



Analysis of Students' Cognitive Abilities Based on Gender and Learning Style

Bayyinah Rismawati¹, Hadi Kusmanto^{2*}, Hendri Handoko³

1,2,3 Mathematics Education Departement, UIN Siber Syekh Nurjati Cirebon

*Corresponding author: Hadi Kusmanto, hadiupi79@gmail.com

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abstract

This study aims to determine the differences in students' cognitive abilities based on gender and the influence of learning styles on cognitive abilities. Using a quantitative method with a One Shot Case Study design, the study involved 40 students of grade VIII MTsN 2 Cirebon. Data were collected through questionnaires and tests, then analyzed descriptively, sample independent t-tests, and simple linear regressions. The results showed that there was a difference in the average cognitive ability between male and female students. The average score of male cognitive ability is 85% and is in the high category. The average cognitive ability of students with visual, auditory, and kinesthetic learning styles is in the moderate category of around 65-66%. In addition, auditory learning styles have the highest influence on students' cognitive abilities, followed by visual and then kinesthetic learning styles.

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Cognitive Abilities, Learning Style, Gender



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INTRODUCTION

Mathematics as a means of education not only aims to improve students' intelligence, but also plays a role in shaping their personalities and developing certain skills. Mathematics has an important role in various fields of science and contributes to the development of human thinking (Maass et al., 2019). The development of students' abilities is greatly influenced by how well they understand the material and concepts in mathematics (Sinaga, Sitorus & Situmeang, 2023). These abilities are indirectly formed from the anticipation process that occurs in students' minds. This anticipation is considered important for improving students' mathematical skills. Each student has different abilities in learning and understanding mathematics, which is also caused by differences in their respective abilities to develop. According to Rosa (2015), student development covers three main aspects, namely cognitive, affective, and psychomotor.

In learning, educators deliberately strive to convey knowledge effectively and efficiently in order to improve students' cognitive abilities. Cognitive abilities are sequential thinking abilities, including the stages of knowledge, understanding, application, analysis, synthesis, and evaluation. According to Zhai (2024), cognitive abilities are skills that can improve students' thinking abilities. Various theories about cognitive abilities continue to evolve over time. One theory that discusses this was proposed by Benjamin S. Bloom. Improving the quality of education can be achieved by applying all levels of the cognitive domain in every learning process. Anderson and Krathwohl explain that there are six cognitive domains in Bloom's taxonomy, namely remembering, understanding, applying, analyzing, evaluating, and creating.

Each student has a different level of cognitive ability. These differences can be caused by various factors, one of which is each student's learning style. Learning style is the method used by a person to absorb and understand information, which also serves as an indicator in acting and interacting with the learning environment (Riyanto et al., 2023; Ningrat et al., 2018). Some individuals may find it easier to learn by taking detailed notes, listening to explanations, or practicing directly.

In addition to differences in learning styles, gender can also influence student profiles in solving mathematical problems. Gender is defined as a biological and physiological concept that naturally distinguishes between males and females and has been inherent since birth (Amaliyah & Witiastuti 2015). In the learning process at school, one important component is the presence of male and female students. Each individual has a unique pattern of solving mathematical problems with different characteristics and ways of thinking, especially when viewed from the perspective of gender differences. Sari et al. (2020) explain that gender differences are often considered a factor that influences a person's physical and cognitive development. Mapping cognitive development according to Piaget based on gender differences involves the process of grouping, describing, and characterizing students' cognitive development stages according to Piaget's theory, taking gender differences into account.

Learning style indicators were developed based on the characteristics described by (Amin & Suardiman 2016). The auditory learning style has the following characteristics: 1) easily distracted by noise, 2) quicker to understand through listening and remembering, 3) likes discussions, question and answer sessions, and explaining problems in detail. The visual

learning style is characterized by: 1) being meticulous and paying attention to details, 2) having difficulty with verbal instructions, 3) finding it easier to remember what is seen, and 4) tending to have difficulty concentrating. Meanwhile, the kinesthetic learning style is characterized by: 1) moving around a lot, 2) often using body language, 3) finding it easier to learn through practice or simulation, and 4) tending to move closer when talking to other people.

The material to be studied includes simplifying algebraic expressions, addition and subtraction of algebraic expressions (PLDV), linear functions, properties of geometric shapes, triangles, and quadrilaterals. Each of these materials requires different cognitive abilities, ranging from memorizing formulas, understanding concepts, to applying and analyzing problems. Students' cognitive abilities are influenced by several factors, namely gender and learning style. Gender is thought to play a role because of differences in the way male and female students think and understand information. Meanwhile, visual, auditory, and kinesthetic learning styles also influence how students receive and process learning materials.

Therefore, the purpose of this study is to analyze the relationship between gender and learning style on students' cognitive abilities so that the learning process can be tailored to the characteristics of each student. Learning styles tailored to individual characteristics, whether visual, auditory, or kinesthetic, can improve students' overall cognitive abilities, despite gender differences.

