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ORIGINAL

Learning Needs Fulfillment and Problem-Solving Skill Correlation of Students in Elementary Schools

Correlación entre la satisfacción de las necesidades de aprendizaje y la capacidad de resolución de problemas en estudiantes de escuelas primarias

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ABSTRACT

Introduction: the need for students to have problem-solving skills is very urgent, especially in science teaching, so that students' potential needs to be facilitated as a form of fulfilling their learning needs in order to achieve the development of 21st-century education. This study investigated the correlation between the fulfillment of learning needs and students' problem-solving abilities in science instruction within elementary schools. The research was grounded in the urgency of 21st-century skills development, especially critical and problem-solving thinking, in response to the educational demands of the industry 4.0 and Society 5.0 eras.
Method: a quantitative correlational survey design was applied. The population included elementary school students in Laweyan District. Data were gathered using a 4-point Likert-scale questionnaire to assess students' perceptions of learning needs (readiness, interest, and learning profile) and open-ended questions to measure problem-solving ability (identification, alternative solutions, best solution implementation, and evaluation). Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4.
Results: findings revealed low but positive correlations between all aspects of learning needs and problem-solving skills. Readiness had the strongest correlation with generating alternative solutions r = 0,220, while interest was most strongly linked to executing the best solution r = 0,217. Learning profile showed the weakest associations across all indicators. The results emphasized that although learning needs are not dominant predictors, their integrated fulfillment contributes to improving problem-solving competence.
Conclusions: the study concluded that comprehensive attention to students' learning readiness, interest, and learning profiles supports the development of their problem-solving abilities. Science instruction should employ a holistic, differentiated approach to address varied student needs and enhance 21st-century skills.

Keywords: Learning Need; Problem-Solving; Readiness to Learn; Student Interest; Learning Profile; Elementary Education.

RESUMEN

Introducción: la necesidad de que los estudiantes tengan habilidades para resolver problemas es muy urgente, especialmente en la enseñanza de las ciencias, por lo que es necesario facilitar el potencial de los estudiantes como una forma de satisfacer sus necesidades de aprendizaje para lograr el desarrollo de la educación del siglo XXI. Este estudio investigó la correlación entre la satisfacción de las necesidades de

aprendizaje y las habilidades de resolución de problemas de los estudiantes en la enseñanza de las ciencias en escuelas primarias. La investigación se basó en la urgencia del desarrollo de habilidades del siglo XXI, especialmente el pensamiento crítico y la resolución de problemas, en respuesta a las demandas educativas de las eras de la Industria 4.0 y la Sociedad 5.0.
Método: se utilizó un diseño cuantitativo con enfoque correlacional mediante encuesta. La población incluyó a estudiantes de primaria en el Distrito de Laweyan. Los datos se recolectaron mediante un cuestionario con escala Likert de 4 puntos para evaluar la percepción de los estudiantes sobre sus necesidades de aprendizaje (preparación, interés y perfil de aprendizaje), y preguntas abiertas para medir la habilidad de resolver problemas (identificación, alternativas de solución, implementación de la mejor solución y evaluación). El análisis de datos se realizó con el modelo de ecuaciones estructurales con mínimos cuadrados parciales (PLS-SEM), usando SmartPLS 4.
Resultados: los hallazgos revelaron correlaciones positivas pero bajas entre todos los aspectos de las necesidades de aprendizaje y las habilidades de resolución de problemas. La preparación mostró la correlación más fuerte con la generación de soluciones alternativas r = 0,220, mientras que el interés se relacionó más fuertemente con la ejecución de la mejor solución r = 0,217. El perfil de aprendizaje mostró las asociaciones más débiles.
Conclusiones: se concluyó que la atención integral a la preparación, el interés y el perfil de aprendizaje de los estudiantes contribuye al desarrollo de sus habilidades para resolver problemas. La enseñanza de las ciencias debe adoptar un enfoque holístico y diferenciado para abordar la diversidad de necesidades estudiantiles y fomentar las habilidades del siglo XXI.

Palabras clave: Necesidades de Aprendizaje; Resolución de Problemas; Preparación para Aprender; Interés del Estudiante; Perfil de Aprendizaje; Educación Primaria.

