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The Relationship Between Learning Readiness and Scientific Reasoning Ability of Elementary School Students

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Abstract. This study aims to examine the relationship between learning readiness and the scientific reasoning ability of Grade V students in public elementary schools in Laweyan District. The research problem is based on the fact that the scientific reasoning ability and learning readiness of elementary school-aged students are still underdeveloped. This research employed a quantitative method with a correlational design. The population of this study were all fifth-grade elementary school students in the Laweyan district, with a sample of 100 students taken by cluster random sampling. Data were collected using two techniques, namely a questionnaire to collect data on learning readiness and a written test to assess scientific reasoning ability. The data were analyzed using Pearson correlation analysis with the results of the coefficient value of 0.816, $p < 0.001$, and an R-square of 0.665. These results indicate a significant relationship between learning readiness and scientific reasoning ability. This finding implies that teachers can use the research results as a reference to develop learning strategies that not only focus on students' cognitive abilities but also focus on factors that influence scientific reasoning, one of which is learning readiness. Therefore, the cultivation of these abilities becomes more effective.

Keywords: Elementary School; High Order Thinking; Learning Readiness; Science Learning; Scientific Reasoning Ability.

1. Introduction

Twenty-first-century learning is an educational concept focused on developing the skills and competencies students need to live, work, and contribute actively in a fast-paced, complex, and technology-based modern era(Le et al., 2022). It emphasizes mastery of higher-order thinking skills (Todorova, 2024). Students are not only assessed based on what they know, but also on how they use that knowledge to think, make decisions, and create solutions (Adeoye & Jimoh, 2023). Therefore, abilities such as scientific reasoning play a crucial role in supporting ideal 21st-century learning.

Modern curricula emphasize the development of competencies that include not only knowledge but also systematic and evidence-based ways of thinking (Yuan, 2023). In science learning, this is reflected in an approach that no longer focuses on memorizing definitions or formulas, but on understanding scientific processes and strengthening scientific thinking (Alberida, 2020).Scientific reasoning ability serves as a tool to achieve these goals. In the context of science education, it is a key indicator of how well students understand scientific concepts and apply them in real-life contexts (Schiefer et al., 2019).

Scientific reasoning ability is a higher-order thinking skill that involves logical thinking processes in observing phenomena based on evidence (Klemm et al., 2020). Operationally, scientific reasoning ability consists of knowledge, evidence, analysis, argumentation, and conclusion. This ability is considered the core of scientific thinking because it underlies various scientific activities such as investigation, exploration, and problem solving (Krell et al., 2020). In 21st-century learning, this ability is placed alongside higher-order thinking skills, namely critical thinking (Thornhill-Miller et al., 2023).

Scientific reasoning ability plays a strategic role in shaping students to be critical, reflective,

and independent decision-makers (Anand, 2024). This skill is not only needed in science subjects but also relevant to solving complex problems that require logical and systematic thinking in everyday life (Hačatrjana & Namsone, 2024). This ability can also protect oneself from the negative effects of rapidly developing technology. In today's digital era, students must be equipped with scientific reasoning skills so they can filter information, evaluate truth, and make evidence-based decisions (Kocagül & Çoban, 2023). However, 21st-century technology can also have a positive impact on the development of students' scientific reasoning. Technology can be used directly to develop students' scientific reasoning skills through the use of interactive simulations, virtual experiments, and digital learning platforms. Students have the opportunity to explore scientific phenomena, collect and analyze data more broadly and without limitations. This approach allows students to reach logical conclusions that are relevant to scientific phenomena. Thus, technology not only serves as a medium for delivering material but also as an effective method for actively training scientific reasoning in line with the demands of the 21st century.

Scientific reasoning is not a skill that emerges automatically — it develops through active, meaningful, and structured learning experiences (Lazonder et al., 2021). Students need to be trained to ask questions, evaluate information, and build evidence-based arguments. However, before they can be trained, they must first demonstrate readiness to learn.

