



THE CORRELATION BETWEEN DIGITAL LITERACY AND SCIENTIFIC LITERACY ABILITIES WITH STUDENTS' LEARNING OUTCOMES ON CHEMISTRY MATERIAL IN EVERYDAY LIFE

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Abstract. The development of science and technology in the 21st century demands the cultivation of literacy culture as an essential life skill. Digital literacy and scientific literacy are crucial literacy skills that need to be developed. Digital literacy emphasizes the ability to critically understand and use digital information, while scientific literacy involves a deep understanding of science and the ability to apply it in everyday life. The objectives of this study are to determine: (1) students' digital literacy abilities; (2) students' scientific literacy abilities; (3) students' learning outcome criteria; (4) the correlation between digital literacy and learning outcomes; and (5) the correlation between scientific literacy and students' learning outcomes on chemistry material in everyday life. This study employed a correlational research design with a quantitative approach. The subjects of the study consisted of 55 tenth-grade students from MAN 1 Nganjuk, selected using purposive sampling from a total population of 96 students. The data collection techniques included a digital literacy skills questionnaire, an essay test for scientific literacy, and a multiple-choice test for learning outcomes, each comprising 20 items. The instruments had been validated, with reliability values of 0.900, 0.854, and 0.863, respectively. The data analysis technique used descriptive statistics and the Spearman rho test. The results of the study showed that: (1) the average level of students' digital literacy is categorized as "good" with a score of 76.87; (2) the level of scientific literacy is categorized as "good" with an average score of 68.09; (3) the average learning outcome score is 85.27, categorized as "very good"; (4) there is a correlation between digital literacy and learning outcomes, with a correlation coefficient of 0.464, categorized as "moderate"; and (5) the correlation between scientific literacy and students' learning outcomes in chemistry is strong, with a correlation coefficient of 0.611.

Keywords: *chemistry learning outcomes, digital literacy, science literacy*

INTRODUCTION

The rapid development of science and technology in the 21st century underscores the necessity for society to cultivate a literacy culture as a fundamental foundation for modern life skills, which should be developed through comprehensive education, starting from the family level to the community as a whole (Febliza & Okatariyani, 2020). The education sector must adapt to create superior human resources. One way to achieve this adaptation is by implementing learning that focuses on technology and science. Additionally, it is essential to promote literacy learning through the six basic literacies, including digital literacy and scientific literacy (A. M. Yusuf et al., 2022). The six fundamental literacy skills are reading and writing literacy, scientific literacy, numeracy, digital literacy, financial literacy, and cultural and civic literacy. As information and communication technology (ICT)

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continues to develop rapidly, digital, informational, and technological literacy skills have become as important as other basic skills (Dinata, 2021).

Potter defines digital literacy as the ability to access and process data in various types of media. This definition has evolved into the ability to access, analyze, evaluate, and create messages in various contexts, referred to as the “life skills” approach. Furthermore, digital literacy encompasses communication practices, relationships, thinking, and existence in relation to digital media. This theory acknowledges that digital media is a social phenomenon that influences the economic, social, and political aspects of society, and the term “practice” includes all the ways individuals actively use literacy (Potter, 2013).

An individual’s ability to utilize computer devices to access information in the digital space is described through eight components of digital literacy, namely: (1) functional skills and beyond, related to proficiency in using information technology; (2) creativity, which involves the ability to think creatively in utilizing information and communication technology to build knowledge; (3) collaboration, which pertains to building knowledge through discussions and feedback in the digital space; (4) communication, which includes the ability to listen, understand, and convey ideas; (5) the ability to find and select information; (6) critical thinking and evaluation; (7) cultural and social understanding; and (8) digital safety. Overall, digital literacy encompasses a wide range of skills and practices that are essential for effective navigation in the ever-evolving digital world (Hague & Payton, 2010).

The ability to use technology effectively and intelligently is crucial in digital literacy. This includes the application of technology as a learning tool and a source of information, as well as guidance from teachers to help students wisely navigate the flood of information. The goal is to avoid information manipulation and fake news, as well as the misuse of information to incite hatred. Unwise use of technology can negatively impact psychological well-being, such as the increasing cases of cyberbullying on social media. Therefore, it is important to build good media, information, and ICT literacy among students to prevent the negative effects of poor digital literacy (Mawarni et al., 2021). In addition to the importance of digital literacy for students, scientific literacy has also become one of the fundamental literacies that is equally important in the 21st century (Kementerian Pendidikan dan Kebudayaan, 2017).

