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Analisis Berpikir Kritis Siswa dalam Pemecahan Masalah Aljabar Ditinjau dari Gaya Belajar Visual

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Abstrak

Ketidakmampuan berpikir kritis siswa dalam memecahkan masalah aljabar tercermin dari siswa yang sering mengandalkan rumus tanpa pemahaman mendalam tentang konsep dasar aljabar. Siswa kesulitan menganalisis masalah dan menemukan strategi yang tepat sebelum menyelesaikannya, serta cenderung terpaku pada satu pendekatan solusi tanpa mengeksplorasi alternatif solusi secara kritis. Berpikir kritis menjadi keterampilan penting dalam pembelajaran abad ke-21 untuk menemukan kebenaran dan membuat keputusan yang tepat. Berpikir kritis diukur melalui indikator Focus, Reason, Inference, Situation, Clarity, dan Overview. Guru perlu memahami siswa dan menyesuaikan metode pengajaran dengan gaya belajar siswa, seperti yang digolongkan oleh Porter dalam tiga tipe gaya belajar: visual, auditori, dan kinestetik. Penelitian ini melihat lebih lanjut berpikir kritis siswa dalam memecahkan masalah aljabar ditinjau dari gaya belajar, menggunakan metode kualitatif deskriptif dengan purposive sampling. Berdasarkan angket gaya belajar yang diberikan menunjukkan bahwa 61,11% siswa XI IPA MAN 2 Kota Jambi memiliki gaya belajar visual. Subjek dengan gaya belajar visual kemudian diberikan tes berpikir kritis dalam pemecahan masalah aljabar. Hasil penelitian menunjukkan rendahnya kemampuan berpikir kritis siswa, mengindikasikan kesulitan siswa berpikir secara kritis dalam memecahkan masalah matematika secara mendalam.

Kata Kunci: berpikir kritis, gaya belajar, pemecahan masalah

Analysis of Students' Critical Thinking in Algebraic Problem Solving in Terms of Visual Learning Style

Abstract

The inability of students to think critically in solving algebraic problems is evident in their tendency to rely on formulas without a profound understanding of basic algebraic concepts. They struggle to analyze problems and devise appropriate strategies before solving them, often sticking to a singular solution approach without critically exploring alternative solutions. Critical thinking has become a crucial skill in 21st-century learning for discerning truths and making informed decisions, assessed through indicators such as Focus, Reason, Inference, Situation, Clarity, and Overview. Teachers need to comprehend students' learning styles and adjust teaching methods accordingly, as categorized by Porter into three types: visual, auditory, and kinesthetic. This study delves into students' critical thinking in algebra problem-solving concerning their learning styles, utilizing a qualitative descriptive approach with purposive sampling. Based on the provided learning style questionnaire, 61.11% of students from XI IPA MAN 2 Kota Jambi exhibit a visual learning style. Subjects with a visual learning style then undergo a critical thinking test in algebra problem-solving. Research findings reveal a deficiency in students' critical thinking abilities, indicating their struggles in critically analyzing mathematical problems thoroughly.

***Keywords**: critical thinking; learning style; problem-solving*

INTRODUCTION

The inability of students to think critically in solving algebraic problems is evident in their tendency to rely on formulas without a profound understanding of basic algebraic concepts. They struggle to analyze problems and devise appropriate strategies before solving them, often sticking to a singular solution approach without critically exploring alternative solutions. The Algebra story problem is a sub-category of math word problems, which uses a short story to present the mathematical properties of math objects. Quantity relations hidden in the mathematical properties of the interconnected math objects are essential information for solving the problem. In practice, some of the quantity relations are presented implicitly by the properties of the interconnected objects, but others may be hidden in the story text (He, Meng, Zhang, Liu, & Zhang, 2023).

Critical thinking is part of the skills in learning objectives in the 21st century that need to be developed in life skills to find the truth and make the right decision by considering many statements. Ennis (2011) states that critical thinking is a process of expressing goals equipped with firm reasons about a belief and activities that have been carried out. In many countries in the world, critical thinking skills have become the main concern and goal of educational system development. Because critical thinking skills are effective in solving any problem, the implementation of critical thinking skills in learning activities is related to any subject of learning today and it will prepare the students for the problems they will encounter (Chusni, Saputro, Rahardjo, & Suranto, 2020).

