

## Mathematical Critical Thinking Profile-based Ennis and Gardner's Theory of Multiple Intelligences

Mujib\*<sup>1</sup>, Sukestiyarno<sup>2</sup>, Hardi Suetno<sup>3</sup>, Iwan Junaidi<sup>4</sup>

<sup>1</sup> Doctoral of Mathematics Education, Universitas Negeri Semarang

<sup>2, 3, 4</sup> Mathematics Education Department, Universitas Negeri Semarang

\*Email address: mujib@radenintan.ac.id

### ABSTRACT

Mathematical thinking is absolutely essential for school learning at all levels, including the HOT and LOT. The purpose of this study is to characterize the mathematical critical thinking ability pattern using Ennis and Gardner's theory of multiple intelligences. The research conducted in this study is qualitative. Purposive sampling was used in this study, which was conducted at SMPN 29 Bandar Lampung. Five people were involved in this study. To collect data, the researcher used a mathematical critical thinking essay test, a multiple intelligence questionnaire administered by a psychology expert, and in-depth interviews. Techniques for data analysis include data reduction, data visualization, inference, and verification (conclusion drawing and verification). The triangulation technique is used to find the truth of the data. The findings indicated that students were able to articulate the steps involved in developing mathematical critical thinking abilities. Additionally, students are more critical when it comes to problem-solving and approach the problem appropriately. Students provide direct responses rather than generalizations. Mathematics-related critical thinking patterns are frequently inductive.

**Keywords:** Ennis and Gardner theory, mathematical critical thinking, multiple intelligence

### ABSTRAK

Berpikir matematis mutlak diperlukan untuk pembelajaran sekolah di semua tingkatan, termasuk level HOT dan LOT. Tujuan penelitian ini adalah untuk mendeskripsikan pola kemampuan berpikir kritis matematis menggunakan teori multiple intelligences Ennis dan Gardner. Penelitian yang dilakukan ini adalah kualitatif dengan teknik purposive sampling di SMPN 29 Bandar Lampung. Lima orang terlibat dalam penelitian ini. Untuk mengumpulkan data, peneliti menggunakan tes esai berpikir kritis matematis, angket multiple intelligences yang diberikan oleh ahli psychology, dan wawancara mendalam. Teknik analisis data meliputi reduksi data, visualisasi data, inferensi dan verifikasi (pengambilan kesimpulan dan verifikasi). Triangulasi teknik digunakan untuk melihat kebenaran data penelitian ini. Temuan menunjukkan bahwa siswa mampu mengartikulasikan langkah-langkah yang terlibat dalam mengembangkan kemampuan berpikir kritis matematis. Selain itu, siswa lebih kritis dalam memecahkan masalah dan menjawab masalah dengan tepat. Siswa memberikan tanggapan langsung daripada generalisasi. Pola berpikir kritis yang berhubungan dengan matematika seringkali bersifat induktif.

**Kata kunci:** berpikir kritis matematis, multiple intelligence, teori Ennis dan Gardner

Received : March 9, 2022

/Revised : March 22, 2022

/Accepted : May 17, 2022

/Published : May 18, 2022

### Introduction

The mathematical paradigm has an effect on the degree to which student change is emphasized during the learning process (Abrahamson & Trninic, 2015). This transition has the potential to alter the global paradigm of mathematics education. The emphasis has shifted away from skill acquisition and toward the development of more adaptive abilities (Kilpatrick et al., 2001; Verschaffel et al., 2007). Routine abilities are more mechanistic in their approach to school-based math tasks that lack context (Mutjah, 2011). On the other hand, adaptive skills emphasize students' ability to think mathematically in an efficient, effective, creative, innovative, adaptive, and meaningful manner (Baroody, 2003; Muhali, 2019; Suherman & Vidákovich, 2022; Yasin et al., 2020).

