THE EFFECT OF LEARNING STYLES ON THE CRITICAL THINKING SKILLS OF ELEMENTARY SCHOOL STUDENTS IN MATHEMATICS

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ABSTRACT

This study describes the effect of learning styles on the critical thinking skills of elementary school students in Banyumas Regency, Central Java. The type of research used is field research with an ex post facto (survey) method, taking the research setting at Sokaraja Tengah Elementary School in Banyumas. The research sample used probability sampling with cluster sampling technique focused on 123 fourth-grade students. Data collection used a learning style questionnaire and critical thinking ability test. The data analysis technique used was Kruskal-Wallis non-parametric statistics because the data was not normally distributed. The Kruskal-Wallis result using a significance level of 0.05 and an Asymp. Sig. value of 0.004 < 0.05 indicates that there is a significant difference in critical thinking skills between students with different learning styles. Thus, the null hypothesis is rejected, meaning that there is an influence of learning style on the critical thinking skills of elementary school students in mathematics in Sokaraja Tengah Village, Banyumas.

Keywords: learning style, critical thinking skills, non-parametric

ABSTRAK

Penelitian ini menggambarkan pengaruh gaya belajar terhadap kemampuan berpikir kritis siswa SD di Kabupaten Banyumas Jawa Tengah. Jenis penelitian yang digunakan adalah penelitian lapangan (*field research*) dengan metode *ex post facto* (survei) mengambil setting penelitian di Sekolah Dasar Desa Sokaraja Tengah Banyumas. Sampel penelitian ini menggunakan *probability sampling* dengan teknik *cluster sampling* difokuskan pada siswa kelas IV yang berjumlah 123. Pengumpulan data menggunakan angket gaya belajar dan tes kemampuan berpikir kritis. Teknik analisis data yang digunakan adalah statistika non parametrik *Kruskal-Wallis*, dikarenakan data tidak berdistribusi normal. Hasil *Kruskal-Wallis* dengan menggunakan taraf signifikansi 0.05, nilai *Asymp. Sig*. 0,004 < 0,05 hal ini menunjukkan bahwa terdapat perbedaan yang signifikan dalam kemampuan berpikir kritis antara siswa yang memiliki gaya belajar yang berbeda. Dengan demikian, hipotesis nol ditolak, artinya terdapat pengaruh gaya belajar terhadap kemampuan berpikir kritis siswa Sekolah Dasar dalam mata pelajaran matematika di Desa Sokaraja Tengah Banyumas.

Kata Kunci : gaya belajar, kemampuan berpikir kritis, non parametrik

A. Introduction

Some students consider mathematics to be challenging. They feel that mathematics requires deep thinking and often makes it difficult for them to find solutions. In fact, through learning mathematics, students are trained to think critically, logically, and systematically. Critical thinking skills play a major role in the learning process, enabling students to analyze, evaluate, and draw conclusions from information rationally.(Firdausi & Yermiandhoko, 2021) Through critical thinking, a person processes information deeply to determine the best steps to solve a problem.(Lismaya, 2019)

Critical thinking is not merely the result of thinking, but rather a process of understanding how thinking itself works. This includes knowing how to ask questions and use proper reasoning. Students' critical thinking skills depend heavily on their ability to disseminate information, test experiences, and weigh arguments. In addition to technical aspects, being a critical thinker also requires certain character traits, such as openness to challenging problems and a strong passion for seeking the truth.(Novikasari, n.d.)

However, in reality, there are still students who have difficulty solving problems because they do not understand the steps to solve them. The lack of motivation to think critically is evidence that students' critical thinking skills are low and still need to be improved.(Amalia et al., 2021) This is reinforced by PISA results showing an increase in Indonesia's ranking to 67th out of 81 countries, but this is not consistent with the increase in global scores. With an average of 366 points, Indonesian students' mathematical abilities are still below the OECD threshold, although this is an improvement compared to 2018.(Kemendikbud, 2023)

Learning styles are one of the factors that influence students' critical thinking skills and academic achievement. In general, learning style is a personal method used by someone to capture and process information in order to gain a complete understanding. The quality of learning outcomes is largely determined by the mechanism of information absorption in various conditions. In essence,

when someone begins to receive and digest new information, whether intentionally or unintentionally, that is when the real learning process is taking place.(Sabagh et al., 2021)