Critical thinking is revealing the truth of the meaning of information from a lot of information available, looking for logical reasons for the truth of information, and being able to make decisions from all actions (Lestari & Siswono, 2022). Critical thinking in solving problems can be measured using indicators of critical thinking. Six basic elements contain critical thinking indicators that are acronymized as FRISCO, namely Focus, Reason, Inference, Situation, Clarity, and Overview (Ennis, 2011). The reason for choosing FRISCO is because it contains the basic elements of the stages of critical thinking skills as a process of solving problems that arise, making decisions, analyzing all possibilities that arise, and conducting research based on data and information that has been obtained to produce the desired information or conclusions.

Focus refers to the student's ability to find facts from the given problem, in this case, students understand the problem so that they can find facts. Reason refers to the student's ability to find problems, in this case, students provide relevant facts/evidence at each step in making decisions and conclusions. Inference refers to the ability of students to find ideas so that in this case students make conclusions with the right reasons to support the conclusions made. Situation refers to the ability of students to find answers, in this case, students use all information that is appropriate to the problem to answer the questions given. Clarity refers to the ability of students when answers students use further explanation of what is intended. Overview refers to the student's ability to examine or recheck thoroughly from start to finish (Wardhani, Rasiman, & Wulandari, 2021).

The importance of emphasizing critical thinking in learning, especially mathematics learning, is to obtain mathematical procedures in problem-solving and find logical results that are impartial. Therefore, critical thinking skills are needed in problem-solving or finding solutions. Problem-solving ability is the ability of students to solve complex and non-routine problems. Students can understand these complex problems and develop a plan to solve these problems so that finally students can determine the solution to these complex and non-routine problems (Rambe & Afri, 2020). The demand for problem-solving skills is always emphasized in every existing curriculum as a basic competency that must be developed and integrated into several appropriate materials. However, in reality, this problem-solving ability has not been mastered by students.

In the context of problem-solving, prioritizing the teaching of secondary knowledge is normally interpreted to mean that content knowledge (both procedural and conceptual) is the only knowledge that matters, and so extensive content knowledge is a necessary and sufficient condition for effective problem-solving. Teachers should focus on teaching mathematical content thoroughly and deeply, and the ability to solve problems using this content knowledge is presumed to develop naturally with exposure to carefully graded sequences of problems. A large amount of research has been conducted on the teaching of problem-solving in school mathematics, although there are still felt to be far more

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questions than answers (Fülöp, 2019; Lesh, 2007; Lester & Cai, 2016; Olivares, Lupiáñez, & Segovia, 2021).

Problem-solving is defined as an attempt to find a way out of a difficulty, to achieve a goal that is not immediately achievable (Polya, 1945). Mathematical problem solving is described as several sequential processes, namely: (1) understanding the problem, at this stage students must be able to know the existing problems to be able to write down all the elements or data given in the problem and the data asked in the problem; (2) devising a plan (determining a problem solving plan), at this stage students must do mathematical modelling of the problems contained in the problem and must find any relationship between the data contained in the problem and the unknown data, then after that students can consider possible problems, and then must get a plan and what solutions can be given to solve the problem; (3) carry out the plan, at this stage it is important for students to maintain the plan that has been made previously, but if the plan or solution cannot be carried out, then another method or plan or solution can be selected so that the problem can be resolved; (4) looking back (checking back), at this stage students check the results of the answer to double-check the correctness of the answer obtained" is correct. This is important because if the student's answer is found to be wrong the student can correct the answer again. In this study, Polya's problem-solving steps are utilized because they are easy to understand and straightforward.

In the learning process, teachers must understand students and adjust to the characteristics of the way of learning that each student has, so that the information conveyed to students can be received properly. Furthermore, teacher strategies in teaching are also highly necessary to support the reasoning process and to enhance critical thinking skills (Minnameier & Hermkes, 2020). One of the characteristics of students is their learning style. The learning style that each individual has is an asset that can be used when they learn. The differences that students have that are less considered in absorbing information in learning optimally are differences in learning styles (Setiyanik, Junarti, & Utami, 2019). Differences in learning styles that each child has cause differences in understanding, processing, and capturing information conveyed by the teacher. Recognizing one's learning style does not necessarily make someone smarter, but it can make them know how to make the most of their learning abilities so that understanding of the material becomes more optimal (Sinta Silviana Muslim, Prayitno, Nilza Humaira Salsabila, & Amrullah, 2022).