The ability to apply scientific concepts in daily life, explain scientific events, and describe them with reference to scientific evidence is referred to as scientific literacy (Bybee et al., 2009). In the 2015 PISA framework, there are four dimensions: context, content or knowledge, competencies, and attitudes (Organisation for Economic Co-operation and Development, 2017). These four dimensions—context, content, competence, and attitude—are the primary criteria used by PISA 2015 to evaluate scientific literacy. It can be concluded that scientific literacy involves the understanding and application of scientific concepts in everyday life. Beyond the academic knowledge taught in the classroom, scientific literacy also includes students’ preparedness to face everyday challenges by understanding situations related to individuals, families, groups, communities, and global aspects.

Learning outcomes encompass students’ abilities after the learning process, involving changes in three main domains: cognitive, affective, and psychomotor. In the cognitive domain, students experience improvements in understanding, knowledge, and intellectual skills, such as grasping new concepts and solving complex problems. The affective domain involves changes in attitudes, values, and motivation, including perceptions of the subject and motivation to learn. The psychomotor domain encompasses improvements in physical and motor skills, such

as performing tasks with greater fluency and expertise. Learning outcomes reflect the enhancement of knowledge, understanding, attitudes, and skills as an integral part of the learning process (Hastuti & Budianti, 2014). One relevant area to study in the context of learning outcomes is the field of chemistry.

Chemistry is a branch of Natural Science that aims to understand natural phenomena related to the composition, structure, properties, transformation, dynamics, and energetics of substances. Chemistry investigates and explains the aspects of substances and their changes, including the identification of components, analysis of transformations, and energy in chemical reactions, using a structured and methodical scientific approach (Hamzah, 2020). Chemistry has advanced rapidly with technological developments and is applied in everyday products such as soap and medicines. Everyday chemistry learning teaches the concepts and roles of chemistry, as well as the application of scientific methods in laboratory experiments. Students learn to formulate problems, collect and analyze data, and evaluate the processes and results of experiments. This emphasizes the importance of understanding chemistry in daily life and the ability to apply scientific methods in experiments (Myranthika, 2020). The expected learning outcomes in chemistry for everyday life are that students should be able to observe, investigate, and explain phenomena according to scientific principles when explaining chemical concepts in everyday life; and apply chemistry concepts in environmental management, including explaining phenomena such as global warming. In addition to chemistry, which is very closely related to students' lives, another aspect that is equally relevant to students is digitalization.

Digitalization, which is closely related to students' lives, should be given the same attention as learning outcomes. Additionally, considering that digital literacy is one of the literacy cultures and a prerequisite for 21st-century life skills that must be developed through education (Febliza & Okatariyani, 2020), it is important to examine the relationship between digital literacy and students' learning outcomes in the context of everyday chemistry. This aims to understand how digital literacy can influence the improvement of students' learning outcomes and encourage students' participation and creativity in utilizing digital learning resources. Scientific literacy, the ability to understand science, is becoming increasingly important for every individual, both in everyday life and in the workplace. A person with a strong understanding of science can use that knowledge to solve everyday problems, improve performance in essential tasks, and create useful products. Therefore, scientific literacy is considered a crucial skill for students (Yuyu, 2017).

Previous research has found several key points related to students' digital literacy and scientific literacy. One of them is that the use of the Kahoot web platform in blended learning can help students improve their understanding of technology (Jumila *et al.*, 2018). Second, the use of animations can enhance students' learning outcomes in colloid material (Awaliyah, 2019). Third, digital literacy can improve students' cognitive learning outcomes and make the classroom more engaging and effective (Eli & Sari, 2018). Fourth, although the correlation in previous studies was moderate, digital literacy and students' learning outcomes in colloid material had a significant correlation (Mabubah *et al.*, 2022). Fifth, scientific literacy has a positive impact on students' cognitive abilities (Lestari, 2017). Sixth, learning that emphasizes scientific literacy positively affects students' achievement, indicating that proficiency in scientific literacy can improve students' learning outcomes (Haristy *et al.*, 2013). From several previous studies, there is still limited information regarding the relationship between digital literacy and scientific literacy with students' learning outcomes in the chemistry material related to everyday life.