Mathematical thinking can be classified into two categories based on the depth or complexity of mathematical activity: high order mathematical thinking or high level mathematical thinking and low order mathematical thinking or low level mathematical thinking (Cramer & Post,

2002). According to several of the definitions above, mathematical critical thinking encompasses a broader range of concepts than mathematical reasoning and can be referred to as mathematical thinking (Barnhart & van Es, 2015; Matondang et al., 2020; Mujib, 2019). Critical thinking is a type of thinking activity that is incorporated into the educational process (Hamidah & Suherman, 2016; Mujib & Mardiyah, 2017; Sulistiani & Masrukan, 2017). Critical thinking is concerned with the truthfulness of answers, facts, or existing information, rather than with the discovery of answers. This undoubtedly motivates students to seek out the most advantageous alternative or solution. Students who require advanced thinking abilities without a doubt require critical thinking abilities (Suherman et al., 2020).

Mathematical critical thinking skills emphasize the importance of students reasoning (Fatimah, 2021), developing diverse strategies from a variety of sources, comparing their findings to prior theories, developing concepts, and drawing conclusions. Students must develop critical thinking skills as part of their mathematics education in order to make sound judgments when solving mathematical problems (Prihatami, 2020). During the transition period, students begin to develop hypothetical, proportional, evaluative, analytical, synthetic, critical, and logical thinking abilities, as well as the ability to comprehend abstract concepts. As a result of these developments, junior high school students can now be encouraged to reason at a higher level, namely Higher Order Thinking, rather than just at the Lower Order Thinking level. It would be ideal if junior high school learning were tailored to the child's cognitive abilities, specifically Higher Order Thinking, Middle Order Thinking, and Lower Order Thinking. Teachers at SMPN 29 Bandar Lampung have made no significant improvements in their students' mathematical critical thinking abilities. There have been no tests of mathematical critical thinking abilities based on Ennis's and Multiple Intelligences (MI) Gardner's theories of intelligence. The researchers are examining the effect of combining critical thinking skills and Multiple Intelligences intelligence on Ennis and Gardner's theory of mathematical critical thinking skills, taking into account the subject's and research material's characteristics, and determining whether the two theories are complementary.

Students' ability to use MI will undoubtedly result in an increase in their activity abilities, accuracy, memory, and comprehension, which will aid them in solving mathematical problems encountered in daily life. The researchers were interested in the pattern and combination of mathematical thinking abilities of Ennis and Gardner's Multiple Intelligences theory on the cognitive development of students at SMPN 29 Bandar Lampung. As demonstrated by students, MI intelligence prioritizes metacognitive abilities and mathematical critical thinking skills. Each student possesses a distinct blend of multiple intelligences. Students' intelligence enables them to comprehend the steps necessary for the development of mathematical critical thinking skills.

The findings from observations and interviews are corroborated by pre-research findings in light of the aforementioned context and existing problems at SMPN 29 Bandar Lampung. The above results indicate that students possess mathematical critical thinking abilities. Three steps must be taken to strengthen students' critical thinking abilities in mathematics. Because this is a difficult difficulty, students who have mathematical critical thinking skills in the Middle Order Thinking category should be guided together in the first stage through independent assignments, group assignments, and group discussions. Students who possess mathematical critical thinking abilities in the Middle Order Thinking category should be guided collaboratively during the initial stage through the use of independent assignments, group assignments, and joint discussions, particularly in the context of learning process activities. This experience will be

shared by all students. During the second stage, students continue to require assistance with independent assignments, group assignments, discussions, and questions and answers, particularly in the category of Middle Order Thinking. During the third stage, however, students with higher order thinking skills do not require assistance in completing independent assignments, group assignments, or group discussions. Thus, by identifying the stage at which students are having difficulty, the teacher can tailor the learning process to the students' needs (scaffolding). They require assistance in achieving cognitive objectives (Lestari et al., 2019). This is also true of other students. The researchers are interested in establishing patterns for Mathematical Critical Thinking Ability based on Multiple Intelligences and Ennis and Gardner Theory (Gardner, 1991, 1995).