INTRODUCTION

The world today is in the era of the industrial revolution 4.0, characterized by the increasing implementation of technology in all aspects of life, marked by the emergence of robots, Artificial Intelligence (AI), blockchain, and the Internet of Things (IoT).[1] Entering this era, the Prime Minister of Japan, Shinzo Abe, at the World Economic Forum (WEF), conveyed an idea in which society is expected to be able to utilize and maximize every technological innovation that arises in the industrial revolution 4.0 era, later referred to as Society 5.0.[2] Competent human resources in the era of Society 5.0 in the field of education can be improved through 21st-century skills.[3] There are five skills that need to be trained and developed in the 21st century, namely problem-solving, critical thinking, creative thinking, communication, and collaboration.[4,5]

Problem solving is considered as the most complex level of individual cognitive activity that requires problem solving efforts that involve all aspects of the individual's intellect that will produce a generation with strong analytical skills.[6-9] In solving complex problems, students must connect concepts that have been previously learned to solve them.[10] To improve problem solving skills, the role of teachers is very important. In the implementation of learning, teachers need to be aware that each student has different characteristics in terms of readiness, interests, learning styles, and so on.[11] To achieve the desired learning objectives, it is important for teachers to have adequate skills in facilitating the diversity of students' potential so that individual learning needs can be met.[12] These learning needs can be seen in three aspects, namely learning readiness, learning interest, and students' learning profiles.[13]

When students' learning needs are fulfilled, they will be able to learn according to their potential and abilities.[14] Students will perform better if the tasks given are in accordance with their skills and understanding, arouse curiosity, and provide the freedom to work in the way they prefer.[15] Learning that fulfills each student's different learning needs helps achieve optimal learning outcomes, and 21st-century skills can continue to develop.[16] Learning readiness includes the initial conditions of students in understanding new material, influenced by prior experience and mastery of prerequisite concepts.[17] Learning interest refers to students' intrinsic interest in a subject matter. This interest can increase motivation, concentration, and persistence in learning.[18,19] Meanwhile, learning profiles describe the ways, styles, and tendencies of each individual's learning, including environmental, cultural, and neurological factors that influence the learning process.[20] These three aspects, when properly identified and addressed, are believed to create more meaningful learning experiences and foster critical thinking skills, including problem-solving abilities. However, the relationship between aspects of learning needs fulfillment and problem-solving ability has not been extensively studied. Most previous studies focused more on the relationship between a single aspect and learning outcomes, without considering the complex latent interrelationships among constructs.

To address this research gap, the Structural Equation Modeling Partial Least Squares (SEM-PLS) approach

becomes a powerful alternative. SEM-PLS is a multivariate statistical method capable of testing causal relationships among latent variables while also accounting for the contribution of manifest indicators.[21] This approach is particularly suitable for conceptual models that are predictive and exploratory in nature, especially when research data are non-normal or sample sizes are relatively small.[22] In this context, SEM-PLS allows researchers to test the relationship between the three aspects of learning needs fulfillment (readiness, interest, and learning profile) and the four indicators of problem-solving ability, namely problem identification, alternative solutions, implementation of the best solution, and evaluation of results. Theoretical studies of their relationship show a logical connection. High learning readiness enables students to more quickly understand problematic situations and formulate relevant solutions.[23] Learning interest provides intrinsic motivation in exploring various alternative solutions and increases persistence when facing obstacles.[24] Meanwhile, well-recognized learning profiles allow students to use learning strategies that match their styles, directly impacting effectiveness in problem-solving.[25]

Through the SEM-PLS approach, this study can produce an empirical model that comprehensively explains how learning needs affect the achievement of problem-solving abilities, as well as serve as a practical reference for teachers in implementing learning that is responsive and adaptive to student diversity. These considerations form the basis for this study, which aims to analyze the structural relationship between aspects of learning needs fulfillment and students' problem-solving ability in science learning at the elementary school level. The research problem can thus be formulated as: what is the relationship between learning needs fulfillment and students' problem-solving ability in science learning at the elementary school level?