In an active learning environment, the diversity of individual learning preferences significantly determines the effectiveness of material absorption. While adjusting teaching methods based on student characteristics can improve positive attitudes and learning achievement, some teachers still use conventional and monotonous methods due to limited facilities. Ignoring this diversity in learning styles ultimately risks hindering students' optimal academic results.(Supit et al., 2023)

According to Jean Piaget, this period is known as the concrete operational stage, in which children's reasoning processes are still fixated on things that can be seen and felt directly. Due to the differences between the nature of mathematics and children's cognitive development stages, mathematics will be difficult to understand if it is presented without learning aids or teaching methods that suit their learning styles.(Handayani, 2021)

There are generally three learning styles: visual, auditory, and kinesthetic. Factors that can influence learning styles include internal and external factors. Internal factors consist of physical, psychological, and fatigue factors. External factors include family, school, and community.(Puspita et al., 2024) Meanwhile, factors that can influence students' critical thinking skills include psychological factors, physical factors, independent learning, and interaction.(Olenggius Jiran Dores, Dwi Cahyadi Wibowo, n.d.)

In addition to readiness, the selection of learning methods and strategies according to students' learning styles affects their enthusiasm for learning. The use of group discussion methods and learning media, such as numerical media, is very important to ensure that educational messages reach students. In addition, images or learning media that suit learning styles have a function in maintaining enthusiasm for learning and clarifying complex concepts that are difficult to grasp through lecture explanations alone, thereby overcoming student boredom.(Suparjo et al., n.d.)

Through this research, it is hoped that it will provide an overview of the influence of learning styles on critical thinking skills. This information will be very valuable for teachers in developing teaching strategies that are more equitable and able to optimize the potential of each student. This research can also help teachers not only to teach, but also to understand how each student receives learning. For example, knowing that a student tends to be visual, teachers can more frequently use media such as graphics, diagrams, or videos in explaining mathematical concepts. For auditory students, group discussions, verbal explanations, or the use of audio recordings can be more effective methods. Meanwhile, kinesthetic students will find it much easier to absorb mathematical principles if learning involves direct experience, either through the manipulation of teaching aids or role-playing activities in the classroom.(Lestari & Widda Djuhan, 1970) When learning is well understood, students will be more confident and able to develop better analytical skills and deeper problem-solving abilities. Students will not only rely on the examples given, but will also have the ability to flexibly implement these principles in various real-life contexts.

B. Research Method

This study is a quantitative study that focuses on the influence of learning styles as an independent variable on students' critical thinking skills as a dependent variable. The researcher applied a field research method by collecting data directly at the research location to obtain accurate results.(Romlah, 2021)

The type of research applied is comparative causal with an ex-post facto method. This approach was chosen because the researcher did not provide direct control over the independent variable. Considering that learning style is a factor inherent in the respondents, the researcher only collected data without engineering or manipulating the variable.(Syahrizal & Jailani, 2023)

The population in this study were 123 fourth-grade elementary school students in Sokaraja Tengah Village, Banyumas. Sampling in this study used probability sampling with cluster sampling technique, so the number of samples used was the entire population.(Prof. Dr. Sugiyono, 2022)

Data collection used a learning style questionnaire and a critical thinking ability test.

Student learning style data in this study was obtained through a questionnaire divided into indicators from (Fleming & Teaching, n.d.) and a Likert scale with a score range of one to four. The test was used to identify the critical thinking skills of fourth-grade elementary school students in mathematics. The tool used was a collection of questions specifically designed with critical thinking indicators in mind from(Facione & Facione, 2013)

The content validity coefficient can be calculated using Aiken's V index, which is based on expert assessment of items according to the extent to which they represent the construct being measured. Each test is valid with high and moderate criteria, according to the results of Aiken's V calculation. In other words, each question can be tested because it is related to this study.

