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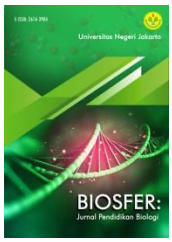

Boosting scientific literacy and learning motivation in elementary students through a contextual plant encyclopedia

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ABSTRACT

The low level of science literacy and student motivation demands innovative, relevant, and engaging learning media. This study aims to measure the effectiveness of a contextual-based plant encyclopedia in improving science literacy and student motivation in elementary schools. This study uses a quantitative method with a quasi-experimental one-group pretest-posttest design. The research population consists of 4th-grade students from SD Kotagede 3, Yogyakarta, with a sample of 20 students selected through simple random sampling. The research instruments include pretest-posttest questions to measure science literacy, Guttman scale questionnaires for learning motivation, as well as observation sheets and interviews to support qualitative data. We analyzed the data using descriptive statistics and the non-parametric Wilcoxon test, as the assumption test results indicated that the data did not meet the criteria for normality and homogeneity. The research results show a significant increase in students' science literacy ($p < 0.001$), although there was no significant increase in learning motivation ($p = 0.492$). These findings indicate that context-based encyclopedias are highly effective in supporting students' understanding of science concepts through the presentation of engaging and structured information. However, the minimal impact on learning motivation indicates the need for additional strategies, such as teacher guidance and increased media interactivity. The implications of this research include the integration of context-based encyclopedias as effective learning media and the need for supporting strategies, such as longer intervention durations and teacher guidance for more optimal results.

INTRODUCTION

In the current era of globalization, improving literacy and motivation has become the main goal in the field of education. The results of PISA 2022 indicate that Indonesia's literacy learning outcomes ranking increased by about 34% from the previous year and reached level 2 or higher in the field of science (İdil, Gülen, & Dönmez, 2024). Mastering scientific literacy can provide significant benefits, both at an individual and collective level (Limiansih, Sulistyani, & Melissa, 2024). Kilag et al., (2024) States that the vision of scientific literacy emphasizes the acquisition of scientific knowledge and skills, emphasizes the development of critical thinking and problem-solving abilities, places greater emphasis on the social and ethical implications of science, as well as the importance of critical thinking, ethical reflection, and social responsibility. This seeks to develop students' abilities to understand and apply science to solve real-world problems. In line with an independent curriculum, students are required to master six basic literacies, including reading and writing, numeracy, science, digital, financial, and cultural and citizenship literacy (Elitasari, Yeni Rakhmawati, Irma Yulianti Budi Safitri, & Muhammad Asip, 2023). Scientific literacy, however, requires a more intersectional approach to address issues like anti-racism and anti-colonialism, enabling students to develop innovative solutions to social problems (Valladares, 2021). Sholikah & Pertiwi, (2021) states that individuals who are scientifically literate will have the ability to apply scientific concepts, scientific processes, scientific attitudes and scientific values in making decisions and interacting with other people and their environment. This comprehensive approach aims to equip students with essential skills that will enable them to thrive in a rapidly changing world. By fostering these literacies, the curriculum not only enhances academic performance but also prepares students for real-life challenges and civic engagement.

Scientific literacy is one of the essential basic literacy skills that students should possess. Scientific literacy is a person's ability to use scientific knowledge and processes to understand scientific phenomena in solving problems or making decisions (Effendi et al., 2020). According Permatasari et al., (2024) explain that scientific literacy is the ability to understand and apply science in overcoming problems in the surrounding environment. Scientific information, the use of digital technology in the field of science to study nature, and decision-making based on scientific thinking are also related to understanding the scientific process. In Addition, Permatasari et al., (2024) scientific literacy does not only involve understanding scientific concepts and theories but also the ability to analyze, evaluate, and make decisions based on existing information. Science literacy is also considered to aid in the development of learning and critical thinking skills in students. Science literacy is beneficial in developing cognitive abilities, allowing students to process information effectively and efficiently (Syah, Winarno, Irvan Kurniawan, Robani, & Khomariah, 2020). Having science literacy skills not only helps students understand concepts in terms of knowledge but also equips them with scientific competence and attitudes that they can apply in real life (Latip & Faisal, 2021).