Learning readiness is the condition of learners who are ready and able to respond positively to learning (Tomak & Ataş, 2023). Operationally, learning readiness consists of several components, such as physical readiness, psychological readiness, motivation, material readiness, as well as knowledge and attitude. Students have a greater opportunity to understand the material if they are ready to learn (Unger & Sloutsky, 2022). Those with good learning readiness tend to adapt more easily to school routines, follow teacher instructions, and develop thinking skills (Çökük & Kozikoğlu, 2020). Therefore, this readiness is crucial, especially in learning activities that involve scientific reasoning.

1.1. Problem Statement

A preliminary survey conducted on fifth-grade students in the 2024/2025 academic year at a public elementary school in Laweyan District shows that students' scientific reasoning skills still need to be developed. Based on the findings, out of 24 students who participated in the survey, only 6 students were able to perform scientific reasoning by presenting sufficient relevant evidence and logical arguments. Meanwhile, the other 15 students still had difficulty presenting relevant evidence or making logical arguments. Meanwhile, 3 students were able to construct arguments, albeit with less relevant evidence. The initial survey also found that 16 students did not study the material before class, 5 students sometimes prepared themselves, and only 3 students routinely studied independently before the material was presented by the teacher. These findings indicate that the majority of students are still very dependent on the teacher's explanations and have not developed their readiness to learn.

Similar conditions were found in research conducted by Farisia & Mukhoyyaroh (2025). The research found that there are still elementary school students who are not yet able to prepare themselves physically. They also struggle to regulate themselves when given difficult tasks and have poor focus due to emotional unpreparedness. These findings emphasize the lack of optimal learning readiness among students, but do not discuss the extent to which learning readiness affects students' ability to master the lessons taught by teachers. Meanwhile, Yildiz (2022) found that many elementary students still demonstrate below-average logical reasoning skills. According to the study, 35% of students were unable to identify scientific phenomena, and another 35% drew biased conclusions because they ignored the evidence. This study focuses on scientific reasoning skills, but does not explore the factors that influence those skills. Thus, the two previous studies had different focuses and did not holistically examine the relationship between learning readiness and scientific reasoning ability in elementary school students, so it is not yet possible to conclude whether the conditions found in the initial survey are interrelated.

Limited learning readiness and underdeveloped scientific reasoning ability have several

negative consequences for students. Lack of learning readiness can make it difficult for students to understand the subject matter, which may lead to unsatisfactory academic performance (Polat, 2024). Weak scientific reasoning skills hinder students' problem-solving abilities, both in science and in everyday life. It can also diminish their critical thinking capacity in responding to scientific issues (Luo et al., 2020).

The issue of low learning readiness and scientific reasoning ability among elementary students must be addressed promptly. One approach is to examine the relationship between these two variables. Identifying the relationship can serve as a basis for designing appropriate learning strategies. Therefore, this study is essential to help improve students' learning readiness and scientific reasoning ability—both of which are crucial to supporting their cognitive development.

1.2. Related Research

A study by Kalinowski & Pelakh (2024) found that learning readiness affects students' engagement in the learning process. Junior high school students who were more prepared were shown to actively engage in reasoning activities during science lessons. Another study found that preparing to learn enhances scientific reasoning by drawing on students' prior knowledge and skills. This preparation enables students to stay focused and improves their ability to reason with data and understand scientific concepts (Masnick & Morris, 2022). Koyunlu Ünlü et al (2024) also discovered that the low level of scientific reasoning ability can be addressed by improving readiness in science education.

In contrast to previous studies, which focused on junior high school and general education, this study focuses more specifically on exploring the relationship between learning readiness and scientific reasoning ability at the elementary school level. This study also does not specifically address the role of learning readiness in student reasoning participation, as in the study by Kalinowski & Pelakh (2024), but rather focuses on the extent to which learning readiness influences students' scientific reasoning ability in greater depth. Compared to the studies by Masnick & Morris (2022) and Koyunlu Ünlü et al (2024), this study not only discusses the general benefits of learning readiness for improving scientific reasoning ability but also explains the benefits of each indicator that contributes to the process of improving scientific reasoning ability.