Porter & Hernacki (2016) classify learning styles into three types: visual type, auditory type, and kinesthetic type. A person will learn using all three styles at certain stages, but most people are more inclined to one of the three. Visual students learn by seeing, auditory students learn by hearing, and kinesthetic students learn by moving, working, and touching. In the research of Wasqita, Rahardi, & Muksar (2022), it can be seen that the critical thinking ability of students with visual learning styles is quite critical. The ability of students with auditory learning styles is less critical. The ability of students with kinesthetic learning styles is less critical. In line with Setiana & Purwoko (2020) research which states that students with visual learning styles tend to have higher critical thinking skills than students with auditory learning styles. Overall, the research indicates that students' critical thinking abilities in solving mathematical problems vary depending on their learning styles, and these abilities remain generally low due to insufficient problem-solving skills.

Previous research indicates that the critical thinking abilities of students with visual learning styles are generally considered adequate, although there are differences compared to the critical thinking abilities of students with auditory and kinesthetic learning styles, which tend to be deemed less critical. Additionally, prior studies have shown that students with visual learning styles exhibit higher levels of critical thinking compared to those with auditory learning styles. However, the findings from my research observations indicate that despite students with visual learning styles possessing critical thinking abilities, their proficiency in algebra problem-solving remains low. Hence, there is a need for more in-depth research to explore the relationship between visual learning styles and the critical thinking abilities of students more specifically within the context of algebra problem solving. This endeavor can aid in understanding the factors influencing the low critical thinking abilities of students with visual learning styles in algebra problem solving, thereby facilitating the search for solutions to enhance these abilities.

Critical thinking involves an individual's ability to analyze information, evaluate arguments, and develop a deep understanding. Problem-solving, on the other hand, is the process of identifying, formulating, and resolving problems (Swart, 2018). The two are interrelated because problem-solving requires effective critical thinking to identify the root of the problem, analyze alternative solutions, evaluate the implications of each option, and choose the appropriate action. Learning styles refer to individual preferences in receiving, processing, and interpreting information. Critical thinking plays a crucial role in selecting an effective learning style. Learning styles can also influence one's ability to solve problems. For example, individuals with a visual learning preference may be better at solving problems involving visual mapping or diagrams. Meanwhile, individuals with an auditory learning preference may be better at solving problems through discussion and oral explanation. Understanding one's learning style can help one adopt an appropriate approach to problem-solving.

METHOD

The research was conducted in class XI IPA 4 MAN 2 Jambi City in the odd semester of the 2023/2024 academic year. The research conducted was a study that used descriptive qualitative research. Qualitative research aims to develop an in-depth exploration of a phenomenon, not to generalize the population (Cresswell, 2014). The approach in this research uses a qualitative descriptive approach based on case studies. The advantage of the case study method is that it can conduct more in-depth research and has the opportunity to gain insight into the basic concepts of human behavior. This is in line with the purpose of this research, which is to find out the critical thinking process in solving algebra problems in terms of students' learning styles.

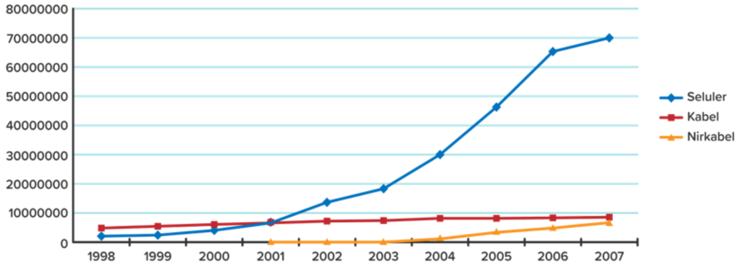
The selection of the subject of this study was to conduct a critical thinking ability test in solving algebra problems in class XI IPA 4 MAN 2 Jambi City. Furthermore, the research subjects were selected using the purposive sampling technique, namely the technique of determining subjects with certain considerations, namely (1) students who represent one of the dominant learning styles; (2) students who understand the phenomenon to be studied, namely students who can express their way of thinking orally and in writing.