METHOD

This study employed a quantitative approach with a correlational survey method. A correlational survey research method is a type of study characterized by research problems in the form of correlational relationships between two or more variables.[26] The main objective is to analyze the relationship between aspects of learning needs fulfillment (learning readiness, learning interest, and learning profile) and students' problem-solving ability in the context of science learning in elementary schools. This design was chosen because it enables researchers to comprehensively test the structural model using multivariate statistical analysis. The design framework of this study is presented as follows:

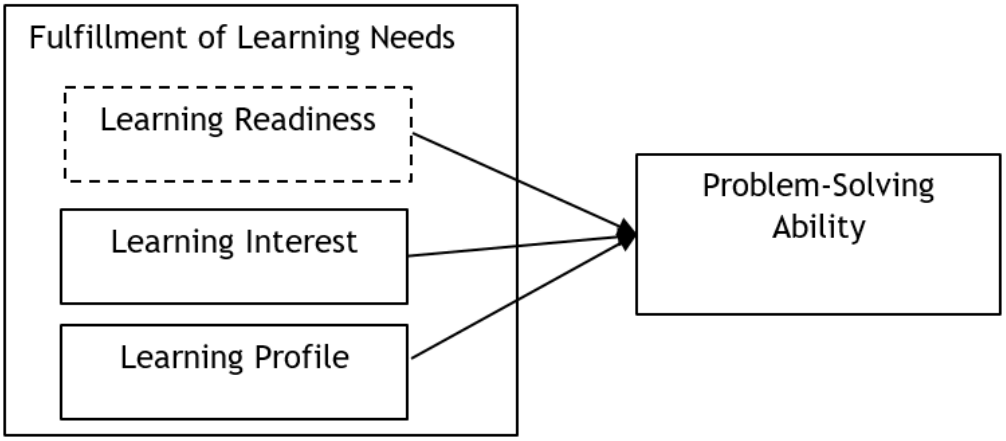

Figure 1. Correlational survey research design

The population in this study consisted of all elementary school students in the Laweyan District who had participated in science learning. These elementary schools included both public and private institutions. The sample was selected using cluster random sampling. This sampling technique is defined as a strategy that divides the population into groups or clusters.[27] The aim is to create a representation of the entire population. Based on this technique, a total of 196 fifth-grade elementary school students across the Laweyan District were chosen as the research sample. This study was conducted from January to July 2025 in Laweyan District, Surakarta, Indonesia.

Data were collected through questionnaires. Data was collected through questionnaires. The class teacher distributed the questionnaires near break time. This was done to avoid disrupting other class hours. The teacher left time for students to complete the questionnaires within a time limit until break time. This time was given to ensure students completed the questionnaires on time and to ensure the researcher received all completed questionnaires.

A questionnaire is a method of data collection that involves a series of written questions or statements to which respondents provide answers.[28] In this study, the questionnaire consisted of declarative statements. The

instrument was designed using a 4-point Likert scale containing the options: strongly agree, agree, disagree, and strongly disagree. The questionnaire includes 12 statements from each component, covering readiness, interest, and profile. The total number of statements comprising these three components is 36. It was designed to measure students' perceptions of learning needs fulfillment, while open-ended questions were used to assess their ability to solve science problems. Open questions are measured using a quantitative rubric with a score of 1 for correct answers and zero for incorrect answers.

The developed instrument requires content validity analysis to refine the test items and prove that the test is capable of measuring what it is supposed to measure. In this study, content validity was analyzed by four expert validators. The researchers provided the instrument outline and items along with a scoring rubric to the validators for input. Expected input includes the suitability of the instrument created with the indicators (readiness, interest, and profile); the suitability of the indicators with the statement items, the truth of the item statements, and the clarity of the sentence in the items. The content validity results were then calculated using the Aiken formula. If the Aiken index is less than 0,4, it is said to have low validity; an Aiken index between 0,4 and 0,8 is said to have medium validity; and if it is more than 0,8, it is said to have high validity.[29]

