chemistry material to students. This can include textbooks, computer software, virtual labs, educational videos, simulations, and others. Effective learning media can make abstract chemical concepts more concrete and easy to understand, as well as increase students' interest and motivation in learning.

This study aims to review various chemistry learning media that can improve science literacy. There are 4 indicators of science literacy, namely indicators of scientific knowledge, indicators of investigation of the nature of science, indicators of science as a way of thinking, and indicators of interaction between science, technology, and society (Septia Marisa et al., 2021). Several journals that discuss improving science literacy skills through learning media in chemistry can be seen in Table 1.

Table 1. Journal of Science Literacy Improvement through Learning Media

No	Writer	Year of Publication	Research Title	Research Conclusion
1	Suryati, Fauziah, D., Kuswanto, H.	2021	Pengaruh Modul PBL Berorientasi Green Chemistry terhadap Literasi Sains Siswa pada Materi Hidrolisis Garam	The green chemistry-oriented PBL module developed has been proven to be able to increase students' science literacy, with students becoming more creative, having a high concern for the environment, and more easily applying their knowledge in the context of environmental problems.
2	Trisna Nugrahini	2020	Efektivitas E- Modul South Kalimantan Foody Untuk Meningkatkan Kemampuan Literasi Sains Peserta Didik Pada Materi Hidrolisis Garam	The E-Module "South Kalimantan Foody" is effective in practicing science literacy skills, as evidenced by the N-Gain value of 0.71 cognitive test results (high category). The response of students to the attractiveness of the E-Module was also high, with a percentage of 86.9%, indicating that this media can broaden students' horizons based on experience and help preserve the culture of the people of South Kalimantan.
3	Airiza Dian Luthfiana, Rusly Hidayah	2022	E-Module of Chemistry Practicum Based on Cooperative Learning on Salt Hydrolysis Material to Improve Students' Scientific Literacy	This chemistry practicum e-module has valid criteria and is very valid in terms of content, language, presentation, and graphics. In terms of practicality, this module is also very practical to use with all student activities that are in accordance with the plan. The results of the Wilcoxon test show that the use of this e-module is effective in improving students' science literacy.
4	Nurul Azkia, Muhamma d Kusasi dan Syahmani	2023	Pengembangan Media Pembelajaran Interaktif Terintegrasi Etnosains pada Materi Hidrolisis Garam	The learning media developed met the validity category with a score of 95.32. This learning media is practically used in chemistry learning with good readability results from individual and small group tests AND This media is effective in increasing science literacy and learning motivation of students with an increase in science literacy N-gain scores of 0.49 and learning motivation of 0.61, both of which are in the medium category.
5	Nanda Naila, Atiek Winarti dan Mahdian	2021	Pengembangan Media Pembelajaran Komik Kimia Bermuatan Literasi Sains Untuk Meningkatkan Pemahaman Konsep Dan Kemampuan Komunikasi	Chemical comic learning media with science literacy content on ion equilibrium material in salt solution is suitable for use in learning. This media is considered very valid, very practical, and very effective in improving students' understanding of concepts and communication skills.

6	Husnul hatimah dan yusran khery	2021	Pemahaman Konsep dan Literasi Sains dalam Penerapan Media Pembelajaran Kimia Berbasis Android	There is an influence of android-based chemistry learning media on students' understanding of concepts. In this case, it can be proven from the existence of a hypothesis test (independent test of t-test samples) where a significant test value is obtained that is smaller than the significant value of $0.000 < 0.05$. There is an influence of android-based chemistry learning media on students' science literacy. In this case, it can be proven from the existence of a hypothesis test (independent test of t-test samples) where a significant test value is obtained that is smaller than the significant value of $0.000 < 0.05$.
7	Etik Krisnawati, Jimmy Copriadi, Maria Erna	2023	Enhancing science literacy through development of acid-base e-module using book creator	The material aspect of the e-module obtained a high average score of 97.14% and 97.27% for the substance of the material and the learning design respectively. The media aspect also received a high average score of 96% for Display (visual communication) and 98.33% for software utilization. Test result one opponents with teachers and students also showed positive responses with an average score of 93.70% and 86.07%. These findings show that the e-module developed has the potential to be effective in supporting students in improving science literacy competencies in the subject of Acid-Base Materials.
8	Muhamma d shohibul ihsan ,siti wardatul jannah	2021	Analisis kemampuan literasi sains peserta didik dalam Pembelajaran kimia menggunakan multimedia Interaktif berbasis blended learning	Interactive multimedia based on Blended Learning can be used to develop students' science literacy skills, especially in learning Chemistry with oxidation reduction reaction material. Interactive multimedia can facilitate students well in understanding chemical materials both in terms of context, knowledge, competence and attitude.
9	Arifin Harianto , Suryati , dan Yusran Khery (2022)	2022	Pengembangan Media Pembelajaran Kimia Berbasis Android Untuk Penumbuhan Literasi Sains Siswa Pada Materi Reaksi Redoks Dan Elektrokimia	The application of android-based chemistry learning media to foster students' science literacy in redox and electrochemical reaction materials meets the criteria of effectiveness in small-scale trials. This is shown by the average results of the pre-test science literacy competency test of 20.27 and the average post-test score of 74.16 and the N-gain value of 0.65 with the category of using android-based chemistry learning media to grow students' science literacy in redox and electrochemical reaction materials, which is moderate.