Numerous previous studies, including those conducted by Yunita et al. (2018), the findings indicate that students with a high level of logical mathematical intelligence possess superior critical thinking abilities, as these students are capable of solving problems coherently and logically. On the other hand, the lower the level of logical mathematical intelligence, the lower the ability to solve problems coherently and logically, and thus the lower the ability to think critically. Mathematical logical intelligence is associated with an individual's ability to think mathematically in terms of calculating, comprehending, analyzing, and solving mathematical problems (Nahdi & Jatisunda, 2020). Additionally, N. P. Wulandari et al. (2018) research indicate that while interpersonal intelligence, critical thinking ability, and self-efficacy have no effect on mathematics learning outcomes, they do have an effect on students' attitudes toward mathematics between accredited A and B. Students who earn an A grade have a very high level of interpersonal intelligence, a high level of self-efficacy, a medium level of critical thinking skills, a medium level of mathematics learning outcomes, and a high level of attitudes toward mathematics. Then, students in B-accredited schools have a very high level of interpersonal intelligence, a very high level of self-efficacy, a low level of critical thinking skills, a medium level of mathematics learning outcomes, and a medium level of attitudes toward mathematics. Furthermore, research by Rejeki & Isharyanti (2020) indicated that there is a strong correlation between critical thinking abilities and students' intrapersonal intelligence and changes in student behavior toward becoming students who believe, think, discipline, and are responsible. According to Maitrianti (2021), intrapersonal intelligence is the intelligence of the inner world, intelligence that arises from a comprehensive self-awareness in order to confront, plan for, and solve various problems. Students with a high level of intrapersonal intelligence will be able to comprehend and then analyze a problem in learning and will be able to plan and solve mathematical problems in the process of learning mathematics from a logic standpoint.

This research is unique in that it measures students' ability to think critically mathematically in terms of MI. Thus, the purpose of this study is to find how to patterns of think critically in students' mathematics using MI in conjunction with Ennis and Gardner's theories, as well as their effectiveness.

### **Research Methods**

This study utilized a qualitative approach in order to obtain a comprehensive picture of the problems formulated by focusing on the process and on the search for meaning behind the phenomena observed in the study, given that the information studied is more comprehensive, in-depth, natural, and unaltered. Additionally, to present an in-depth study model based on multiple intelligences about the pattern of mathematical critical thinking abilities.

The population for this study was comprised of all seventh-grade students at SMPN 29 Bandar Lampung for the academic year 2019/2020. The subjects for this study were 32 seventh-grade students who had undergone psychological testing. Purposive sampling was used to collect subjects from up to 5 students. Unfortunately, 1 subjects is issue in this results based on the level 4 (very critical). The test is used to assess students' mathematical critical thinking abilities in terms of Multiple Intelligences in essay type. The questionnaire was developed with the assistance of psychologists to ascertain the Multiple Intelligences proclivity for closure. The indicator of MI questionnaire is come from psychology expert, then we cannot display in this research. The data analysis technique makes use of the Huberman and Miles cycle, as illustrated in the following figure (Miles et al., 2018).