There are two types of instruments used in this study, namely the main instruments and supporting instruments. The main instrument in this research is the researcher himself who acts as a planner, executor of data collection, data analyst, data interpreter, and finally a reporter of research results. The supporting instruments in this study are tests, interview guidelines, and learning style questionnaires. The data in this study comprises a description of students' critical thinking processes in solving algebraic problems. The research commenced by administering a learning style questionnaire (consisting of 30 questions and validated by experts) as a guide for classifying students' learning styles. Subsequently, the researcher selected one student deemed as the research subject, based on limitations faced during the research process. The study was confined solely to students with visual learning styles. This decision stemmed from the responses to the learning style questionnaire provided by students in class XI IPA 4 MAN 2 Kota Jambi, where 61.11% of 36 students tended towards visual learning styles. Further, the researcher administered a critical thinking test for solving algebraic problems, comprising one question that had been validated by experts in mathematical learning psychology. Students answered the questions using the think-aloud technique, followed by unstructured interviews. For data validity purposes, the results of data analysis were triangulated to obtain valid data. In this study, researchers used the method of triangulation. The method triangulation carried out is the results of the subject's worksheet, the results of the subject's think-aloud when solving algebra problems, and the researcher's interview with the subject to gain a deeper understanding of their critical thinking abilities in problem-solving based on critical thinking indicators.

RESULTS

The critical thinking test question in solving algebraic problems given to the students is as follows:

The telecommunications system in Indonesia is divided into fixed networks and mobile networks. In its development, there has been a transition in the telecommunications sector from initially using *cable-based telecommunications networks, but the need for accurate information access has shifted the telecommunications mode in Indonesia since the 2000s. From 2000 to 2007, the number of mobile phone users f(x) (in millions) is modeled by thwhich e equation* $f(x) = 1{,}3x^2 + 1{,}6x + 3{,}7$, *where x = 0 represents the year 2000.*



Pertumbuhan Pengguna Telepon seluler. Nirkabel, dan Kabel Sumber Indikator TIK BPPT)

The graph above illustrates the development of mobile phone, wireless, and cable users in Indonesia (rounded to the nearest ten million). Determine the number of mobile phone users on the graph in 2005!

The following presents the results of the answers and analyses of the answers of each respondent to the problems given. The indicator of Focus refers to the student's ability to understand the problem so that they can extract facts from the given question. Student experience Focus critical thinking indicators at one stage of problem-solving. This can be seen in the student's answer in Figure 1.

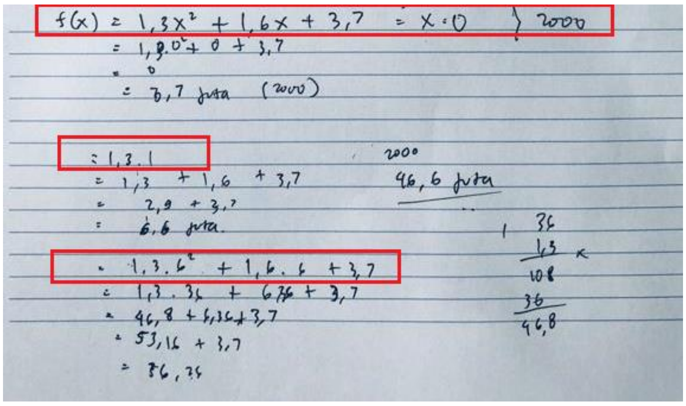


Figure 1. Student answers on the indicator about Focus

At the stage of understanding the problem, students seem to be able to find facts from the given problem. Students can rewrite the data elements given, namely the number of cellular telephone users modeled by the equation $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$, where $x = 0$ representing the year 2000 and what is asked is the number of cellular telephone users in Indonesia in 2005. At the stage of making a solution plan, students have not experienced the focus indicator seen when students have not fully found the relationship between the data given and the data they want to ask. Students were able to interpret the modeling of $x = 0$ to represent the year 2000 in the equation $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$ but was unable to interpret that $x = 6$ represented the year 2005. At the stage of implementing the plan, students did not experience the focus indicator as students mistakenly worked on the problem using the data given, namely assuming the value of $x = 6$ represented the year 2005. At the rechecking stage, students do not experience the focus indicator, as seen when students make calculation errors by substituting the value of $x = 6$ into the equation $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$.