In this study, the novelty lies in a more in-depth analysis of the relationship between learning readiness and scientific reasoning ability in elementary school students. This study not only examines whether there is a relationship between the two variables but also analyzes the extent to which learning readiness contributes to scientific reasoning ability in students at this level. In addition, the contribution of learning readiness is also discussed in more detail through each indicator to provide a more detailed understanding and new perspectives on how learning readiness shapes scientific reasoning ability in elementary school students, which has certainly not been widely explored in previous studies, especially in elementary school-aged students.

1.3. Research Objectives

The objective of this study is to determine the relationship between learning readiness and scientific reasoning ability of fifth-grade students in science learning at public elementary schools in Laweyan District.

Research question:

Is there a significant relationship between learning readiness and the scientific reasoning ability of fifth-grade students in science learning in public elementary schools in Laweyan District?

2. Theoretical Framework

The following discussion presents the theoretical framework underlying the two main variables in this study: learning readiness and scientific reasoning ability.

2.1. Scientific Reasoning Ability

Scientific reasoning ability is the logical thinking skill used to understand, test, and evaluate scientific knowledge through a systematic process (Üzerİne & Deneyleri, 2022). It involves reflective and logical thinking processes to solve problems based on evidence (Carroll, 2020). Poggiolesi (2024) explains that the concept of scientific reasoning is grounded in logic to understand concepts and phenomena, enabling individuals to construct rational and accountable explanations.

Students in Grades 3–5 are in the early stages of developing scientific reasoning ability. At this stage, they are capable of systematically examining sources of data and evidence. They can critically evaluate data contexts, recognize simple cause-and-effect relationships, and make predictions based on identified patterns. These abilities typically emerge through prior learning experiences, which are key factors in the development of scientific reasoning (Jung et al., 2020).

The capacity for scientific reasoning is one indicator of intellectual maturity (Akış & Metli, 2022). Students who demonstrate intellectual maturity are more likely to master the scientific concepts taught, and scientific reasoning plays a contributory role. This is because conceptual understanding essentially results from a series of reasoning processes (Bartley et al., 2019). Students with scientific reasoning ability tend to be more active in discussions, better at explaining the rationale behind concepts, and more prepared to face problem-solving challenges (Akış & Metli, 2022).

Based on the explanation above, it can be concluded that scientific reasoning ability is the logical thinking skill used to explain phenomena based on evidence. This ability begins to emerge and develop in elementary school-aged students. Scientific reasoning has a positive impact on students' cognitive development, and therefore must be continuously nurtured in accordance with their developmental level.

2.2. Learning Readiness

Learning readiness is often understood as a student's condition in responding to learning (Mai, 2022). It refers to the optimal state a student must be in to engage effectively in the learning process (Yancey et al., 2023). More specifically, learning readiness encompasses an individual's physical, psychological, and motivational capacity to support learning (Demetriou & Papageorgiou, 2020).

When students are ready to learn, they tend to show positive responses, creating a conducive learning environment (Tamasova & Zapletal, 2022). This positive response is essential in the learning process. Thorndike emphasized that learning involves a strong interaction between stimulus and response. His Law of Readiness highlights the importance of an individual's readiness to respond and absorb information (Cruz, 2020). This law includes several points: first, when someone is ready to respond or act, doing so brings satisfaction and can encourage further action. Second, if someone is ready to respond but is prevented from doing so, it may lead to frustration. Third, if someone is not ready to respond, forcing them to do so can result in dissatisfaction.

For learning to be successful, students must be physically and mentally prepared (Faciolan, 2020). When students are ready, they are more capable of asking questions, testing their understanding, and developing reasoning skills related to the material being taught (Rigolizzo, 2019). Therefore, before beginning any lesson, students' readiness across all aspects — physical, psychological, and prior knowledge — must be adequately prepared.

Based on the explanation above, learning readiness can be defined as the physical and psychological condition of students that allows them to respond positively during learning. This readiness is essential for creating effective learning experiences and contributes significantly to successful learning process.

3. Method

3.1. Research Design

This study employed a quantitative research approach with a correlational design. A correlational design is used to explore the pattern of relationships between research variables. This design can identify both the strength and direction of the relationship between variables, which then serves as an empirical basis for the research findings. In this design, the researcher does not apply any treatment to the research subjects. Nonetheless, the relationship patterns between the two variables can still be observed (Cuzzocrea, 2024). This study examines the correlation between two variables: students' readiness to learn and their scientific reasoning abilities.