Empirical validity relates to the variables responsible for measuring the values that should be measured. An instrument or item is considered valid if the calculated r value is greater than the table r value. In addition,

reliability is a term that refers to the likelihood that the instrument used can be relied upon as a data collection tool. With 45 students as test respondents, the validity test with a significance level of 5% obtained r table pearson = 0.2940. The questionnaire instrument obtained 18 out of 30 valid statements, with a Cronbach's Alpha value of 0.761>0.6, which is in the high category in the range of $0.6< r\_11 \leq0.80$. For the test instrument, 8 out of 12 questions were valid, with a Cronbach's Alpha value of 0.667>0.6, which is in the high category in the range of $0.6< r\_11 \leq0.80$.(Rohmad & Sarah, 2021)

C. Research Results and Discussion

The purpose of this study was to determine how different learning styles affect the critical thinking skills of fourth-grade elementary school students in matemathics. Students' learning styles can influence how they understand and process information, which ultimately affects their critical thinking skills. This study collected data using tests and questionnaires. The results of both instruments were then analyzed to obtain critical thinking scores and identify the learning style characteristics of the

students. The following table presents the students' scores, which describe the results of the critical thinking skills test based on each student's score and learning style category. This data forms the basis for further analysis of the influence of learning styles on students' critical thinking skills.

1. Descriptive Statistics

Tabel 1. Descriptive of Learning Style

Gaya_Bela jar	123	21	62	47.00	6.322
Valid N (listwise)	123				

From the table above, the highest score was 62 and the lowest was 21 out of a total of 123 students. The average score was 47.00 with a standard deviation of 6.322.

Furthermore, from the results of the student learning style questionnaire, the categories of student learning styles based on learning style indicator scores were obtained using SPSS 25 for Windows software, as follows :

Tabel 2. Distribution of learning styles

Valid	Visual	63	51.2	51.2	51.2
	Auditori	11	8.9	8.9	60.2
	Kinestetik	38	30.9	30.9	91.1
	Visual-Auditori	4	3.3	3.3	94.3
	Visual-Kinestetik	4	3.3	3.3	97.6
	Auditori-Kinestetik	3	2.4	2.4	100.0
	Total	123	100.0	100.0	

The output above shows that 63 students or 51.2% are visual learners, 38 students or 30.9% are kinesthetic learners, 11 students or 8.9% are auditory learners, 4 students or 3.3% are visual-kinesthetic learners, 4 students or 3.3% are visual-auditory learners, 3 students or 2.4% are auditory-kinesthetic learners. The data shows that the average fourth-grade student is a visual learner.

Tabel 3. Descriptive of Critical Thinking Skills

Kemampuan _Berpikir_Kri tis	123	38	100	59.79	13.705
Valid N (listwise)	123				

The results show that 123 fourth-grade students scored the highest at 100 and the lowest at 38. This critical thinking test question had an average of 59.79 with a standard deviation of 13.705. Furthermore, the frequency distribution of students' critical thinking skills was obtained using SPSS 25 for Windows software as follows:

Tabel 4. Distribution of critical thinking skills

Valid	38	9	7.3	7.3	7.3
	50	47	38.2	38.2	45.5
	63	44	35.8	35.8	81.3
	75	14	11.4	11.4	92.7
	88	5	4.1	4.1	96.7
	100	4	3.3	3.3	100.0
	Total	123	100.0	100.0	

The output results above show that 47 students or 38.2% obtained a score of 50, 44 students or 35.8% obtained a score of 63, 14 students or 11.4% obtained a score of 75, 9 students or 7.3% obtained a score of 38, 5 students or 4.1% scored 88, and 4 students or 3.3% scored 100.

2. Normality Test

Tabel 5. Normalitas Data

	Unstandardized Residual
N	123
Test Statistic	.206
Asymp. Sig. (2-tailed)	.000c

The normality test shows that students' learning styles and critical thinking skills are not normally distributed (non-significant value (2-tailed) ≥ 0.05) where 0.000 is smaller than 0.05. In other words, the data as a whole is not normally distributed.

3. Homogenity Test

Tabel 6. Homogenity Test

Based on Mean	.055
Based on Median	.473

Furthermore, the linearity test shows that students' learning styles and critical thinking skills have a linear relationship (significance value (2-tailed) ≥ 0.05) where 0.055 is greater than 0.05. In other words, the data as a whole has a linear relationship.