Based on the background outlined above, it is important to conduct research titled “The Correlation Between Digital Literacy and Scientific Literacy Abilities and Chemistry Learning Outcomes of Grade X Students on the Material of Chemistry in Everyday Life.” This research is expected to provide deeper insights into how digital literacy and scientific literacy contribute to students’ understanding of chemistry material. Additionally, the findings from this research can serve as a foundation for developing more effective learning strategies to improve students’ learning outcomes. The study will focus on cognitive learning outcomes.

The objectives of this research are to determine: (1) the students’ digital literacy abilities; (2) the students’ scientific literacy abilities; (3) the criteria for students’ learning outcomes; (4) the relationship between digital literacy abilities and learning outcomes; and (5) the relationship between scientific literacy abilities and students’ chemistry learning outcomes related to chemistry in everyday life.

METHOD

The type of research conducted was correlational research using a quantitative approach. The subjects in this study comprised 55 students from Grade X at MAN 1 Nganjuk. The sampling in the research was carried out using purposive sampling techniques by selecting from a population of 96 students. The selection was made by considering the students’ cognitive abilities, which were nearly uniform, and they had already received chemistry material in the context of everyday life.

The data collection technique involved tests and questionnaires. Tests were used to assess students’ learning outcomes related to chemistry in everyday life, as well as to measure scientific literacy, which adapted the assessment aspects of the PISA 2015 instruments and reading materials that were adapted from basic chemistry textbooks published by the Ministry of Education and Culture, written by Hamzah (2020). The digital literacy questionnaire was used to describe students’ digital literacy skills, with each instrument consisting of 20 items. The learning outcome tests, scientific literacy tests, and digital literacy questionnaires underwent a trial phase to determine their validity and were validated by an academic expert and a practitioner from the chemistry subject teacher, with scores of 96.28, 86.45, and 89.59, respectively, indicating that all three measurement instruments were in the valid category with very high criteria. The instruments also underwent reliability testing, with scores of 0.900, 0.854, and 0.863, indicating that all three instruments had very high reliability levels.

The digital literacy questionnaire was developed based on eight aspects of digital literacy: functional skills and beyond, creativity, collaboration, communication, the ability to find and select information, critical thinking and evaluation, cultural and social understanding, and e-safety. Several statements in the questionnaire adopted items from the digital literacy assessment scale research by Sidauruk et al. (2021). Table 1 presents the aspects of digital literacy skills in this study.

Table 1. The aspects of digital literacy abilities

Component	Indicator	Statement Items
<i>Functional skill and beyond</i>	Expertise in using computers and utilizing the internet.	1,2
<i>Creativity</i>	Creativity in presenting content to groups using digital media; ability to think creatively and imaginatively when planning and studying concepts.	3,4,5

Component	Indicator	Statement Items
<i>Collaboration</i>	Ability to participate in digital spaces; ability to understand and communicate ideas to others in digital environments.	6,7
<i>Communication</i>	Ability to communicate through digital technology; ability to understand others in the digital world.	8,9
<i>The ability to find and select information</i>	Ability to search for and select information.	10,11,12
<i>Critical thinking and evaluation</i>	Ability to analyze, contribute, and think critically about data.	13,14,15
<i>Cultural and social understanding</i>	Understanding social and cultural contexts.	16,17
<i>E-safety</i>	Understanding safety while exploring, developing, and working with digital technology.	18,19,20

The analysis of digital literacy skills was conducted for each component using the questionnaire assessment scores based on a Likert scale of 1-4. This scale included the following descriptions: STS (Strongly Disagree), TS (Disagree), S (Agree), and SS (Strongly Agree). The measurement of the frequency percentage was performed using a formula, which is:

$$P = \frac{F}{N} \times 100$$

Description:

NP : the sought percentage value

F : frequency/the number of respondent answers

N : the number of respondents

After obtaining the sought percentage value, it was then categorized based on the interpretation that corresponded to that percentage. The categorization of digital literacy skills was presented in Table 2 below.