3.2. Participant

This study involved fifth-grade students from three public elementary schools in Laweyan District, Surakarta, in the 2024/2025 academic year. Fifth-grade was chosen because students at this level have developed their reasoning skills, which are appropriate for the objectives of this study. The sample was selected using cluster random sampling based on the total population of fifth-grade students in 33 public elementary schools in Laweyan District. The sample consisted of 100 students, comprising 47 male and 53 female, with an average age of 10-11 years. The percentage of gender and age differences in the research sample can be seen in the following Table 1.

Table 1. Characteristics of Participants

Characteristics	Category	Frequency (f)	Percentage (%)
Gander	Male	47	47%
	Female	53	53%
Age	10 years	42	42%
	11 years	58	58%
Total		100	100%

3.3. Data Collection

This study used a combination of test and non-test techniques for data collection. The test, in the form of essay questions, was used to assess students' scientific reasoning ability. The non-test technique, in the form of a Likert-scale questionnaire with 4 levels, was used to assess learning readiness. The four Likert-scale categories were: Always, Often, Sometimes, and Never. The use of four options was chosen to avoid central tendency bias (Pimentel, 2019).

The questionnaire contained both positive and negative items. Each item was scored from 1 to 4, as shown in Table 2 below.

Table 2. Distribution of Questionnaire Scale Scores

Positive Statements	Score	Negative Statements	Score
Always	4	Always	1
Often	3	Often	2
Sometimes	2	Sometimes	3
Never	1	Never	4

The total score from the questionnaire was then converted into a 100-point scale. For the scientific reasoning ability test, each item was scored from 0 to 5, and the scores were then transformed into standardized values.

3.4. Data Analysis

To analyze the relationship between the two variables (learning readiness and scientific reasoning ability), Pearson Product-Moment Correlation was used. The significance level was set at $p < 0.05$. Pearson correlation analysis was conducted after the data met the assumptions of normality and linearity. The entire data analysis process was assisted by SPSS version 27. The

interpretation of the Pearson correlation coefficient is shown in Table 3 below.

Table 3. Levels of Pearson Product-Moment Correlation

Range	Level of Correlation
0.00–0.19	Very low
0.20–0.39	Low
0.40–0.59	Medium
0.60–0.79	Strong
0.80–1.00	Very strong

Source: Sugiyono (2022, p. 274)

3.5. Validity and Reliability

The validity of the questionnaire and test items was measured using Pearson Product-Moment Correlation, with a threshold of r > 0.3 considered valid. Reliability was measured using Cronbach's Alpha, with a threshold of ≥ 0.60. The learning readiness questionnaire a reliability coefficient (r_{11}) of 0.872 for all items, indicating high reliability. The learning readiness questionnaire had 18 valid items out of 20 during the instrument trial. The invalid items were then corrected so they could be used in data collection. The learning readiness questionnaire had 18 valid items out of 20 during the instrument trial. The invalid items were then corrected so they could be used in data collection. More specifically, the validity values of each item in the learning readiness questionnaire can be seen in Table 4.

Table 4. Validity Scores for the Learning Readiness Questionnaire

Item Number	r_{it}	Description
Item 1	0.485	Valid
Item 2	0.602	Valid
Item 3	0.580	Valid
Item 4	0.195	Invalid
Item 5	0.384	Valid
Item 6	0.682	Valid
Item 7	0.674	Valid
Item 8	0.465	Valid
Item 9	0.776	Valid
Item 10	0.356	Valid
Item 11	0.386	Valid
Item 12	0.412	Valid
Item 13	0.542	Valid
Item 14	0.330	Valid
Item 15	0.511	Valid
Item 16	0.150	Invalid
Item 17	0.509	Valid
Item 18	0.407	Valid
Item 19	0.623	Valid
Item 20	0.586	Valid

The scientific reasoning test also consisted of indicating strong reliability with a reliability coefficient value (r_{11}) of 0.861. The test items also had all items valid with an appropriate level of difficulty ($0.3 \leq P \leq 0.7$) and good discrimination power ($D \geq 0.3$). The validity, discriminating

power, and difficulty level of the questions can be seen in Table 5.