METHODS

Population and Sample

The population in this study was all 370 eighth-grade students at MTsN 2 Cirebon in the 2024/2025 academic year. The research sample consisted of 23 students from each of the eighth-grade classes, A and B. The sample was determined using the simple random sampling technique, so that each student had an equal chance of being selected as a research responden.

Research Design

This study used a quantitative method with a quasi-experimental approach. The research design used was a one-shot case study, which only involved one group without a control group (Priyanda et al., 2022).

Data Collection and Analysis

Data was collected using two types of instruments, namely questionnaires and test questions. Questionnaires were used to measure students' visual, auditory, and kinesthetic learning styles. The tests were used to measure the cognitive abilities of male and female students. Before use, both instruments underwent expert validation and trials in other classes to ensure their reliability and accuracy. Specifically for the test instruments, validity, reliability, difficulty level, and discriminating power tests were conducted.

Data analysis was conducted in two stages, namely descriptive statistical analysis, which aimed to provide an initial overview of the questionnaire and test results. Inferential

statistical analysis included t-tests to examine differences in cognitive abilities based on gender, and simple linear regression to determine the relationship between learning styles and students' cognitive abilities.

Table 1
Categeory Score

Interval (%)	Category
95 – 100	Very High
75 – 94	High
60 – 74	Moderate
55 – 59	Low
0 – 54	Very Low

RESULT AND DISCUSSION

Result

Based on the results of descriptive statistical analysis, it was found that the average cognitive ability of male students was 85.45 or around 85%, which is classified as high. Meanwhile, the average cognitive ability of female students was 74.35 or around 74%, which is classified as moderate.

Table 2
Percentage of Cognitive Ability Based on Gender

No.	Gender	N	Avg	%	Categories
1	Female	20	74,35	74%	Medium
2	Male	20	85,45	85%	High

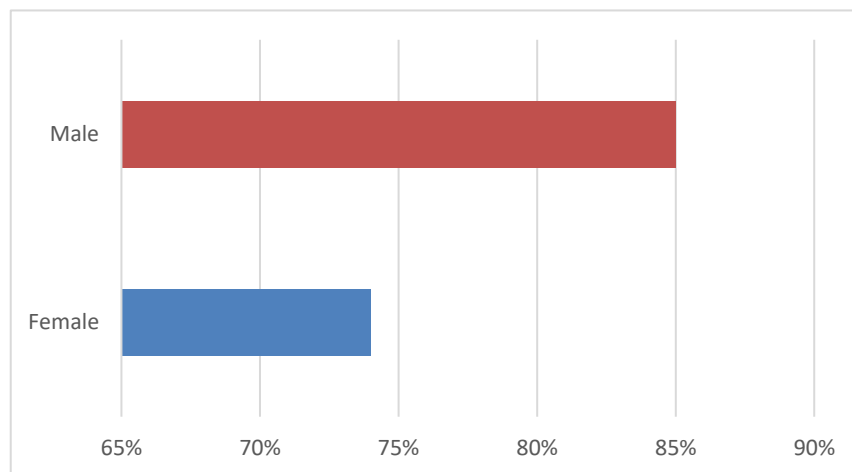


Figure 1
Cognitive abilities based on gender

Table 3
Percentage of Cognitive Ability Based on Learning Style

No.	Learning Style	Average	Percentage	Category
1	Visual	26,275	66%	Currently
2	Auditory	26,45	66%	Currently
3	Kinesthetic	26,15	65%	Currently

From the results of the study, it was found that students with a visual learning style had an average score of 26.275 or 66%, which is classified as moderate. Students with an auditory learning style had an average score of 26.45 or 66%, which is also classified as moderate. Students with a kinesthetic learning style had an average score of 26.15 or 65%, which is also classified as moderate.

The results of the independent sample t-test showed that there was a significant difference between the average cognitive abilities of male and female students. This means that the ability to think, understand concepts, and solve problems between the two groups of students was not the same. In mathematics learning, this is an important finding because mathematics is highly dependent on cognitive abilities, especially in logical reasoning, analysis, and student understanding. These differences in cognitive abilities can affect how students understand mathematics material, as in a previous study conducted by Rosa (2015), which showed that in terms of cognitive abilities, female students have better thinking and comprehension skills than male students.

Table 4
Independent Sample T-Test Results

Statistics	df	Sig.
Equal Variances assumed	38	0,001
Equal variances not assumed	37,519	0,001

Based on the results of a simple linear regression test, it is known that learning styles have an influence on students' cognitive abilities. The auditory learning style has the greatest influence, at 37.3%. This means that students who have an auditory learning style tend to have higher cognitive abilities than students with other learning styles. The visual learning style has an influence of 24.5%, while the kinesthetic learning style has the smallest influence, at 11.4%. These results show that although all three learning styles fall into the moderate category in terms of average scores, the auditory learning style plays a greater role in supporting the achievement of students' cognitive abilities. Therefore, teachers are advised to pay more attention to students' learning styles, especially in terms of how material is delivered to suit students' learning needs.