Table 2. Interpretation of the percentage of students' digital literacy abilities

Percentage	Interpretation
86-100%	Very Good
76-85%	Good
60-75%	Moderate
55-59%	Poor
≤54	Very Poor

(Jamil et al., 2022)

The stages of analyzing students' science literacy skills were as follows: (1) assigning initial scores to each student's answers in the essay test based on the prepared answer standards; (2) calculating the total score for the essay test for each student on each question; (3) determining the percentage of science literacy abilities for each student by converting the initial scores into percentage values using the same formula as the measurement of the average score of digital literacy abilities. The categorization of science literacy abilities was presented in Table 3 below:

Table 3. Interpretation of the percentage of science literacy abilities

Score	Category
80-100	Very Good

Score	Category
60-80	Good
40-60	Moderate
20-40	Poor
0-20	Very Poor

(Septiani et al., 2019)

The analysis of learning outcomes data utilized a structured procedure to process the collected data. The process began by assigning scores to each item in the students' test results and then calculating the percentage of scores for each test item. The search for learning outcomes values used the same formula as for science literacy and digital literacy. The categorization of learning outcomes was presented in Table 4 below:

Table 4. Interpretation of the percentage of learning outcomes

Percentage	Criteria for Assessment
81-100	Very Good
61-80	Good
41-60	Moderate
21-40	Poor
0-20	Very Poor

(Nurrita, 2018)

The data obtained from each variable was then subjected to prerequisite analysis tests, which included normality and linearity tests. The results of the statistical normality and linearity tests for each variable could be seen in the following Table 5:

Table 5. Results of the Normality and Linearity Tests

	Digital Literacy	Science Literacy	Learning Outcomes
N		55	
Kolmogorov-Smirnov Z	0,824	1,412	1.350
Asymp. Sig. (2-tailed)	0,506	0,037	0,052
Linearity	Deviation from Linearity		
Digital literacy with learning outcomes		0,000	
Science literacy with learning outcomes		0,142	

Table 5 presented the results of the normality and linearity tests for each variable studied. For the digital literacy and learning outcomes variables, the data was normally distributed, while for the scientific literacy variable, the data was not normally distributed. In the linearity test, the relationship between digital literacy and learning outcomes was found to be non-linear, whereas the relationship between scientific literacy and learning outcomes was linear. Since one of the prerequisite tests did not meet the parametric statistical criteria, the relationship testing between each variable utilized non-parametric inferential statistics, namely the Spearman rho test. After obtaining the correlation values, these were categorized according to the following table:

Tabel 6. Correlation criteria

Coefficient Interval	Level of Correlation
0,00-0,199	Very Low
0,20-0,399	Low
0,40-0,599	Medium
0,60-0,799	Strong
0,80-1,000	Very Strong

(Malik, 2018)

After determining the correlation coefficient, the next step was to find the coefficient of determination. The coefficient of determination was used to ascertain the extent of the contribution of digital literacy and scientific literacy to learning outcomes, as well as the degree of influence of these two factors on learning outcomes. The formula used was Coefficient of Determination = $R^2 \times 100\%$. Where R was the previously known correlation coefficient.

RESULTS AND DISCUSSION

Students' Digital Literacy Ability

The results of students' digital literacy abilities were obtained from questionnaire responses, which were then processed based on the total scores of each student who completed the questionnaire. The categorization of digital literacy skills results can be seen in Table 2. The distribution of classifications and frequencies of students' digital literacy skills can be seen in Table 7 below:

Table 7. Classification of the digital literacy skill results

No.	Score Range	Category	Frequency
1.	86-100	Very Good	6
2.	76-85	Good	26
3.	60-75	Moderate	22
4.	55-59	Poor	1
5.	≤54	Very Poor	0
Total			55
Average			76,87
Category			Good

Table 7 showed the results of students' digital literacy abilities. The majority achieved a "good" result. The overall average score for students' digital literacy abilities was 76.87, classified as "good." The results of students' digital literacy skills in each aspect could be seen in Table 8 below:

Table 8. The average results of digital literacy abilities for each aspect

Aspect	Score	Category
<i>Functional Skill and Beyond</i>	80,45	Good
<i>Creativity</i>	80,90	Good
<i>Collaboration</i>	80,00	Good
<i>Communication</i>	72,95	Moderate
<i>The Ability to Find and Select Information</i>	73,18	Moderate
<i>Critical Thinking and Evaluation</i>	76,21	Good
<i>Cultural and Social Understanding</i>	80,45	Good
<i>E-Safety</i>	75,00	Moderate
Total		619,14
Average		77,39
Category		Good

Table 8 showed the average results for each aspect of digital literacy. In the “Functional Skill and Beyond” aspect, with an average score of 80.45, it was categorized as “good.” This aspect assessed students’ proficiency in using information technology, demonstrating their ability to effectively use computers and the internet, supported by widespread smartphone ownership. In the “Creativity” aspect, with an average score of 80.90, also in the “good” category, students showed competency in creating creative products and presenting materials attractively through digital tools. In the “Collaboration” aspect, with an average score of 80.00, it was categorized as “good.” Although students preferred listening over actively participating in digital platforms like Zoom, they could still engage and explain ideas well. In the “Communication” aspect, with an average score of 72.95, it was categorized as “moderate.” While students were fairly good at discussing different perspectives, they still needed to build more confidence in communicating and interacting digitally.