Table 5. Validity, Discrimination Power, and Difficulty Levels of Scientific Reasoning Ability Test

Item	r_{it}	Description	D	P
Item 1	0.337	Valid	0.34	0.64
Item 2	0.681	Valid	0.38	0.60
Item 3	0.756	Valid	0.64	0.54
Item 4	0.842	Valid	0.69	0.68
Item 5	0.842	Valid	0.71	0.67
Item 6	0.553	Valid	0.54	0.54

4. Findings

The data description for the learning readiness variable shows that students scored an average of 56.35 on the learning readiness questionnaire. The median score was 56.25, and the most frequently occurring score was 60. The lowest score recorded was 46.25, while the highest score was 66.25. Overall, the score distribution was fairly uniform, indicated by a relatively small standard deviation of 4.92. The frequency distribution data showed that most students (38%) scored in the 56–60 range, followed by 30% in the 51–55 range. Only 2% scored in the 66–70 range, the smallest proportion.

For the scientific reasoning ability variable, the mean score was 44.37, the median was 43.33, and the mode (most frequent score) was also 43.33, indicating a relatively symmetrical distribution. The minimum score was 23.33, and the maximum was 66.67, showing a fairly wide range of results. The standard deviation was 10.48, indicating a moderate spread around the mean. Most students (27%) scored in the 44–50 range, followed by 25% in the 37–43 range and 24% in the 30–36 range. Only 4% scored in the 58–66 range, indicating a small number of students with high scores. Overall, the score distribution was approximately normal, with no extreme score dominance.

The statistical tests for learning readiness and scientific reasoning ability are explained in more detail below. The results of the normality test for the learning readiness and scientific reasoning ability variables are presented in Table 6 below.

Table 6. Normality Test Results

Variable	Kolmogorov-Smirnov			Conclusion
	Statistic	Df	Sig.	
Learning Readiness (X)	0.068	100	0.200	Data are normally distributed
Scientific Reasoning Ability (Y)	0.079	100	0.124	Data are normally distributed

Based on the Kolmogorov–Smirnov normality test, the learning readiness variable had a significance value of 0.200, and the scientific reasoning ability variable had a significance value of 0.124. Since both values are greater than 0.05, the data for both variables are considered normally distributed.

4.1. Linearity Test

After confirming the data were normally distributed, a linearity test was conducted. The

results of the linearity test between learning readiness and scientific reasoning ability are shown below.

Table 7. Linearity Test Results

		F	Sig.	Conclusion
Learning Readiness (X) Scientific Reasoning Ability (Y)	Linearity	195.485	< 0.001	Data are linear
	Deviation from Linearity	1.025	0.439	

Based on the results, the relationship between learning readiness and scientific reasoning ability is linear. This is supported by the significance value for the linearity test (< 0.001), which is less than 0.05, and the deviation from linearity value (0.439), which is greater than 0.05. These results confirm that parametric testing is appropriate for hypothesis testing.

4.2. Hypothesis Testing

The existence or absence of a correlation between learning readiness and scientific reasoning ability was tested using the following tests.

4.2.1. Correlation Test

To examine the relationship between learning readiness and scientific reasoning ability, a parametric hypothesis test using Pearson's correlation was conducted. The results are presented in Table 8 below.

Table 8. Correlation Coefficient Results

Variable	Pearson Correlation	Sig./p	Conclusion
Learning Readiness (X) Scientific Reasoning Ability (Y)	0.816	0.001	Significant relationship exists

Based on the results of the hypothesis test, the correlation coefficient is 0.816 with a significance level of 0.001, which is less than 0.05. These findings indicate that there is a very strong and significant relationship between learning readiness and scientific reasoning ability. This means that readiness to learn also influences students' scientific reasoning ability.

4.2.2. Regression Test

To determine the exact value of the contribution of learning readiness to scientific reasoning ability, a follow-up test was conducted using a linear regression test. The results of the linear regression test can be seen in Table 9.