The indicator of Reason refers to the student's ability to provide reasons based on relevant facts/evidence at each step in making decisions and conclusions. Through the results of the researcher's interview with the subject, students have experienced Reason critical thinking indicators at two stages of problem-solving. This can be seen in the student's answer in the following figure 2.

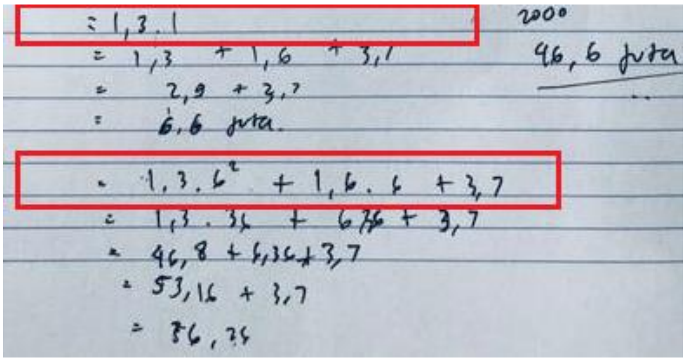


Figure 2 Student answers on the indicator about Reason

At the stage of understanding the problem, the reason indicator is illustrated that students can mention the reasons for writing what is known, namely the number of mobile phone users f(x) (in million) can be modeled by the equation $f(x) = 1{,}3x^2 + 1{,}6x + 3{,}7$ and the element asked in the problem, namely the number of mobile phone users in Indonesia in 2005. At the stage of determining a problem-solving plan, the reason indicator illustrates that students can explain whether the information given in the problem is sufficient to answer the question and can mention the reasons for choosing the form of solution to be used in the problem. At the stage of implementing the plan, students have not experienced the reason indicator, illustrating that students have not been able to explain each step of the work on the problem and the reasons for taking that step, namely, students guess or just estimate the value of $x = 1$ then the value of $x = 6$ which may be a solution by looking through the graph given in the problem. At the rechecking stage, students have not experienced the reason indicator, illustrated by students not being able to provide reasons for checking further arguments related to the results found when substituting the value of $x = 6$ into the equation $f(x) = 1{,}3x^2 + 1{,}6x + 3{,}7$.

Indicator about Inference refers to the ability of students to generate ideas so that in this case students conclude with appropriate reasoning. Through the results of the researcher's interview with the subject, students have not experienced the critical thinking indicator Inference in problem-solving. At the stage of understanding the problem, students have not experienced inference indicators, it can be seen that students have not been able to draw the right conclusions from the series of reasons expressed by using the equation $f(x) = 1{,}3x^2 + 1{,}6x + 3{,}7$ in solving problems and finding the value of x that matches what is asked in the problem. At the stage of determining the solution plan, students have not experienced the inference indicator illustrated when students have not been able to draw the right conclusions in using certain strategies to the decision to use the strategy. At the stage of implementing the plan, students have not experienced the inference indicator as illustrated when students have not been able to conclude a series of reasons for the decision on the steps of implementation. At the stage of checking back, students have not experienced the inference indicator illustrated when students have not been able to draw the right conclusions from a series of reasons to the decision to check other possible answers.

The indicator about the Situation refers to students' ability to find answers, wherein they utilize all pertinent information to address the given questions. Through the results of the researcher's interview with the subject, students have experienced the Situation critical thinking indicator at one stage of problem-solving. This can be seen in the student's answer in Figure 3.