Next, in “The Ability to Find and Select Information” aspect, with an average score of 73.18, it was categorized as “moderate.” Despite being fairly competent, some students struggled with efficiently and accurately locating information. In the “Critical Thinking and Evaluation” aspect, with an average score of 76.21, it was categorized as “moderate.” Students could analyze information, assess the credibility of sources, and differentiate between valid and inaccurate information. In the “Cultural and Social Understanding” aspect, with an average score of 80.45, it was categorized as “good.” Students were able to integrate information with cultural and social values and recognize fake news related to social and cultural issues. Lastly, in the “E-safety” aspect, with an average score of 75.00, it was categorized as “good.” Students were cautious in online activities and could recognize suspicious or fake links. Overall, the average digital literacy skills of students in each aspect were categorized as “good,” with an overall score of 77.39.

Students’ Science Literacy Abilities

The classification of the results of science literacy abilities is also available in the following Table 9:

Table 9. Classification of Science Literacy Abilities Results

No.	Score Range	Category	Frequency
1.	81-100	Very Good	12
2.	61-80	Good	25
3.	41-60	Moderate	18
4.	21-40	Poor	0
5.	0-20	Very Poor	0
Total			55
Average			68,09
Category			Good

From the table, it could be determined that the majority of students had science literacy skills in the “good” category. The average science literacy result for students was 68.09, which also fell into the “good” category. The results of students’ science literacy skills for each aspect can be seen in the following Table 10:

Table 10. The average science literacy abilities of students for each aspect

	Aspect			
	Context	Content	Competence	Attitude
	Average	Category	Average	Category
	71,91	Good	62,65	Good
	Good	Good	Good	Good

The discussion of each aspect provided an overview of students' science literacy abilities in the context of chemistry in everyday life. The overall average of science literacy indicated that the science literacy skills of Grade X students in chemistry related to daily life were categorized as "good," with an average score of 68.09. The highest average was found in the attitude aspect. Teaching and evaluation using science literacy aspects must always be carried out, considering that science literacy is one of the six fundamental literacies that students must possess to prepare for their future.

The Learning Outcomes of Students in Chemistry Related to Everyday Life

Chemistry learning related to everyday life taught concepts and the role of chemistry, as well as the application of scientific methods in laboratory experiments. Students learned to formulate problems, collect and analyze data, and evaluate the processes and results of their practical work. This emphasized the importance of understanding chemistry in daily life and the ability to apply scientific methods in experiments (Myranthika, 2020). The learning objectives for the topic of chemistry in everyday life expected students to be able to observe, investigate, and explain phenomena according to scientific work principles in explaining chemical concepts in daily life; apply chemical concepts in environmental management, including explaining the phenomenon of global warming. The chemistry learning outcomes of students on the topic of chemistry in everyday life were processed from the scores obtained from the total scores of students during the test, which were then classified into specific categories. The classification of the chemistry learning outcomes can be seen in the following Table 11:

Table 11. Classification of the chemistry learning outcomes of students

No.	Score Range	Category	Frequency
1.	81-100	Very Good	39
2.	61-80	Good	16
3.	41-60	Moderate	0
4.	21-40	Poor	0
5.	0-20	Very Poor	0
Total			55
Average			85,27
Category			Very Good

Based on the research results presented in Table 11, it appeared that the test scores of students' learning outcomes in the subject of chemistry in everyday life showed that the majority fell into the "very good" category. This indicated a very good achievement in understanding the material. From the data presented, the overall average score of students' learning outcomes was 85.27. This average clearly fell into the "very good" category, indicating that, overall, students had achieved a very satisfactory level of understanding of the chemistry material in everyday life. These results illustrated that students were able to apply that knowledge well.