Table 9. Regression Test Results

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.816	.665	.662	2.289	.665	194.754	1	98	.001

The coefficient of determination (R-squared) between learning readiness and scientific reasoning ability is 0.665. This result shows that the learning readiness variable contributes 66.5% to the variation in students' scientific reasoning ability, while the remaining 33.5% is influenced by other factors outside the variables studied. The relatively high coefficient of determination value proves that students' learning readiness plays a significant role in their mastery of scientific reasoning ability.

To obtain a more in-depth picture, a contribution analysis was conducted on each learning

readiness indicator. This analysis aimed to identify which indicators had the most dominant influence on students' scientific reasoning abilities. The contribution value of each learning readiness indicator to students' scientific reasoning ability is presented in the following Table 10.

Table 10. Contribution value of learning readiness indicators

Indicator	B	Beta	T	Sig.	Tolerance	VIF
Physical Readiness	2.077	.367	5.467	.001	.878	1.139
Psychological Readiness	2.640	.425	6.289	.001	.868	1.152
Motivation	2.358	.384	5.807	.001	.904	1.106
Material Readiness	3.475	.524	8.278	.001	.989	1.011
Knowledge and Attitude	1.923	.351	5.359	.001	.922	1.085

The Table 10 above presents the contribution value of each learning readiness indicator to students' scientific reasoning ability. Among the five indicators, material readiness shows the highest contribution value (β = .524), indicating its strong influence on students' scientific reasoning. In contrast, the knowledge and attitude indicator demonstrates the lowest contribution value (β = .351), although it still has a significant impact. Overall, all learning readiness indicators have been proven to significantly contribute to students' scientific reasoning ability, as reflected by the significance value of p = .001 for each indicator.

5. Discussion

The data analysis results indicate a significant positive relationship between learning readiness and scientific reasoning ability. The correlation coefficient and significance level were both high. This means that students with higher learning readiness tend to have better scientific reasoning ability, and vice versa.

Learning readiness refers to a student's preparedness to engage in the learning process. A prepared student tends to exhibit a positive response, which contributes to a supportive learning environment (Tamasova & Zapletal, 2022). This positive response is essential because, according to Thorndike's learning theory, learning is the result of interactions between stimulus and response — a theory known as connectionism. Thorndike further explained that learning involves forming as many stimulus-response connections as possible. The more optimal the response to a stimulus, the more effective the learning (Wubante, 2020).

Thorndike also stated that a response is more likely when the individual is ready, known as the Law of Readiness. This law explains the relationship between a learner's readiness to respond and their ability to receive information (Cruz, 2020). When students are mentally and emotionally prepared, they understand material more easily(Chorrojprasert, 2020). Thus, there is a close link between a student's preparation and their learning success.

Given this close connection, it is reasonable to conclude that learning readiness is related to students' scientific reasoning ability. This ability can develop after students successfully go through effective learning processes. Essentially, scientific reasoning is a learning outcome in the form of a cognitive skill that develops through well-executed learning experiences (Schlatter et al., 2022).

The high correlation between learning readiness and scientific reasoning ability demonstrates that readiness plays a key role in developing this ability. Each component of learning readiness can support and enhance students' scientific reasoning. These components — including physical readiness, psychological readiness, motivation, material readiness, and attitude/knowledge — interact with the elements of scientific reasoning, such as knowledge, evidence, analysis, argumentation, and conclusion. The indicators of learning readiness form

a strong foundation for the development of scientific reasoning ability.

Among these indicators, physical readiness plays a role across all aspects of scientific reasoning ability. When students are not in good physical condition, they may struggle to carry out their usual activities or experience difficulty concentrating (Galitskaya, 2024). Student concentration greatly affects their ability to absorb learning material and enhance their cognitive functions (Joshi et al., 2022). The concentration achieved through physical readiness directly contributes to improving students' scientific knowledge in the process of scientific reasoning. Physical readiness also helps students focus better when observing, recording, and identifying evidence. Through physical readiness, students' ability to analyze, argue, and draw logical conclusions is also influenced.