The ability to have scientific literacy is important to possess in a modern world that is constantly changing and evolving. With excellent science literacy, one can actively participate in a society based on scientific knowledge, make better decisions, and be competitive in a job market increasingly linked to science and technology (Sholihan et al., 2023). Despite its importance, scientific literacy among students in Indonesia remains low. Factors contributing to this include students' lack of understanding of basic science concepts, reliance on conventional teaching methods, and limited interest in reading and analyzing educational materials (Yusmar & Fadilah, 2023).

Efforts to improve science literacy also require learning motivation, which can encourage students to continue learning. Learning motivation is one of the factors that can determine the effectiveness of learning. Students will learn well if they have high learning motivation (Nuryasana & Desiningrum, 2020). Students' motivation lays the groundwork for achieving optimal learning outcomes, which in turn guides the determination of expected competency achievements (Rahman, 2021). In this scenario, students' low motivation to learn stems from their boredom with monotonous teaching methods, like simply listening and taking notes during the learning activities (Sari, Chan, Hayati, Syaferi, & Sa'diah, 2021). The emergence of such conditions is likely due to the teacher's monotonous model or approach in science learning, which fails to consider the diverse characteristics of the students (Anggraini & Maryani, 2023).

In elementary school, incorporating media into learning activities is an effective way to enhance students' science literacy and learning motivation. By using media, it can provide students with an enjoyable learning experience and make the material easier to understand. Science learning becomes

more meaningful when students are directly involved in every stage of the learning process (Maryani, Prasetyo, & Wilujeng, 2022). Teachers must employ and choose interactive learning media that facilitate student comprehension and align with the desired learning objectives (Pradani, 2022). Incorporating various types of media, such as videos, simulations, and educational games, can cater to different learning styles and keep students engaged. This multifaceted approach not only fosters a deeper understanding of scientific concepts but also promotes critical thinking and problem-solving skills among young learners.

We need an interesting, educational, and effective learning resource in this situation. An encyclopedia serves as a valuable learning resource. An encyclopedia is a collection of writings presented in book form that contains brief explanations about various fields of knowledge (Fadhilah, Auliaty, & Wardhani, 2022). According to Andini et al. (2022), an encyclopedia is a book that contains systematically and alphabetically arranged material, including definitions, backgrounds, and the content within it. The use of encyclopedias in learning activities can provide complete, in-depth, and reliable information about the topics discussed. Additionally, it can function as a learning reference to bolster educational activities.

Previous research that aligns with this study includes findings (Fadhilah et al., 2022) that indicate that the use of contextual-based digital encyclopedia products for ornamental plants falls into the excellent category, making this media suitable as a learning resource in science education. Furthermore, Pangesti (2023) reported that the product's trial results yielded a percentage of 85.2%, placing it in the very good category. This demonstrates the suitability of the learning media, in the form of an encyclopedia on angiosperms, for the biology learning process in 10th-grade high school. According to (Habiba, Ngabekti, & Indriyanti, 2023) The Biodiversity Encyclopedia can be understood and read by students, as shown by the data on the practicality of the encyclopedia by teachers getting an average of 91.67% and the classical completeness of students' learning outcomes after learning with media is 91%, so this value shows the teaching material effectively improve student learning outcomes. According to Ananda et al. (2024), the encyclopedia falls into the practical category for use, as indicated by the learning completeness formula. This formula shows the effectiveness of the students' answers after using the encyclopedia, with a percentage of 87.30%, thereby categorizing it as very effective. As for research from Istiani, (2023) which shows that encyclopedia media based on local wisdom is effectively used to increase students' scientific literacy, it is shown from the results of field trial analysis, 16 out of 19 students scored above the KKM with an average score of 79.6, so that the percentage of student learning completeness reached 84.2%. Maharani (2023) reports that the response rate of 84% from teachers and students falls into the very good category, indicating its suitability for use without any improvements. The agreement of both subject teachers and students on the development of the medicinal plant encyclopedia confirms this. In this case, the renewal of this research is using encyclopedia media in the form of contextually based printed books with material on plant body parts that are connected to everyday life.