4. Hypothesis Test

Hypothesis testing was applied to ensure that the preliminary assumptions in this study had a strong statistical basis. This study did not require classical assumptions such as normality, so the nonparametric Kruskal-Wallis test was used. This method was used specifically to determine the difference in mean values between more than one independent sample group.(Haryanto et al., 2024)

Tabel 7. Mean Ranks

Kemampuan_ Berpikir_Kritis	Visual	63	72.65
	Auditori	11	37.14
	Kinestetik	38	53.92

Visual-Auditori	4	74.38
Visual-Kinestetik	4	37.38
Auditori-Kinestetik	3	48.17
Total	123	

Based on the Ranks table, it shows the number of subjects (N) and the mean rank of critical thinking skills for each learning style. Visual learning style had 63 students with a mean rank of 72.65; auditory learning style had 11 students with a mean rank of 37.14; kinesthetic learning style had 38 students with a mean rank of 53.92; visual-auditory learning style had 4 students with a mean rank of 74.38; visual-kinesthetic learning style had 4 students with a mean rank of 37.38; and auditory-kinesthetic learning style had 3 students with a mean rank of 48.17. The higher the mean rank, the higher the critical thinking ability of that learning style group compared to groups with lower mean ranks. The group with the highest critical thinking ability was found in the visual-auditory learning style group with a mean rank of 74.38 and the visual learning style group with a mean rank of 72.65, while the group with the lowest critical thinking ability was found in the auditory learning style group with a mean rank of 37.14.

Tabel 8. Kruskal-Wallis test

Kruskal-Wallis H	17.586
df	5
Asymp. Sig.	.004

The output above shows a Kruskal-Wallis H value of 17.586 with df = 5 because there are six learning style categories, so the degrees of freedom are the number of categories minus one. The asymptotic significance value (Asymp. Sig.) is recorded as 0.004.

The results are in line with research conducted by Amanda Namira et al. This study shows that learning styles do indeed affect mathematical critical thinking skills through a one-way ANOVA test. The data shows that the kinesthetic group had the best critical thinking performance compared to the other groups. Through further testing, a significant influence was identified, particularly between students with visual and kinesthetic learning styles.(Namira et al., 2025) Previous studies that applied a combination of qualitative and quantitative descriptive analysis showed a positive trend in student learning outcomes across all modality types. Based on

observations from cycle I to cycle II, there was a significant increase in achievement, with the following details: the visual group increased by 15%, the auditory group by 11.60%, and the kinesthetic group experienced the highest increase of 20%.(Djara & Sae, 2023)

In addition, research by Dimas Qondias also explains that there are differences in learning styles among fifth-grade students in elementary schools in the Golewa subdistrict, with 23% of students having a visual learning style, 30% auditory, and 47% kinesthetic. These results serve as a basic study for teachers to accommodate their students' learning styles.(Qondias & Pendidikan, 2025)

Participatory learning models such as discussions and project-based learning can improve critical thinking skills. However, the integration of technology in these methods still faces operational challenges, ranging from limited tools to differences in students' readiness to adapt to the material. This shows that active learning strategies require more mature infrastructure and classroom management support in order to achieve maximum results.(Humam et al., 2025)

According to Grinder's theory, approximately 73% of students demonstrate high learning effectiveness when material is delivered through visual, auditory, and kinesthetic approaches, while the remaining 8 students learn depending on the learning model they prefer.(Mel Silberman, 1996) Identifying students' learning styles not only makes it easier for teachers to design learning techniques that are more likely to be effective, but it can also encourage students to learn more freely and effectively, thereby supporting the development of their critical thinking skills.(Wilujeng & Sudihartinih, 2021)

D. Conclusion

Based on the Kruskal Wallis test output, the significance level is 0.05, the Asymp. Sig. value is 0.004 < 0.05, so the Kruskal-Wallis test results show that students with different learning styles have significant differences in critical thinking skills. The hypothesis is not rejected, while the alternative hypothesis acknowledges that there are differences in critical thinking skills.

It shows that the more suitable the students' learning styles are, especially visual and certain

combinations, the higher their critical thinking skills are, so it can be said that there is an influence of learning styles on the critical thinking skills of fourth-grade students in mathematics.

The practical implication of these findings is the importance of strengthening students' awareness of their individual learning styles. Students can improve their critical thinking skills by understanding good learning styles and creating more effective learning methods. Students' learning abilities are greatly influenced by the teacher's learning approach, one of which is critical thinking skills. Teachers who teach using critical questions or HOTS can accustom students to critical thinking.

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