10	Nikmatur, I Nyoman Suardana dan Aku Nyoman Tika	2023	Efektifitas E- LKPD Kimia SMA/MA dengan Model Pembelajaran Berbasis Masalah Berkonteks Isu-isu Sosial Sains dalam Meningkatkan Literasi Sains Peserta Didik	This E-LKPD obtained effective results in improving students' science literacy. The average score of the Pretest was 45.8 with the poor category, while the average score of Posttest was 75 with the fairly good category. The normalized N-gain score obtained was 0.54 so it was included in the medium category.
11	Trisna Maulidiya wati, Lailatul Maulidiya, Reza Suci Rahmadan i dan Rusly Hidayah	2022	Pengembangan E-Lkpd Berbasis Inkuiri Flipped Classroom Pada Materi Kesetimbangan Kimia Untuk Melatihkan Literasi Sains Di Era Merdeka Belajar	The results of the research data concluded that E-LKPD based on flipped classroom inquiry on chemical equilibrium material to train students' science literacy in the era of independent learning was declared valid, practical and effective. It is shown by the validity value of 94% content, 93% language, 93% presentation with very valid criteria. The value of practicality of content is 96%, linguistics is 94%, presentation is 98% with very practical criteria. The effectiveness value was studied from the n-gain results from the average pretest-posttest of science literacy ability which showed a score of 0.73 with very high criteria so that the E-LKPD developed was effective in practicing science literacy in the era of independent learning.
12	Dea Zulian Refelita	2021	Desain Media Pembelajaran Weblog Kimia Berbasis Sains Teknologi Masyarakat (STM) untuk Mendukung Literasi Sains Siswa	The designed weblog defense media is declared valid by media design experts, learning material experts and practicality experts. This can be seen from the average percentage of questionnaire analysis of media design experts, learning material experts and teacher practicality are 93.33%, 92.5% and 93.33% respectively. The STM-based weblog learning media on petroleum material was declared very interesting by students with a percentage of 80%.
13	Shinta Nur Cholifah1, Dian Novita	2021	Pengembangan E-lkpd guided Inquiry-Liveworksheet untuk Meningkatkan Literasi Sains pada Submateri Faktor Laju Reaksi	LKPD guided inquiry-liveworksheet to improve science literacy on reaction rate factor material that is declared feasible to be used as a teaching material in chemistry learning. The validity aspect of e-lkpd was obtained with very valid criteria. The practical aspect of e-lkpd was obtained in the very practical category. The effectiveness of e-lkpd was also obtained very effective criteria, as evidenced by the results of cognitive tests and science literacy skills that received n-gain high category scores and each domain received a t-test (sig. value 0.000).

In a study that examined the use of green chemistry-oriented problem-based learning (PBL) modules on students' science literacy. The analysis of pre-test and post-test data showed that the average score of the experimental class was higher compared to the control class. The normality and homogeneity test of the data showed that the data were distributed normally and homogeneously. The use of Green Chemistry-oriented PBL modules significantly improves students' science literacy (Suryati et al., 2021). Research conducted by Nikmatur (2023) showed that the results of the viability test of E-LKPD chemistry for high school/MA with a problem-based learning demonstrate within the setting of social science issues are viable in progressing students' science literacy (Nikmatur Rohmaya et al., 2023). The results of Suryati's research analysis showed that the average score of science literacy of students in the experimental class (77.28) was higher than that of the control class (72.75). The t-test pooled variance test showed a $t_{table} > t_{count}$ ($2.03 > 1.99$), which means H_a was accepted and H_0 was rejected, so that this PBL module was effective in improving students' science literacy (Suryati et al., 2021).

The results of the research on the development of science literacy-based learning media and assessing the validity and practicality of the media. The results of the study show that the learning media is valid and practical based on the validity assessment and concept comprehension test as well as communication skills. The science literacy-based learning media developed is able to improve students' understanding of concepts and communication skills. The practicality of this media lies in its ability to be easily accessed via smartphones, which supports online learning. The high media validity shows that the science literacy component can be effectively integrated in chemistry learning media (Maulida et al., 2022).

The use of laboratories and practicum using E-modules as science learning media has also been proven to be effective in increasing science literacy. The practicum allows students to experience first-hand scientific processes, which helps them understand scientific concepts in depth. The results of the study showed that students who were involved in practicum activities were active in discussions and were able to draw conclusions based on the evidence they observed themselves. Laboratory activities provide a contextual and interactive learning experience, which is essential for improving science literacy. This learning emphasizes the importance of the relationship between science, technology, and society, so that students can see the impact of science in daily life (Luthfiana & Hidayah, 2022).