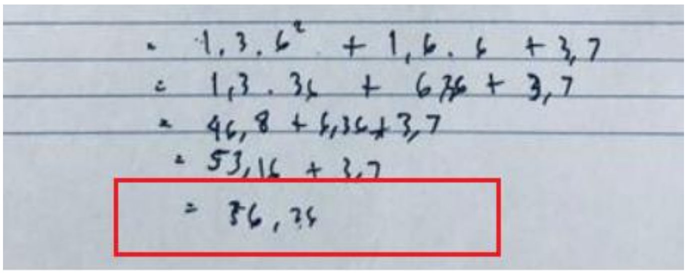


Figure 3. Student answers on the indicator about Situation

At the stage of understanding the problem, it can be seen that students can find information that is by the problem to answer the questions given, namely: From 2000 to 2007, many telephone users were modeled by the equation $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$ with $x = 0$ representing the year 2000. At the stage of determining a problem-solving plan, students have not yet experienced the situation indicator seen that students do not know the important things that need to be considered in making a strategy plan, namely, students do not carry out the planning steps coherently, namely when determining the number of mobile phone users (x) from 2000 to 2005. At the stage of implementing the plan, students have not experienced the situation indicator, it can be seen that students ignore important things that need to be considered in the steps of implementing the strategy, namely, students do not try step by step the step-by-step process of substituting the value of $x = 0$ to $x = 5$ as a representation of 2000 to 2005 into the equation $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$. At the stage of checking back, students have not experienced the situation indicator, it seems that they do not know the important things that need to be considered in checking the answers obtained, namely when students substitute the value of $x = 6$ into the equation f $\mathrm{f(x)} = 1{,}3\mathrm{x}^2 + 1{,}6\mathrm{x} + 3{,}7$ = 56.26 and get the wrong calculation.

Indicator about Clarity refers to students' ability to provide further explanation when arriving at an answer, ensuring a clearer elucidation of the conclusions reached. Through the results of the researcher's interview with the subject, students have not experienced the Clarity critical thinking indicator in problem-solving at all. Clarity critical thinking indicators refer to the ability of students when find answers using further explanations of the conclusions that have been made and can explain the terms in the problem. At the stage of understanding the problem, students have not experienced the clarity indicator illustrated by students not being able to understand the terms of the information provided by the problem. At the stage of determining problem problem-solving plan, students have not experienced the clarity indicator illustrated by students not being able to explain the terms planned in problem-solving well. At the stage of implementing the plan, students have not experienced the clarity indicator illustrated by students not being able to use further explanation related to the terms used in the solution. At the stage of re-examining students have not experienced the clarity indicator illustrated by students not being able to further justify the terms that have been used to the conclusion.

Through the results of the researcher's interview with the subject, students have not experienced the overview critical thinking indicator in problem-solving. This can be seen in Figure 4.

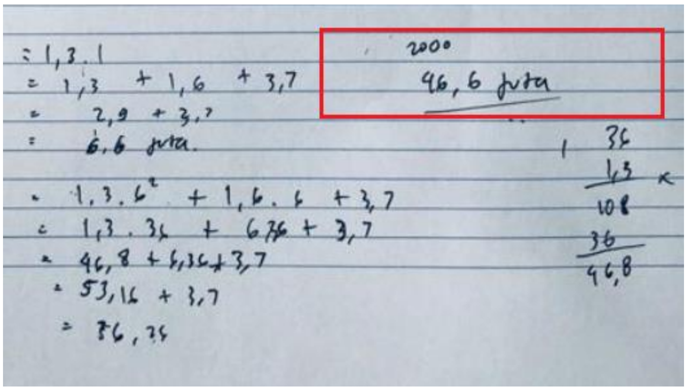


Figure 4. Student answers on the indicator about the Overview

The indicator of Overview refers to the student's ability to examine, check, or thoroughly review the results of problem-solving. Overview Critical thinking indicators refer to students' ability to examine, check, or re-correct the results of problem-solving thoroughly from start to finish. At the stage of understanding the problem, students have not experienced the overview indicator seen from students who do not check all the things that have been done from the reasons given to the conclusion of whether everything is right. At the stage of determining the solution plan, students have not experienced the overview indicator seen from students who do not check all the things that have been done from the reasons given to the decision about the strategy to be used and whether everything is right. At the stage of implementing the plan, students have not experienced the overview indicator seen from students who have not been able to provide confidence that the answers that have been obtained are correct. At the stage of re-examining, students have not experienced the overview indicator seen from students not being able to re-examine or reinterpret the results of problem-solving to conclude.