The brain functions better and thinks more logically when the body is not fatigued (Joshi et al., 2022). Therefore, avoiding fatigue by preparing physically is essential to optimizing brain performance and enhancing logical reasoning.

The psychological readiness indicator in learning readiness also plays a role in the scientific reasoning process. Psychological readiness makes it easier for students to absorb new scientific knowledge. When students are emotionally prepared, they experience increased cognitive engagement, which supports more effective memory storage of scientific knowledge — positively impacting learning outcomes (Zhang, 2024). This is important because knowledge serves as the initial foundation for scientific reasoning ability. Moreover, to gather and identify evidence objectively, students need mental calmness and emotional stability. Students who are panicked, stressed, or anxious tend to think irrationally (Casares et al., 2024). Emotional readiness significantly affects students' ability to observe phenomena, process data, and distinguish relevant information as scientific evidence (Vilhunen et al., 2023). Students with psychological readiness are capable of performing logical analysis and argumentation. This is because those who are mentally and emotionally prepared can more effectively compare information, recognize patterns, and establish cause-and-effect relationships (Xu et al., 2024). Utkurovna (2024)highlights that a healthy psychological state fosters independence in decision-making and responsibility in developing ideas and personal thinking. As a result, students are able to develop a healthy thinking pattern, which enhances their ability to make accurate decisions when drawing conclusions.

High motivation encourages students to actively engage in the learning process, increases their interest and effort in seeking new information, enables them to use effective learning strategies to achieve better academic results, and fosters a positive learning environment (Filgona et al., 2020). Higher levels of motivation are associated with improved scientific reasoning skills, as motivated students tend to engage more deeply with scientific concepts (Van Vo & Csapó, 2023). Motivation plays a major role in stimulating students' curiosity and internal drive to understand the material more thoroughly. This leads them to read more actively, ask questions, and explore learning resources, thereby expanding and strengthening their knowledge base for scientific thinking. Students with intrinsic motivation are more focused on academic achievement, emphasize ability, and develop persistence and self-confidence (Gahramanli, 2024). The persistence that stems from motivation causes students to be less likely to approach tasks carelessly — especially when gathering evidence, conducting analysis, and drawing conclusions. Students become more careful and systematic in their reasoning processes, which leads to better-quality reasoning and greater confidence when presenting their arguments. Motivation also increases students' willingness to apply critical thinking skills, such as problem-solving and decision-making, in academic contexts (Chen, 2022). In this way, motivation becomes a driving factor when students analyze scientific problems and make effective decisions.

Material readiness also plays a role in helping students build conceptual scientific knowledge. Access to comprehensive learning resources enables students to construct their scientific understanding in a structured and thorough manner. Material readiness — including textbooks, modules, digital media, and learning tools — provides students with sufficient access to information and helps enrich their scientific knowledge (Kasymaliev et al., 2023). With these resources, students can explore scientific concepts independently and in greater depth.

Material readiness makes it easier for students to analyze scientific problems and find supporting evidence using relevant information sources. Haro et al (2022) state that material readiness affects students' argumentation skills, as insufficient understanding of learning materials results in limited arguments. Therefore, well-developed arguments in the process of scientific reasoning depend greatly on students' prior knowledge. Likewise, in drawing conclusions, thorough material preparation leads to more relevant outcomes in scientific reasoning ability.

The final indicator of learning readiness that contributes to the development of scientific reasoning ability is knowledge and attitude. This refers to how well students understand the attitudes they should adopt during learning — in this context, particularly discipline. Students who are disciplined in their learning are better able to analyze information and solve problems effectively (Chen, 2024). This analytical ability is clearly essential in scientific reasoning. Students who possess a good understanding of learning attitudes are more likely to achieve better learning outcomes and actively participate in discussions with logical and respectful opinions, as well as show a willingness to answer questions across different subjects (Iqbal et al., 2023). This provides a valuable foundation of knowledge before engaging in scientific reasoning and helps them identify scientific evidence more easily. When students can demonstrate the confidence to speak up and express their opinions, they are more capable of improving their argumentation and conclusion-drawing skills.