The creation of a contextual plant encyclopedia in the form of a package book with an attractive and interactive layout represents this research's innovation. The contextual approach is a learning method that begins with taking, simulating, narrating, dialoguing, questioning, and discussing real-world events in the daily lives experienced by students (Fatihah, 2022). In this case, the contextual plant encyclopedia media includes detailed information about various types of plants, including morphological descriptions and habitats. Included are colored images and photos of plants to facilitate understanding and attract students' interest. The encyclopedia contains important information, which is equipped with supporting images or photos. The encyclopedia is also arranged alphabetically or by certain groupings so that the encyclopedia is easy to use (Hana, Ekaningtias, & Jannah, 2020). The stories relate to the students' daily lives and connect to their surrounding environment. Group student worksheets and quizzes are incorporated at the conclusion of the discussion topic to gauge students' comprehension and enhance their memory of the material. Fourth-grade students can easily comprehend the language, and the material is arranged in a systematic manner, starting from a general overview and progressing to detailed information about each plant. The curriculum also includes simple activities or projects that students can implement in their surroundings to apply the knowledge they have learned. The purpose of this research is to measure the effectiveness of using the Contextual-Based Plant Encyclopedia media and whether it is suitable for use in learning activities.

METHODS

Research Design

This study employs a quantitative approach, utilizing a quasi-experimental design with a one-group pretest-posttest design (Rambe, 2024). The data collection methods used in this research are observation, interviews, questionnaires, and documentation. We conducted the observations and interviews to understand the location conditions and the characteristics of the research subjects, collect data related to the evaluation of the developed product through questionnaires. The analysis of the collected data will allow us to assess the effectiveness of the developed product and draw meaningful conclusions regarding its impact on the subjects involved. Validate the data as evidence of the implementation of the research and the obtained results.

Population and Samples

The population in this study is the 4th-grade students of Kotagede 3 elementary school, consisting of 25 students with details of 11 male students and 14 female students. A simple random sampling yielded a sample of 25 students from class 4B. In this research, there was no use of control classes in measuring the pretest and posttest. Due to the research design emphasizes individual analysis of each student without comparing different groups. During the action, five students did not always attend every meeting, resulting in unreliable data. Therefore, the researcher decided to use data from 20 students who consistently attended all learning processes throughout the research period.

Data Collection

This research involves learning instruments consisting of lesson plans, where the use of teaching modules is used to obtain assessment data from the learning tools developed (Sulaiman, Afdalia, Rosita, & Anggraini, 2023). Encyclopedias were developed based on the results of an analysis of students' needs regarding the importance of teaching materials that are not dominated by materials but rather teaching materials with more detailed explanations, equipped with pictures and illustrations (Habiba et al., 2023). Science literacy measurement tools are in the form of pretest-posttest essay questions, and learning motivation measurement tools are in the form of Guttman scale questionnaires. Assessment of students' scientific literacy is carried out with two tests, namely a pretest before learning and a posttest at the end of the practicum (Widiastuti, Pratiwi, Fatmaryanti, & Hakim, 2022). Experts developed and validated all instruments, adjusting them to align with relevant theories of science literacy and learning motivation. We carried out construct validation using Pearson correlation, which confirmed the validity of all items. Meanwhile, KR-20 demonstrates its high reliability (> 0.700)(Kennedy, 2022).

Procedure

Data collection in this study began in the first meeting by distributing questionnaires and pretest questions to students, aimed at measuring their initial abilities before the learning process started. We invited students to discuss the learning material using a contextually based encyclopedia, where adding images to the teaching media uses concrete images that are relevant to the material to facilitate students' understanding. After they completed the questionnaires and pretest questions. The second meeting continued the learning process by discussing the first meeting's material using the encyclopedia to reinforce student understanding. In the third meeting, we asked students to complete questionnaires and post-test questions to assess their learning progress and understanding.

Data Analysis Techniques

Data analysis in this study uses descriptive statistics to describe science literacy and learning motivation data. We obtained the data presented in Table 1 after testing the assumptions of normality and homogeneity.