Table 5
Simple Linear Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	33,567	13,272		2,529	0,016
Visual learning	1,763	0,502	0,495	3,515	0,001

The regression constant value of 33.567 indicates that the base value of cognitive ability is 33.567. Meanwhile, the regression coefficient X of 1.763 indicates that every 1% increase in the influence of visual learning style will increase the cognitive ability score by 1.763. Because the regression coefficient is positive, it can be concluded that variable X has a positive effect on variable Y.

Table 6
Auditory Learning Style Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Concstant)	21,624	12,338		1,753	0,088
Auditory learning	2,203	0,463	0,611	4,755	0,000

The constant (21.628) represents baseline cognitive ability. The coefficient for X (2.203) means a 1% increase in auditory learning raises cognitive ability by 2.203, indicating a positive effect of X on Y.

Tabel 7
Kinesthetic Learning Style Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Konstan)	46,096	15,350		3,003	0,005
Gaya Kinestetik	1,293	0,583	0,338	2,216	0,033

The regression constant value of 46.096 indicates that the base value of cognitive ability is 46.096. Meanwhile, the regression coefficient of 1.293 indicates that every 1% increase in kinesthetic learning style will increase the cognitive ability score by 1.293. Because this regression coefficient is positive, it can be concluded that variable X has a positive effect on variable Y.

Discussion

The results of the study show that there is a significant difference in cognitive abilities between male and female students, with male students scoring an average of 85.45% (high category), while female students scored only 74.35% (medium category). This finding contradicts Firdaus' (2018) research, which states that female students actually have better thinking and comprehension skills than male students. This difference can be examined from the perspective of Jean Piaget's cognitive development theory, which states that children's intellectual development does not depend on gender, but rather on the cognitive stages (sensory-motor, preoperational, concrete operational, and formal) that each individual goes through universally (Ramesh, 2022; Peng & Kievit, 2020). Given the significant differences in cognitive abilities between male and female students, teachers and schools are advised to implement learning strategies that are sensitive to gender characteristics.

Gender and education theories, as proposed by Sadker & Zittleman (2009), show that the education system and teachers' treatment in the classroom can affect academic performance based on gender. It is possible that male students in this study received more intensive cognitive stimulation, or were more competitive in mathematics learning, which emphasizes logical and analytical reasoning. Teachers need to create a fair classroom environment and provide equal opportunities for cognitive potential development, especially in subjects that require logical reasoning such as mathematics.

Regarding learning styles, the study found that all learning styles (visual, auditory, kinesthetic) were in the moderate category in terms of average cognitive scores. However, the auditory learning style had the greatest influence on students' cognitive abilities (37.3%), followed by visual (24.5%) and kinesthetic (11.4%). These findings reinforce Fleming's VARK model (Visual, Auditory, Reading/Writing, Kinesthetic) theory, which states that individuals have different learning preferences, and learning effectiveness increases if the teaching strategy matches the student's dominant learning style (Chuang, 2021; Motivation, Arnado & Buot, 2020).

The findings indicate that the auditory learning style has the largest regression coefficient (2.203), meaning a 1% increase in its use is associated with a 2.203 rise in students' cognitive scores. This aligns with cognitivist theory, which highlights the role of internal processes like listening and comprehension in building strong knowledge structures. Students who respond well to verbal input tend to form more effective mental representations, especially in understanding mathematical concepts. As noted by Kartimi (2023), the auditory style has the strongest impact on cognitive ability. Therefore, teachers should emphasize auditory-based approaches such as interactive lectures, discussions, storytelling, and audio media. Although all learning styles positively affect cognitive ability, their diversity should be maintained. Teachers are encouraged to apply varied, multimodal strategies (audio, visual, and kinesthetic) to address different learning needs.

The differences in the contribution of learning styles to cognitive abilities demonstrate the importance of a differentiated learning approach, as expressed in Howard Gardner's Multiple Intelligences theory. This theory states that individuals have multiple intelligences and that a uniform learning approach will actually reduce the maximum potential of each student (Xhomara & Shkempi, 2020). Given the diversity of learning styles and cognitive abilities among students, it is highly recommended that educators apply a differentiated learning approach as outlined in the Multiple Intelligences theory. Teachers can design varied tasks, provide learning options, and assess students using a variety of instruments that are appropriate for their learning styles.

CONCLUSION AND IMPLICATION

The results of the study show that male students have higher cognitive abilities with an average score of 85.45 (high category) compared to female students who have an average of 74.35 (medium category). Even so, female students still show good abilities in following lessons. In addition, the average cognitive ability of students with visual learning styles was 66%, auditory 66%, and kinesthetic 65%, all of which were in the medium category. However, the regression test results showed that auditory learning styles had the greatest influence on cognitive abilities at 37.3%, followed by visual learning styles at 24.5% and kinesthetic at 11.4%. Researchers are advised to add mediating variables such as learning motivation, metacognitive strategies, or mathematics anxiety levels to the analysis model.

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