Technology plays an important role in the modernization of science learning, there is an influence of android-based chemistry learning media on students' science literacy (Hatimah & Kherly, 2023). The use of digital tools, simulations, and e-learning platforms can make science learning more interesting and interactive. Technology can be used to bridge the gap between theory and practice in science learning. Technology allows access to a wide range of learning resources and evaluation tools that can be tailored to the individual needs of students. This provides opportunities for students to learn according to their respective pace and learning style, which ultimately improves their science literacy (Azkia et al., 2023). For example, research that has been conducted by Shinta et al. (2022) that Based on the discussion, it can be concluded that e-LKPD guided inquiry-liveworksheet to improve science literacy on reaction rate factor material which is declared feasible to be used as a teaching material in chemistry learning (Cholifah & Novita, 2022). Based on research that aims to test the effectiveness of science literacy-based chemistry comic learning media. The validity of the media is assessed from three aspects: content, appearance, and science literacy. The validation results showed that all aspects received a "highly valid" rating from five expert validators, with scores of 95.35 for content, 92.91 for display, and 93.46 for science literacy, respectively. Chemistry comic learning media is able to increase students' responsibility, learning independence, and enthusiasm for learning. This is in line with an interview with a chemistry teacher who stated that the science literacy component has been applied, although not fully to all aspects of learning. Implementasi komponen literasi sains dalam komik kimia ini diharapkan dapat mengatasi tantangan literasi sains yang masih berada di bawah rata-rata internasional (Naila et al., 2022).

The use of Android-based learning media has a positive impact on improving students' understanding of concepts and science literacy. Students who participated in learning with this medium showed significant improvements in both aspects compared to students who followed traditional learning methods (Hatimah & Kherly, 2023). Flexible android-based learning media can be used repeatedly according to the readiness and willingness of students, so that it can improve students' science literacy through repeated and high-frequency use (Harianto et al., 2019). The integration of technology in the form of Android-based learning media is effective in improving students' understanding of concepts and science literacy, which is very important in the context of modern education (Hatimah & Kherly, 2023). Thus, the use of android-based learning media can be an effective alternative in improving students' science literacy through an interactive and flexible approach (Harianto et al., 2019).

Learning media such as E-LKPD and Android-based applications are very effective in improving students' science literacy. The implementation of technology in learning helps students understand

concepts better through an interactive and relevant approach to daily life. This increase in science literacy can be seen from the results of the pretest and posttest which show a significant improvement in students' literacy skills (Harianto et al., 2019) (Nikmatur Rohmaya et al., 2023) The use of problem-based E-LKPD in the context of social science issues can significantly increase students' science literacy. This method has proven to be effective and can be applied as a learning medium in the classroom to improve students' understanding and science skills (Nikmatur Rohmaya et al., 2023) The use of innovative learning media such as E-LKPD based on flipped classroom inquiry, STM-based weblogs, and e-LKPD guided inquiry-liveworksheet, is effective in improving students' science literacy. This improvement was measured through various analysis methods such as the N-Gain test and the t-test, all of which showed significant and positive results in students' science literacy skills. The implementation of interactive learning media that suits the needs of students during the pandemic is very important to overcome student passivity and improve the quality of learning (Maullidyawati et al., 2022)(Zuliana & Refelita, 2022) (Cholifah & Novita, 2022).

Increasing literacy through media, especially science literacy-based e-modules, shows significant effectiveness in learning. This media not only facilitates access to information but also improves students' understanding and literacy competence. Rigorous validation and positive responses from end-users (teachers and students) show that this medium can be relied on as an effective learning tool. The use of technology in the development of teaching materials is one of the keys to success in increasing literacy in the current digital era (Krisnawati et al., 2023). The use of interactive multimedia in the blended learning model can also improve students' science literacy skills. This study found that experimental classes that used interactive multimedia showed a higher increase in science literacy compared to control classes that used traditional methods (Ihsan & Jannah, 2021).

4. CONCLUSION

A literature review shows that the use of various innovative learning media, such as the Green Chemistry-oriented Problem Based Learning (PBL) module, E-LKPD, Android-based media, and interactive multimedia, is effective in improving students' science literacy. The application of problem-based PBL and E-LKPD modules showed a significant improvement in students' understanding and science literacy skills compared to conventional methods. Science literacy-based learning media, such as chemistry comics and Android-based applications, are valid, practical, and able to improve students' understanding of concepts and communication. The use of laboratories and practicums with E-modules also increases students' understanding and involvement in the scientific process.

Overall, innovative and technology-based chemistry learning media is effective in improving students' science literacy, which is important to overcome science literacy challenges at the international level.

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