From the description of the observation results above, students only fulfill some critical thinking indicators at each stage of problem-solving from the given questions. This indicates that the critical thinking ability of visual learners is still low. This is different from previous research by Wasqita et al., (2022) which showed that the critical thinking ability of students with visual learning styles is quite critical. The ability of students with auditory learning styles is less critical. The ability of students with kinesthetic learning styles is also less critical. This is consistent with the research by Setiana & Purwoko, (2020) which stated that students with visual learning styles tend to have higher critical thinking abilities than students with auditory learning styles.

DISCUSSION

Critical thinking involves an individual's ability to analyze information, evaluate arguments, and develop deep understanding. Problem-solving, on the other hand, is the process of identifying, formulating, and resolving problems. The two are interrelated because problem-solving requires effective critical thinking to identify the root of the problem, analyze alternative solutions, evaluate the implications of each option, and choose the appropriate action. Learning style refers to an individual's preferences in receiving, processing, and processing information. There are several common learning styles, such as visual, auditory, and kinesthetic. Critical thinking plays an important role in choosing an effective learning style. Learning style can also influence a person's ability to solve problems. For example, individuals with a visual learning preference may be better at solving problems that involve visual mapping or diagrams. Meanwhile, individuals with an auditory learning preference may be better at solving problems through discussion and verbal explanations. Understanding a person's learning style can help them adopt an appropriate approach to solving problems.

The research findings of Lailani & Rusmana (2023) indicate that students with visual learning styles are capable of identifying problems and drawing general conclusions, as well as tending to be meticulous about details. Students with auditory learning styles are less meticulous in solving problems/questions sequentially. This is consistent with the characteristics of auditory learning style where they have difficulties with tasks that require visualization. They prefer answering questions orally, engaging in discussions, and listening to explanations rather than writing. Kinesthetic learning style shows a good level of critical thinking ability. This is supported by the characteristics of the kinesthetic learning style where they prefer learning through manipulation and practice, and enjoy books with a focus on plot and content (Wahyuni, 2017).

The research conducted by Setiana & Purwoko (2020) that students with visual learning styles demonstrate very good critical thinking abilities. On the other hand, students with auditory learning styles have adequate critical thinking abilities, while students with kinesthetic learning styles show good critical thinking abilities. This is also supported by research conducted by Safitri & Miatun (2021), which shows that students with visual learning styles have very good critical thinking abilities, students with auditory learning styles have good critical thinking abilities, and students with kinesthetic learning styles have fairly good critical thinking abilities. Students with visual learning styles are already able to explain mathematical concepts visually before solving their mathematical problems. Whereas auditory learning styles have not been able to explain solutions completely, and kinesthetic learning styles are unable to analyze and evaluate the critical thinking ability indicators. However, this contradicts the research conducted by Jalil, Siskawati, & Rawati (2023) which categorizes students with visual and auditory learning styles as having good critical thinking abilities based on their level of critical thinking. Whereas students with kinesthetic learning styles can be categorized as having less good critical thinking abilities. Students with visual learning styles tend to have high critical thinking abilities, supported by the characteristics of visual learning style where students will strive to solve problems/questions neatly and sequentially, recalling and utilizing knowledge acquired when reading and seeing material presentations (Papilaya & Huliselan, 2016).

Previous research indicates that the critical thinking abilities of students with visual learning styles are generally considered adequate, although there are differences compared to the critical thinking abilities of students with auditory and kinesthetic learning styles, which tend to be deemed less critical. Additionally, prior studies have shown that students with visual learning styles exhibit higher levels of critical thinking compared to those with auditory learning styles. However, the findings from my research observations indicate that despite students with visual learning styles possessing critical thinking abilities, their proficiency in algebra problem-solving remains low. Hence, there is a need for more in-depth research to explore the relationship between visual learning styles and the critical thinking abilities of students more specifically within the context of algebra problem solving. This endeavor can aid in understanding the factors influencing the low critical thinking abilities of students with visual learning styles in algebra problem solving, thereby facilitating the search for solutions to enhance these abilities.