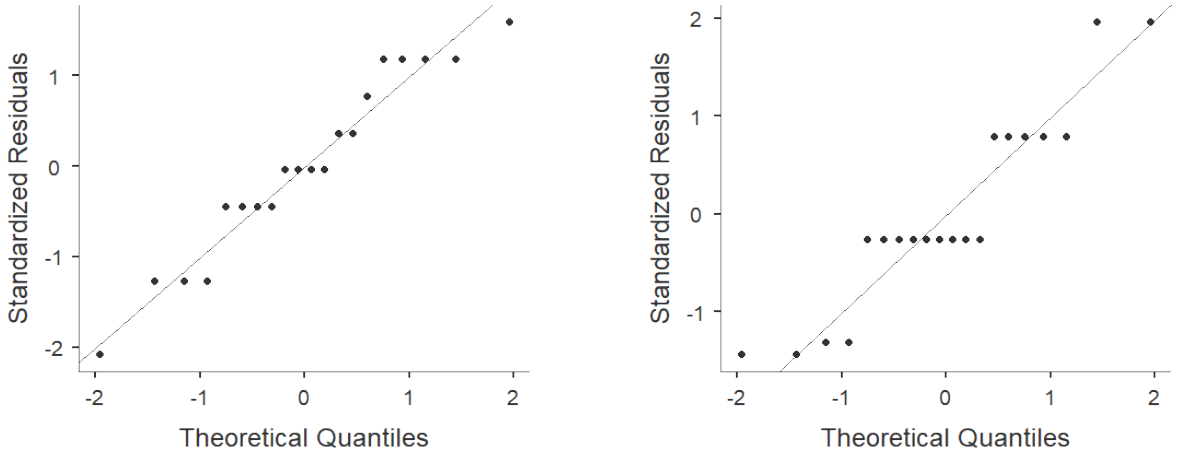
Table 1

Results of the Normality Test of Science Literacy Data and Learning Motivation with Shapiro Wilk

		W	p
Pretest Scientific Literacy	Posttest Scientific Literacy	0.950	0.361
Pretest Motivation	Posttest Motivation	0.886	0.022

Note. A low p-value suggests a violation of the assumption of normality

The normality test for Table 1 was done using the Shapiro-Wilk test, which, according to menurut Agustin, Putri dan Permatasari (2020), is a way to find out how random data is distributed in a small sample of no more than 50 samples used for data simulation. The normality test is used to determine whether the data is normally distributed or not, with the condition that the data is normally distributed if it meets the criteria of sig value > 0.05, and conversely, if the sig value < 0.05, then the data is said to be not normally distributed (Ismail, 2022). Based on Table 1, the science literacy data yielded a p-value of 0.36, indicating that the data is normally distributed. Meanwhile, we obtained a p-value of 0.022 for student learning motivation, indicating that the data is not normally distributed. We conducted a Q-Q plot test, as shown in Figure 1, to see the homogeneity.



(a) (b)

Figure 1. Q-Q Plot Scatter Pretest-Posttest Science Literacy (a) and Learning Motivation (b)

The interpretation of Q-Q plots reveals the homogeneity criterion; data is considered homogeneous if its distribution follows a straight line without forming a specific pattern (Bombongan Rantesalu & Timuneno, 2020). Figure 1 illustrates that the distribution of points does not align with the horizontal line but rather deviates from it. Thus, the data on science literacy and learning motivation are not homogeneous. The hypothesis test cannot use parametric statistics because one of the assumption tests does not meet the criteria. We conducted the hypothesis testing using a non-parametric test, the Wilcoxon test. We conducted the Wilcoxon for the difference test first, then used the effect size test for effectiveness testing.

RESULTS AND DISCUSSION

This research produces data on science literacy, learning motivation, and the effectiveness of testing the encyclopedia on both variables. The section presenting examples/models is where the encyclopedia integrates contextual aspects. Some examples of this integration include the use of plant part examples derived from local plants that students often encounter. Additionally, we make the images concrete to enhance student understanding. Figure 2 displays examples of visualizations from the encyclopedia.

Figure 2. The encyclopedia visualization features contextual integration in relation to examples and models.

Table 2 shows the results of the descriptive analysis of the pretest and posttest scores for the variables of science literacy and learning motivation.