The Relationship Between Digital Literacy Abilities and Learning Outcomes

The purpose of this research was to determine the relationship between digital literacy and science literacy with students' learning outcomes. The results of the Spearman test to determine the relationship between digital literacy and learning outcomes can be seen in the following table:

Table 12. Results of Spearman on digital literacy and learning outcomes

Spearman Correlation	Digital Literacy Abilities	Learning Outcomes
<i>Coefficient Correlation</i>	1.000	0,464
<i>Sig (2-tailed)</i>	.	0,000
<i>Coefficient Correlation</i>	0,464	1.000
<i>Sig (2-tailed)</i>	0,000	.
R^2	21,52%	

The results of the Spearman correlation test indicated that there was a relationship between digital literacy, as shown in Table 12, where the significance value was 0.00, which was less than 0.05. It could be concluded that there was a relationship between digital literacy and learning outcomes. The degree of the relationship between digital literacy abilities and learning outcomes could also be seen in Table 12, where the obtained value was 0.464. The decision-making regarding the level of relationship between the two refers to Table 6, which indicated that the range of values from 0.40 to 0.599 fell into the moderate category, meaning the relationship between the two variables was positive. A positive relationship indicated that if students' digital literacy abilities increased, their learning outcomes would also improve. The coefficient of determination was calculated to be 21.52%. This figure indicated that students' digital literacy abilities contributed 21.52% to their learning outcomes.

The findings of this study aligned with the research conducted by Yusuf, which showed a positive relationship between digital literacy and students' cognitive learning outcomes (A. M. Yusuf, 2021). In the 21st century, learning has been influenced by various factors, including the digitalization of education. The benefits of digital literacy are numerous, including saving time and budget, staying updated with the latest information, enabling quick and accurate decision-making, and maintaining constant connectivity with others, which can be used to build new knowledge (Sumiati & Wijonarko, 2020). Additionally, the application of digital literacy could enhance students' creativity, awareness of information technology, communication, and technical skills, leading to a more critical understanding due to the easy access to diverse information sources, and making them more active in learning (Y. Yusuf, 2019). This research also echoed the findings of Hafiza et al., (2022), which indicated a relationship between digital literacy and learning outcomes.

The findings from the study by Kärnä et al. (2022) indicated that several factors could influence digital literacy, including interpersonal, institutional, and social aspects. These three aspects play a significant role in enhancing digital literacy skills. Additionally, teachers should also possess strong digital literacy abilities, which are essential for their professional development, teaching, and providing support to students (Nguyen & Habók, 2024). To improve students' digital literacy in chemistry lessons, using virtual labs for practical experiments can be effective. A study conducted by Suryandari et al. (2023), found that learning through a Go-Lab-assisted virtual laboratory could develop digital literacy skills, covering all eight components of digital literacy. Furthermore, digital literacy skills can also be

enhanced with the right teaching models. These models serve as guides for teachers to adjust their approaches, create engaging learning environments, and better meet the needs of their students (Komarudin *et al.*, 2024).

The Relationship Between Science Literacy Ability and Chemistry Learning Outcomes of Students on Chemistry Material in Everyday Life

Science literacy is measured because it is crucial in education and offers significant potential for preparing students to face the challenges of globalization and industrialization. This includes fostering students who are proficient in their respective fields and capable of developing skills in logical and creative thinking, problem-solving, critical analysis, technological mastery, and adaptability to ever-changing situations (Nofiana & Julianto, 2018).

The research conducted provided results regarding the level of students' science literacy, particularly in the context of chemistry in everyday life. To assess students' science literacy, they were given essay tests designed according to the aspects of PISA 2015 to evaluate their understanding of chemistry topics in daily life. The mastery level was then processed and summarized from the students who were the subjects of this research. The students achieved scores that reflected a good understanding of chemistry in everyday life, with the average percentage of students' abilities reaching 68.09%. This was a positive indicator of the students' comprehension of the material. The scoring process was conducted carefully, starting with evaluating each student's responses and summarizing them into scores ranging from 0 to 3. These scores provided a clear picture of the extent to which students understood chemistry concepts applied to daily life. The results of the Spearman test to determine the relationship between science literacy and learning outcomes could be seen in the following table:

Table 13. The results of the Spearman's test of scientific literacy with learning outcomes

Spearman Correlation	Science Literacy Ability	Learning Outcomes
<i>Coefficient Correlation</i>	1.000	0,611
<i>Sig (2-tailed)</i>	.	0,000
<i>Coefficient Correlation</i>	0,611	1.000
<i>Sig (2-tailed)</i>	0,000	.
<i>R²</i>	37,33%	

The results of the Spearman correlation test analysis showed a relationship between science literacy and learning outcomes, as seen in Table 13, which indicated a significance value of 0.00, a number smaller than 0.05. It could be concluded that there was a relationship between science literacy and learning outcomes. The strength of the relationship between science literacy and learning outcomes was also displayed in Table 13, with a correlation value of 0.611. Based on Table 6, this fell within the 0.60 to 0.799 range, indicating a "strong" relationship. The positive relationship between the two variables meant that if students' science literacy improved, their learning outcomes would also increase. The coefficient of determination was found to be 37.33%, indicating that science literacy contributed 37.33% to students' learning outcomes.