The data analysis technique in this study employed the Partial Least Squares (PLS) approach with the aid of SmartPLS version 4 software. PLS is one of the alternative methods of Structural Equation Modeling (SEM) used to address similar problems. PLS is a type of SEM analysis that involves several components with formative construct properties.[30] The PLS approach is specifically designed to predict dependent variables by involving a large number of independent variables. The analysis focused on determining the correlation coefficients between aspects of the variables, namely the indicators within the construct of learning needs fulfillment (learning readiness, learning interest, learning profile) and the indicators within the construct of problem-solving ability (problem identification, alternative solutions, implementation of the best solution, and evaluation of results). The following is the sequence of quantitative analysis:

First, testing the reliability and validity of the CBC measurement model. Reliability is measured by Composite Reliability and Average Variance Extracted (AVE) for the three constructs (readiness, interest, and learning profile). The criteria are if the composite reliability is greater than 0,7 and AVE is greater than 0,5, it means reliable. Validity is measured using the factor loading values of the CBC latent variables, namely Detail, Deviate, Intensity, and Emphasis. The criteria are valid if the loading factor is greater than 0,6.

Second, model testing: Partial Least Square (PLS) method to estimate measurement and structural models. SmartPLS software was used to assist data processing. Goodness of Fit (GoF) test criteria: if GoF > 0,36 means the model has good predictive/explanatory power.

Third, hypothesis testing and structural models including interaction effects, using Ordinary Least Square (OLS) Regression, using a two-stage approach: (a) stage I: model estimation includes the direct and main influence of independent variables (learning readiness, learning interest, and learning profile) on the dependent variable of problem-solving ability; (b) stage II: the same estimation model as stage I, but adding the interaction between learning needs fulfillment and problem-solving ability.

RESULTS

The analysis was conducted using the Partial Least Squares (PLS) approach to examine the correlation between each aspect within the construct of Learning Needs Fulfillment (X) and Problem-Solving Ability (Y). The three main aspects of variable X consist of Learning Readiness, Learning Interest, and Learning Profile. Meanwhile, variable Y consists of four aspects: Problem Identification, Alternative Solutions, Implementation of the Best Solution, and Evaluation of Results. Table 1 below presents the correlation results among the aspects based on the path coefficient values from the bootstrapping results:

Table 1. Empirical correlation matrix

Variabel	LNF1	LNF2	LNF3	PS1	PS2	PS3	PS4
LNF1	1,000	0,484***	0,511***	0,064	0,220**	0,136	-0,025
LNF2	0,484***	1,000	0,610***	0,139	0,186**	0,217**	0,141*
LNF3	0,511***	0,610***	1,000	0,139	0,156*	0,114	0,016
PS1	0,064	0,139	0,139	1,000	0,329***	0,088	0,151*
PS2	0,220**	0,186**	0,156*	0,329***	1,000	0,044	0,085
PS3	0,136	0,217**	0,114	0,088	0,044	1,000	0,201**
PS4	-0,025	0,141*	0,016	0,151*	0,085	0,201**	1,000

Note: * = signifikan pada p < 0,05; ** = signifikan pada p < 0,01; *** = signifikan pada p < 0,001
Source: SmartPLS4 output.

The results of the correlation analysis indicate a positive relationship between the learning needs fulfillment (LNF) aspect, which includes indicators of readiness, interest, and learning profile, and students' problem-solving ability (PS). In general, this relationship is statistically significant, although its strength tends to be low. First, the LNF indicators demonstrate strong internal consistency. The correlation between LNF1, LNF2, and LNF3 indicators ranges from 0,484 to 0,610 and is significant at $p < 0,001$. This confirms that the three indicators are closely interrelated and represent a homogeneous construct. Therefore, it can be concluded that the learning needs fulfillment aspect is measured consistently through these three indicators.

Second, the results for the PS construct indicate a relatively low correlation between indicators. Only a few pairs of indicators showed significant correlations, such as PS1–PS2 ($r = 0,329$; $p < 0,001$), PS1–PS4 ($r = 0,151$; $p < 0,05$), and PS3–PS4 ($r = 0,201$; $p < 0,01$). Correlations between the other indicators were very low and insignificant. This indicates that the PS construct is likely multidimensional or that some indicators are not representative enough to consistently measure problem-solving ability.