Table 2
Descriptive Statistics of Pretest-Posttest Results on Science Literacy and Learning Motivation

	N	mean	median	SD	SE
Pretest scientific literacy	20	60.00	59.00	7.77	1.74
Postest scientific literacy	20	77.10	76.50	9.40	2.10
Pretest motivation	20	67.90	67.00	11.88	2.66
Postest motivation	20	69.90	67.00	17.20	3.85

Based on Table 2, these results show a statistical increase in the scientific literacy variable as well as learning motivation before being given treatment and after being given treatment. This increase shows that the application of contextual-based encyclopedia media used in learning has succeeded in having a positive impact on both variables. Like previous research, such as that conducted by (Rahma, Sholehah, & Siswoyo, 2024), there is evidence that contextual-based learning can improve students' understanding. However, we performed the Wilcoxon test to determine the significance of the differences, and the results are shown in Table 3.

Tabel 3
Wilcoxon Test Comparison of Pretest-Posttest Science Literacy and Learning Motivation

			Statistic	p		Effect Size	95% Confidence Interval	
							Lower	Upper
Pretest Science Literacy	Posttest Science Literacy	Wilcoxon W	0.0	< .001	Rank biserial correlation	-1.000	-18.5	-16.000
Pretest Motivation	Posttest Motivation	Wilcoxon W	25.0[a]	0.492	Rank biserial correlation	-0.242	-12.5	0.500

Note. H_a μ Measure 1 - Measure 2 $\neq 0$
[a] 9 pair(s) of values were tied

The results of the Wilcoxon analysis in Table 3 show that there is a significant difference between the pretest and posttest scores of students' scientific literacy, while in learning motivation, there was no significant difference in student motivation between the pretest and posttest scores. In addition, 9 tied pairs in the motivation data may have influenced the results of this analysis.

Contextual plant encyclopedia media has several advantages in supporting the effectiveness of learning. (Y. Permatasari et al., 2022)assert that schools can utilize encyclopedic media as an alternative learning resource, as it offers concise explanations and visually appealing visualizations, thereby simplifying the understanding of learning materials. Moreover, there are many advantages gained from using encyclopedic media in the learning process, such as enhancing knowledge and understanding and enriching information about the sciences for the students who read it. Additionally, encyclopedias have their unique appeal (Mulyani & Armiati, 2021). As a learning medium, encyclopedias offer several advantages, such as providing detailed and comprehensive information, containing numerous images that encourage students to explore their imagination, and presenting factual information (Putri, Rini, & Perdiansyah, 2022). The use of media or special learning tools can help students understand science, communicate science, and use scientific knowledge to solve problems (Juniawan, Salsabila, Prasetya, & Rengga, 2023). Learning media that supports contextual learning can also help improve students' scientific literacy in terms of context, content, and scientific attitudes.

The use of encyclopedias in this research has proven effective in improving students' science literacy. This is in line with Aviarizki et al. (2024) the that digital encyclopedias have enormous potential in improving the science literacy of elementary school students by providing more interactive and engaging information. Encyclopedias provide structured and comprehensive content, allowing students to independently access scientific information, thereby strengthening their understanding of scientific concepts and critical thinking skills. Additionally, research Ramadhani (2023) demonstrates the effectiveness of developing a digital encyclopedia based on science literacy for fifth-grade elementary school students studying ecosystems. Consideration of the local context and students' needs in the design of an encyclopedia can enhance student engagement and interest in learning, thereby promoting an increase in science literacy. Thus, the integration of encyclopedias into the science learning process can be an effective strategy to enhance students' science literacy.

Contradictory to that, the research results also show that the use of encyclopedias does not have a significant impact on students' learning motivation. This finding may be affected by student characteristics, particularly their initial interest in encyclopedias. Students' initial interest in learning media greatly determines the effectiveness of the media in enhancing learning motivation (Pratama, 2021). If students do not have an interest or enthusiasm for encyclopedias, then the use of this media will not be effective in increasing students' motivation. Furthermore, external factors such as the learning environment (Cayubit, 2022), teacher support (Lu, Xie, & Liu, 2022), and the availability of other learning resources (Mulang, 2021) can have a more significant impact on student motivation than the use of encyclopedias alone.