A more comprehensive discussion is needed to deepen our understanding of the intricate relationship between critical thinking and visual learning styles. Critical thinking, characterized by the ability to analyze information, evaluate arguments, and develop profound understanding, serves as a cornerstone in educational settings. Visual learning styles, on the other hand, emphasize the preference for receiving and processing information through visual aids such as diagrams, charts, and images. Research has indicated a correlation between visual learning preferences and enhanced critical thinking abilities, particularly in tasks involving visual representations. Visual learners often excel in tasks that require spatial reasoning, pattern recognition, and the ability to interpret complex visual information. Understanding the cognitive processes underlying visual learning can shed light on how these individuals approach problem-solving tasks and engage in higher-order thinking. However, it is essential to delve deeper into the mechanisms through which visual learning styles influence critical thinking skills. This entails examining how visual stimuli impact cognitive processes such as information processing, memory encoding, and decision-making. Furthermore, exploring individual differences within visual learners, such as variations in spatial intelligence and visualization skills, can provide valuable insights into the nuances of this relationship. By unraveling the intricate interplay between visual learning styles and critical thinking abilities, educators can tailor instructional strategies to better support visual learners in developing and applying critical thinking skills across various academic domains.

A more in-depth discussion of the relationship between learning styles and students' critical thinking abilities enriches the understanding of this phenomenon. In the context of educational research, the concept of critical thinking ability has been a primary focus due to its relevance to effective learning and the development of life skills. The article has provided initial insights into how visual, auditory, and kinesthetic learning styles influence students' critical thinking abilities. However, to enhance this understanding, a more comprehensive and up-to-date literature review is needed. Recent studies can offer more detailed insights into how specific learning styles contribute to the development of students' critical thinking abilities (Wang, Wu, & Jiang, 2023). A deeper analysis of various factors influencing critical thinking abilities, such as environmental factors, student motivation, and teaching strategies used, can also provide a more holistic understanding. In exploring the interaction between learning styles and critical thinking abilities, sophisticated research approaches and appropriate statistical analyses are required. Inclusive research methods, such as longitudinal studies that consider changes in critical thinking abilities over time, are also needed to better understand the dynamics of this interaction. The practical implications of research findings also need to be carefully considered. How can teachers and educators use knowledge of students' learning styles to design more effective learning strategies to facilitate the development of critical thinking abilities? These questions demand further research and wise implementation in real educational contexts. Approaching this topic with a strong scientific foundation, considering recent findings, and paying attention to practical implications, the discussion of the relationship between learning styles and students' critical thinking abilities can make valuable contributions to the development of more effective and inclusive education. Furthermore, the research conducted by Khan (2023) to determine whether learning styles influence the academic achievements of medical school students showed no difference in the outcome of academic achievement among different subgroups of learning styles. Further analysis revealed no gender differences in the effect of learning style on academic achievement. Critical thinking is an important skill possessed by students as a higher-order thinking skill that supports independent and research-based learning for students. One effort to fulfill the scientific learning process is through project-based learning, taking into account students' motivation and learning styles. Based on the conducted research, students' critical thinking skills can be enhanced through project-based learning by considering factors such as students' motivation and learning styles (Rini, Adisyahputra, & Sigit, 2020).

CONCLUSION

Students with visual learning styles only experience some critical thinking indicators at each stage of problem-solving from the problems given. Student experience Focus critical thinking indicators at one stage of problem-solving. At the stage of understanding the problem, students seem to be able to find facts from the problems given. Through the results of the researcher's interview with the subject, students have experienced Reason critical thinking indicators at two stages of problem-solving. At the stage of understanding the problem, the reason indicator is illustrated so that students can mention the reasons for writing down what elements are known. At the stage of determining a problem-solving plan, the reason indicator illustrates that students can explain whether the information given in the problem is sufficient to answer the question and can mention the reasons for choosing the form of solution to be used in the problem. Through the results of the researcher's interview with the subject, students have not experienced the critical thinking indicator Inference in problem-solving. Through the results of the researcher's interview with the subject, students have experienced the critical thinking indicator Situation at one stage of problem-solving. At the stage of understanding the problem, it can be seen that students can find information that is by the problem to answer the questions given. Through the results of the researcher's interview with the subject, students have not experienced the Clarity critical thinking indicator in problem-solving at all. According to the results of the researcher's interview with the subject, students have not experienced the critical thinking indicator Overview in problem-solving.

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