Third, the relationships between the LNF and PS constructs were generally significant, although weak. For example, the correlations between LNF1–PS2 ($r = 0,220$; $p < 0,01$), LNF2–PS3 ($r = 0,217$; $p < 0,01$), and LNF2–PS4 ($r = 0,141$; $p < 0,05$). This positive correlation indicates that the more students' learning needs are met—in terms of readiness, interest, and learning profile—the better their problem-solving abilities. However, the relatively low correlation indicates that problem-solving is influenced by factors beyond meeting learning needs, such as the learning strategies used by teachers, the supportive learning environment, and the students' basic cognitive skills.

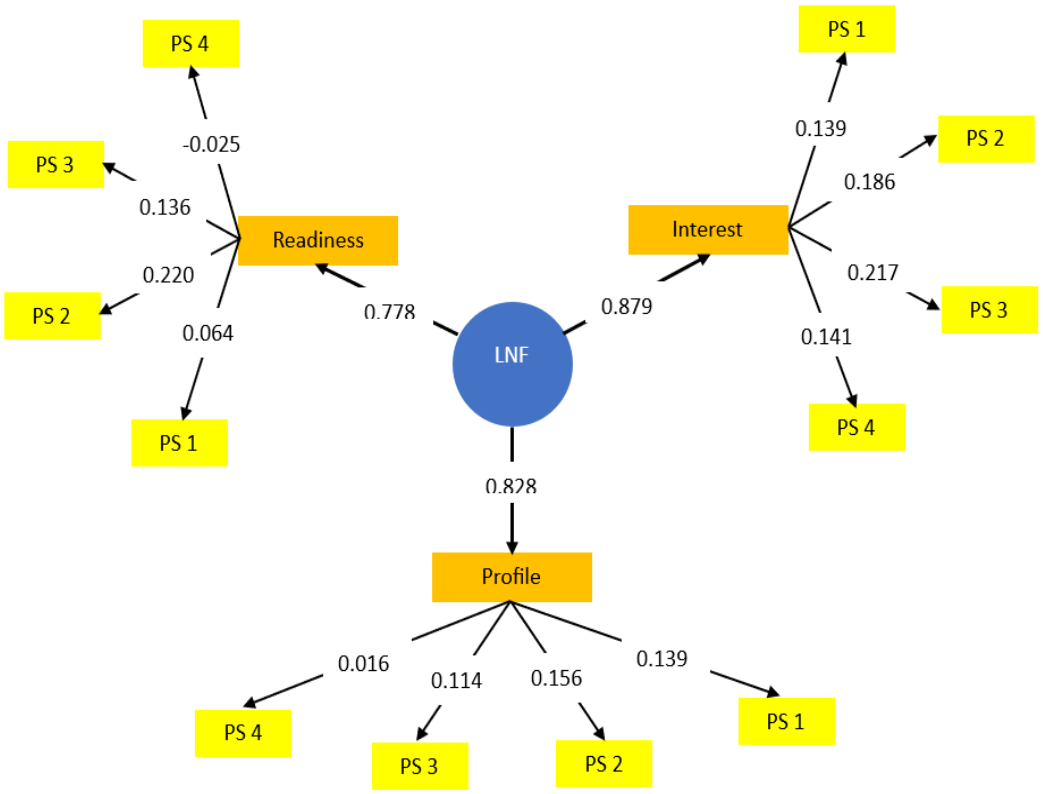

Figure 1. Analysis of learning needs fulfillment and problem-solving skill correlation using SEM PLS
Source: SmartPLS4 output.

The model in the figure shows the relationship between the learning needs fulfillment (LNF) construct and problem-solving ability (PS) through three main dimensions: readiness, interest, and profile. High factor loadings for all three dimensions (0,778; 0,879; 0,878) indicate that the LNF construct is consistently measured across all three. The readiness dimension appears to be positively related to PS1, PS2, and PS3 indicators, although the strength is low, while the relationship with PS4 is even negative. This indicates that learning readiness supports initial problem understanding more than advanced problem-solving skills.