In addition to considering the effectiveness of contextual encyclopedias in improving science literacy, it is important to identify strategies that can enhance the limited impact on students' learning motivation. Extending the intervention's duration is one of the possible steps. A longer duration allows students to become more familiar with the learning media used, enabling them to explore the contents of the encyclopedia more deeply and feel more engaged in the learning process. In addition, adjusting the encyclopedia content to be more relevant to students' interests can be an effective strategy. For instance, you could incorporate captivating tales or information about plants that are frequently encountered in the students' environment or incorporate project-based activities like basic experiments that involve these plants. This approach can enhance the appeal of the encyclopedia and make students more enthusiastic about studying it. Next, teachers can take an active role by providing guidance and facilitating interactive discussions based on encyclopedias. This allows students to feel more engaged in the learning process and connect the material with their own experiences. For example, the teacher can ask students to share their experiences with plants they have encountered and then relate it to the material in the encyclopedia. We must design such interventions holistically, considering the students' needs and the factors of the learning environment. We hope that combining these strategies will significantly increase students' learning motivation, thereby allowing the contextual encyclopedia to have a broader impact on their learning outcomes.

The results of this study have several implications for learning, particularly in science education at the elementary school level. Among these, the integration of contextual plant encyclopedia media as an effective learning medium encourages active student involvement in the learning process. Its attractive layout and visually engaging design motivate students to participate more enthusiastically in discussions and science-related activities. Additionally, the use of contextual plant encyclopedias plays a significant role in enhancing students' observation and analytical skills. The use of contextual plant encyclopedia media also plays an important role in enhancing students' observation and analysis skills. In line with this research, research from (Ananda et al., 2024) states that encyclopedias are learning resources that can improve student learning outcomes. In addition, increasing student learning motivation compared to learning without media assistance will have a positive impact on student learning outcomes. To enhance the effectiveness of the encyclopedia in improving learning motivation, several recommendations can be proposed (Putra et al., 2021). First, extending the duration of the intervention can allow students more time to explore the encyclopedia and engage deeply with the content (Fiel'ardh, Fardhani, & Fujii, 2023). A longer intervention period may help build familiarity and interest, enabling students to maximize the encyclopedia's potential as a learning tool. Second, tailoring the encyclopedia's content to align with students' specific interests and preferences can increase its relevance and appeal. For instance, incorporating local plant species or real-life examples that students encounter in their environment can foster a stronger connection to the material.

Moreover, integrating interactive activities and project-based learning within the encyclopedia's framework can make the learning process more engaging (Huang, Li, & Shang, 2023). Teachers can facilitate group projects where students research plants in their surroundings using the encyclopedia, followed by presentations or hands-on experiments. Such activities can not only boost motivation but also improve collaborative and problem-solving skills. Teachers and instructional designers also play a crucial role in the successful implementation of the encyclopedia. Providing structured guidance and interactive discussions during the use of the encyclopedia can help sustain student interest. For example, teachers can initiate open-ended questions or exploratory tasks related to the encyclopedia's content to spark curiosity. Additionally, a sustainable and flexible intervention design that incorporates ongoing feedback from students is essential for ensuring the encyclopedia's long-term effectiveness. Therefore, the implementation of the contextual plant encyclopedia requires a well-planned pedagogical strategy. This strategy should consider content relevance, the duration of use, and opportunities for active engagement. By combining these approaches, educators can maximize the benefits of the encyclopedia in enhancing both scientific literacy and learning motivation, creating enjoyable and meaningful learning experiences for students.

CONCLUSION

The use of a contextual-based plant encyclopedia has proven effective in improving the science literacy of elementary school students. This is evident from the data analysis results, which show a significant increase in students' science literacy scores after using the encyclopedia. On the other hand, students' learning motivation did not show a significant increase, which is likely due to factors such as students' initial interest in this media and the relatively short duration of the intervention. The relationship between these two variables underscores the importance of careful planning in the implementation of learning media, including engaging design and pedagogical approaches that support optimal student engagement. This research suggests that integrating context-based encyclopedias into science learning can enhance students' science literacy. However, to achieve a broader impact, we need supporting strategies such as teacher guidance, extended usage duration, and media adaptation to student needs, which can maximize the benefits for both literacy and learning motivation.

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