The results of this study aligned with research conducted by Rahmah *et al.*, which showed a positive relationship between science literacy and achievement motivation with students' learning outcomes (Rahmah, 2021). Science literacy is an essential skill that students must possess in the 21st century, as it influences how they

think, act, and implement the knowledge gained in their work (Ardiansyah et al., 2016). Science literacy is crucial for students, highlighting the need for teachers to integrate it into their teaching methods to enhance understanding, problem-solving skills, and research abilities, as well as proficiency in both oral and written communication. Incorporating science literacy into education allows students to acquire scientific understanding and knowledge, as well as practical skills important for engaging with society. These skills include the ability to explore and find answers driven by curiosity, predict and explain phenomena, and recognize technological and scientific challenges. Furthermore, individuals are expected to communicate effectively by reading and understanding scientific content, evaluating information from various sources, and formulating conclusions, while also possessing critical skills—namely, the ability to evaluate opinions based on evidence (Pertiwi et al., 2018). Another study conducted by A. M. Yusuf et al., (2022) revealed a positive and significant relationship between digital literacy and science literacy with cognitive learning outcomes. It is important for both teachers and students to apply digital literacy and science literacy to enhance cognitive learning outcomes.

A study conducted by Xie et al. (2023) also showed that science literacy can be influenced by reading literacy and the ability to evaluate the credibility of statements in a text. Another study by Bae et al. (2023) indicated that parental encouragement to explain causal phenomena has a strong direct impact on children's scientific literacy, although its effect on future literacy is relatively small, emphasizing the need for continuous practice by parents at home. Conversely, engagement in science activities at home during preschool plays a more significant role in predicting the development of scientific literacy over the next four years. Therefore, students should continually train their science literacy abilities in both family environments and, most importantly, through daily activities. Additionally, science literacy should be developed using a clear approach. Without a clear approach, science education will struggle to implement effective pedagogical actions that are sensitive to cultural and social contexts, aligned with the goals of social transformation to address various forms of change (Valladares, 2021). If science literacy is low, several efforts can be made to address it, including teaching science literacy continuously, organizing the scope of the material, and planning the learning process with appropriate teaching models (Sumanik et al., 2021).

The study had several limitations. First, the identification of digital literacy abilities was only conducted on tenth-grade science students, so the results might not be generalizable to students from other grades or majors. The material used in this research was limited to chemistry in daily life, which did not encompass other subjects that might influence the results. The learning outcomes measured only included cognitive aspects, without considering affective and psychomotor aspects that could also play significant roles in learning. The analyzed aspects of digital literacy were limited to functional skill and beyond, creativity, collaboration, communication, the ability to find and select information, critical thinking and evaluation, cultural and social understanding, and digital safety (e-safety), which did not cover other potentially relevant aspects of digital literacy. Additionally, the dimensions of science literacy analyzed only included the context, content or knowledge, competencies, and attitudes, which might restrict the understanding of science literacy in a broader context.

CONCLUSION

Based on the results of the data analysis and the discussion of the research findings, the conclusions of this study were: (1) the average level of students' digital

literacy was categorized as “good,” with a score of 76.87; (2) the average level of scientific literacy for Grade X in the context of chemistry in everyday life was categorized as “good,” with an average score of 68.09; (3) the overall average learning outcomes were 85.27, falling into the “very good” category; (4) there was a relationship between digital literacy and learning outcomes, with the level of correlation between digital literacy and learning outcomes being 0.464, indicating a “moderate” relationship; (5) the relationship between scientific literacy and students’ learning outcomes had a strong correlation, with a correlation coefficient of 0.611. This study highlighted the importance of digital and scientific literacy in supporting students’ learning outcomes. For future research, it was recommended to explore other factors that might influence this relationship, such as the impact of teaching methods, the use of technology, or the learning environment, in order to further strengthen the role of literacy in education in the digital age, as well as its relationship to other subjects or the use of digital literacy aspects from other references.

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