The interest dimension shows a more stable relationship pattern with all PS indicators (0,139–0,217). Learning interest appears to encourage students to engage more in the problem-solving process, particularly in the PS3 aspect related to problem-solving strategies. Meanwhile, the profile dimension shows a weak influence on all PS indicators, with the largest correlations in PS2 (0,156) and PS1 (0,139). This indicates that the

suitability of students' learning styles or profiles has a limited contribution to problem-solving skills. Overall, although the relationship between the fulfillment of learning needs and problem-solving skills is relatively weak, the pattern that emerged still indicates that readiness, interest, and learning profile have a significant positive contribution in supporting the development of students' problem-solving skills. This indicates that the fulfillment of students' learning needs has a contributive, but not dominant, influence on problem-solving skills in differentiated science learning.

DISCUSSION

The research results indicate a positive relationship between learning needs and problem-solving ability, with a low correlation strength. This positive relationship is evident across all three aspects of learning needs (Readiness to Learn, Interest in Learning, and Learning Profile). Of the three aspects of learning needs, the learning readiness aspect has the highest correlation value compared to the other two aspects. However, its relationship with the Evaluation of Results aspect, part of problem-solving ability, yields a negative value. This means that initial readiness does not always correlate with metacognitive ability to review solutions.

This finding aligns with previous findings that there is no significant relationship between learning readiness and students' problem-solving abilities.[31] This is because problem-solving skills depend not only on initial readiness but also on reflective learning experiences. Student readiness to learn can emerge when students possess initial abilities that prepare them to face existing problems. Students with insufficient readiness will lack self-confidence, tend to be less responsible, and hesitate in making decisions.[32] Individual readiness enables them to respond to encountered situations in their own way, including responding to emerging problems.[33] Other studies have found that students with higher learning readiness tend to perform better in planning actions when facing science-based problem-solving tasks.[34,35] Planning solutions to solve problems can be done better if students have good learning readiness. This research is very different from the theory that learning readiness has an important role in students' ability to plan solutions in the context of mathematics learning.[36]

Interest in learning is also a factor in the weak correlation between learning needs and problem-solving abilities. This weak correlation is indicated by many factors, both intrinsic and extrinsic. Expert research shows that students with a strong interest in learning can solve problems quite well, but they still lack the ability to identify them.[37] In the same study, some students with high interest were able to solve problems correctly without any mistakes but were still unable to evaluate the results of their solutions. Students with high interest tend to be more focused on the process of solving problems but pay less attention to key steps such as identifying the problem or designing possible solutions and are less inclined to evaluate the outcomes.

Although the relationship between learning needs and problem solving is relatively low, the learning interest aspect has the best relationship among other learning needs aspects with the Best Solution Implementation (as an aspect of problem-solving ability). The learning interest aspect supports the view that intrinsic interest encourages persistence and focus in completing complex tasks.[38,39] One factor influencing students' learning interest is their enjoyment and enthusiasm in the learning process, which makes it important for teachers to create engaging learning experiences, particularly in problem-solving.[40] Interest helps students maintain attention and enhances their cognitive engagement in learning activities. Thus, students with high interest demonstrate greater effort in understanding problems, designing solutions, and evaluating their results.[41]

Furthermore, the low correlation, when viewed from the learning profile aspect, has the lowest overall influence. This indicates that adapting learning styles with differentiated teaching methods contributes to students' thinking flexibility, as explained in the theory of universal design for learning which emphasizes the importance of providing multiple options for representation, engagement, and expression in learning.[42,43] The low correlation may be caused by several factors. It is recommended that teachers deliver material using a uniform approach, taking into account the visual, auditory, or kinesthetics learning styles of each student.[44] This is so that students with certain learning styles can understand and respond to information optimally, so that their ability to identify problems and formulate solutions does not develop optimally.

Theoretically, learning profiles have the potential to influence cognitive processes, including problem-solving. Howard Gardner's multiple intelligences theory states that individuals possess different learning style tendencies and learning tailored to these tendencies can improve learning effectiveness.[45] If teachers align instructional methods with students' learning styles, students will feel more comfortable receiving information, thinking critically, and developing problem-solving strategies that match their way of thinking.