Based on the results of the analysis, scientific reasoning ability cannot develop optimally without adequate learning readiness. This study makes a theoretical contribution by emphasizing that learning readiness is an important factor closely related to the development of scientific reasoning ability. This finding reinforces Thorndike's theory, which emphasizes that individual readiness is a major prerequisite for internalizing knowledge and developing higher-order thinking skills. Learning readiness is an important foundation for the growth of scientific reasoning ability in students because the components of learning readiness contribute to the learning process of students. Therefore, the learning process must also focus on improving students' learning readiness. Fundamentally, inadequate learning readiness can reduce the quality of the learning process and hinder academic achievement (Dangol & Shrestha, 2019).

The importance of learning readiness requires teachers to be skilled at developing learning strategies that are not monotonous and do not only focus on improving students' cognitive abilities. Teachers can use the results of this study as a reference in developing learning strategies that can take into account the learning readiness of students. Teachers need to recognize the physical and mental conditions of students before starting learning so that the strategies used are more targeted and the results of students' scientific reasoning ability can be maximized. Support from the school is also certainly needed in providing comfortable learning facilities and environments that support the physical and emotional health of students. A balanced learning schedule and tutoring programs can help improve overall learning readiness.

Although this study can be used as a reference for educators, it has several limitations. First, this study was only conducted during a specific and limited period, so it does not reflect long-term conditions. Second, the sample size was limited to one grade level in several schools in one area, so the generalization of the results to a wider population is still limited. Third, the measurement of variables only used questionnaires and tests, so the possibility of subjective bias in student responses cannot be avoided. Therefore, further research is recommended to continue conducting similar studies over a longer period of time to describe the development of learning readiness and scientific reasoning ability in a sustainable manner and involve a larger sample, as well as using a mixed approach so that the results obtained are more comprehensive.

6. Conclusion

Based on the results of the study, it can be concluded that the correlation test between learning readiness and scientific reasoning ability showed a correlation coefficient of 0.816

with a significance value of 0.001 and an R-squared value of 0.665. These results indicate a very strong and significant relationship between the two variables, with a contribution of 66.5% shown through the coefficient of determination. This means that scientific reasoning ability can develop in students due to the role of their learning readiness. Moreover, the components of learning readiness also support various skills required to carry out scientific reasoning. Theoretically, this study implies that learning readiness is an important factor that contributes to the development of scientific reasoning ability from the basic education level. Learning readiness helps students respond positively during the learning process. Therefore, teachers can implicate the results of this study as a reference for developing learning strategies that do not only focus on students' cognitive abilities but also pay attention to other factors that affect students' learning outcomes or, in this case, scientific reasoning ability. Thus the learning process can be more effective, and the cultivation of these abilities in students is maximized.

Limitation

This study has several limitations. First, this research was only conducted in one specific period, so it does not reflect long-term conditions. Second, the research sample only involved fifth-grade students from one particular area, so the results cannot be generalized to the entire population of elementary school students at all levels. Third, the instruments used to measure learning readiness and scientific reasoning are still limited to tests and questionnaires, so they may not fully describe the ability of elementary school students as a whole.

Recommendation

Based on the limitations of this study, recommendations for further research are, first, because the research was only conducted in one specific period, it is recommended that future studies be carried out over a longer duration to describe the development of learning readiness and scientific reasoning ability on an ongoing basis. Second, the sample involves a limited number of fifth-grade students from a single district, so future research should include a larger and more diverse sample across different grade levels and school contexts to improve the generalizability of the findings. Third, because the instruments used in this study were limited to questionnaires and tests, it is recommended that future studies incorporate additional data collection methods—such as interviews, classroom observations, or performance assessments—to obtain a more comprehensive understanding of students' learning readiness and scientific reasoning ability.

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Conflict of Interest

This research is scientific in nature, conducted objectively, and there are no conflicts of interest from the researchers or any external parties.

Declaration of Generative AI-assisted Technologies

This manuscript was prepared with the assistance of Generative AI SciSpace, DeepL, Grammarly, and Quillbot. AI was used to assist with reference finding and language refinement. All intellectual contributions, critical analysis, and final revisions were made by the authors. The authors take full responsibility for the accuracy, authenticity, and integrity of the content presented in this work.

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