The results of this study indicate a positive relationship between aspects of fulfilling learning needs, including readiness, interest, and learning profiles, and students' problem-solving abilities. Although the correlation strength is relatively low, this finding remains significant because it indicates that fulfilling learning needs contributes to the development of students' thinking skills, particularly in the context of problem-solving. Detecting this information can provide valuable data for teachers to optimize the three areas of learning needs. This information serves as a basis for schools to create more practical classroom policies, particularly those related to strengthening students' problem-solving skills. These findings also indicate that meeting learning

needs still plays a role in supporting students' problem-solving skills, although it is not the dominant factor. For teachers, these results emphasize the importance of ensuring readiness to learn, fostering interest through contextual and engaging learning strategies, and tailoring instruction to students' learning profiles. Thus, an adaptive approach can be a foundation for improving higher-order thinking skills in both elementary and secondary schools.

This is consistent with findings that achieving higher-order thinking skills requires the integration of cognitive readiness, emotional engagement, and personal learning strategies.[46,47] Therefore, science learning needs to emphasize a more holistic approach to learning needs, as well as strengthening reflective activities and experiential problem-solving, in order to improve 21st-century learning outcomes. This aligns with other studies that state appropriate learning is needed to address the low level of 21st-century skills, especially problem-solving skills of elementary school teachers and teacher candidates.[48,49]

Theoretically, good learning readiness enables students to more easily understand the problems they face, while learning interests act as motivational factors that encourage active engagement in the learning process. A learning profile that matches individual characteristics can also help students optimize the strategies used to find solutions. However, the low strength of the relationship indicates that problem-solving abilities are influenced not only by learning needs but also by other factors such as the learning strategies used by teachers, the learning environment, and students' basic cognitive abilities. Therefore, although these results provide empirical support for the importance of fulfilling learning needs, further research involving mediating and moderating variables is needed to gain a more comprehensive understanding of the factors that influence students' problem-solving abilities.

This study has several limitations that should be considered when interpreting the results. First, although the fulfillment of learning needs (readiness, interest, and profile) showed a positive relationship with problem-solving ability, the strength of the correlation was relatively low. This indicates that other variables outside the scope of the study, such as learning strategies, environmental support, and individual cognitive factors, may also influence students' problem-solving ability but were not analyzed further. Second, the problem-solving ability (PS) construct showed uneven correlations between indicators, some of which were very low. This may indicate that the PS indicators are not yet fully able to represent the construct consistently, so interpretation of the results should be approached with caution.

Third, this study used a correlational design with a limited sample size (N = 196), so the results are descriptive in nature and cannot be used to infer causal relationships. Therefore, generalization of the findings to broader contexts should be limited. Fourth, the instruments used to measure the LNF and PS variables still relied on student responses, potentially being influenced by subjective bias. Therefore, further research is recommended to use a mixed-method approach, add other relevant variables, and develop more comprehensive instruments to obtain a deeper picture of the relationship between fulfilling learning needs and problem-solving abilities.

CONCLUSIONS

This study concludes that there is a positive relationship between the aspects of learning needs fulfillment—readiness, interest, and learning profile—and students' problem-solving skills, although the strength of the correlation is relatively low. Learning interest contributes most strongly to the implementation of the best solutions, while learning readiness supports the search for alternative solutions. These findings highlight the importance of a science learning approach that integrates all aspects of learning needs to foster students' critical and reflective thinking skills in solving problems.

These findings reinforce learning theories that emphasize individual student characteristics as a form of fulfilling learning needs, which include readiness, interest, and learning style. Such theories can create more effective learning experiences. This is consistent with Piaget's theory of constructivism and Rogers' humanistic theory, both of which suggest that learning can run optimally when adjusted to students' internal characteristics. Practically, this study provides teachers with an understanding of how to accommodate students' learning needs to make learning more meaningful. By paying attention to aspects of learning readiness, interest, and learning style, teachers can create an environment that encourages students to think critically and solve problems independently.

Based on the findings, several suggestions are provided. First, teachers are advised to conduct an initial identification of students' learning needs, which can serve as a basis for designing learning strategies that facilitate the development of critical thinking and problem-solving skills. Second, schools need to support teachers in conducting training or workshops that enhance understanding of students' learning needs. Third, future researchers are encouraged to explore more deeply the relationships among aspects of learning needs with critical thinking and problem-solving abilities. In addition, qualitative and mixed-method approaches can be employed to gain a more holistic understanding of students' learning processes.

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