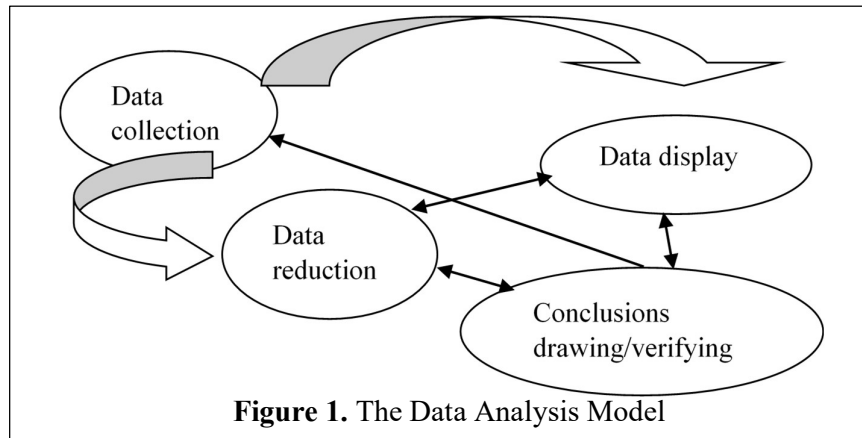
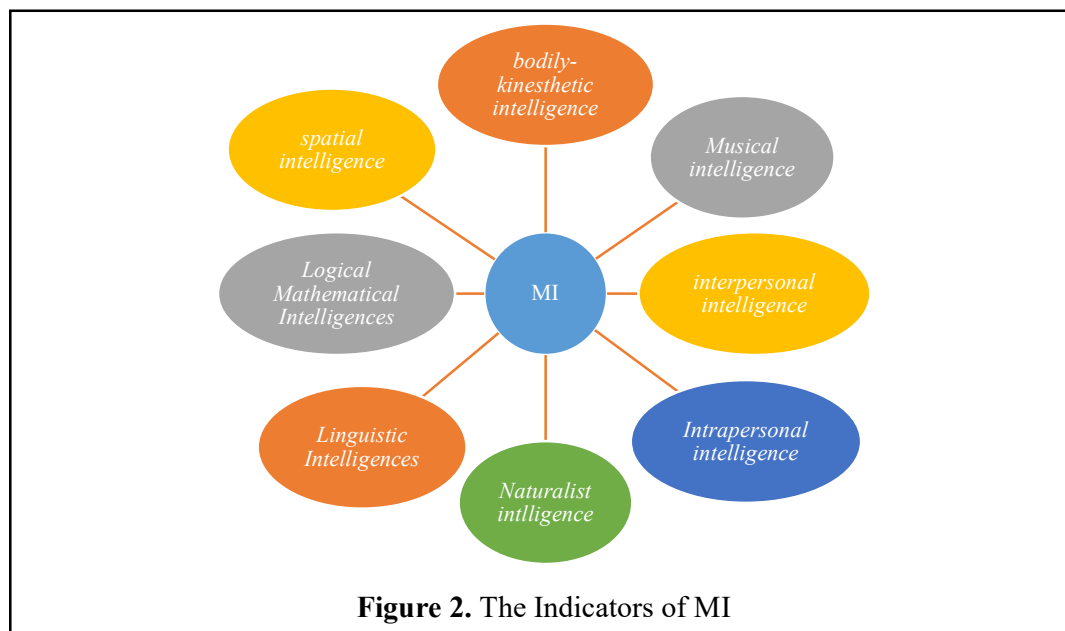


Figure 1 illustrates about the data analysis model. Firstly, the data collection is addressed in the school. Secondly, the data reduction is needed. This aimed to minimize data as research aim. Lastly, data display and conclusions. The following table summarizes the indicators for multiple intelligences (Setiawan & Mardapi, 2020):



Based on Figure 2, we can see that the MI indicators are 8 points. There are bodily- kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, naturalist intelligence, linguistic intelligences, logical mathematical intelligences, and spatial intelligence.

Psychological tests used to determine the type of intelligence possessed by students can also be used to determine the students' MI level based on their final score. The following table 1 summarizes the students' multiple intelligences level:

**Table 1.** The Characteristic of MI

<i>Categories of MI</i>	Frequency	Score
Very High	3	122-140
High	7	111-115
Moderate	11	100-109
Low	8	92-98
Very Low	3	86-89

While the pattern of mathematical critical thinking skills used is level 4 (very critical), students are able to identify problems, explain them, use appropriate evidence, draw conclusions, provide additional explanations, and combine decision-making in order to solve mathematical problems. Level 3 (critical), namely Students are capable of identifying problems, explaining them, utilizing appropriate evidence, drawing conclusions, and providing additional explanations, but are less capable of integrating decision-making into the solution of mathematical problems. Level 2 (critical enough), i.e., Students are able to identify problems, explain them, use appropriate evidence, and draw conclusions, but are unable to provide explanations or integrate decision-making into the solution of mathematical problems. Level 1 (Less Critical) i.e., Students are able to identify problems and explain them, but they did not use the appropriate evidence, were unable to draw conclusions, were unable to provide additional explanations, and were unable to combine decision-making in solving mathematical problems. Level 0 (not critical), i.e. Students are unable to identify problems, provide explanations, use appropriate evidence, draw conclusions, or integrate decision-making in solving mathematical problems (Mujib, 2019). Technical triangulation is the technique used. That is based on the interview and task results.

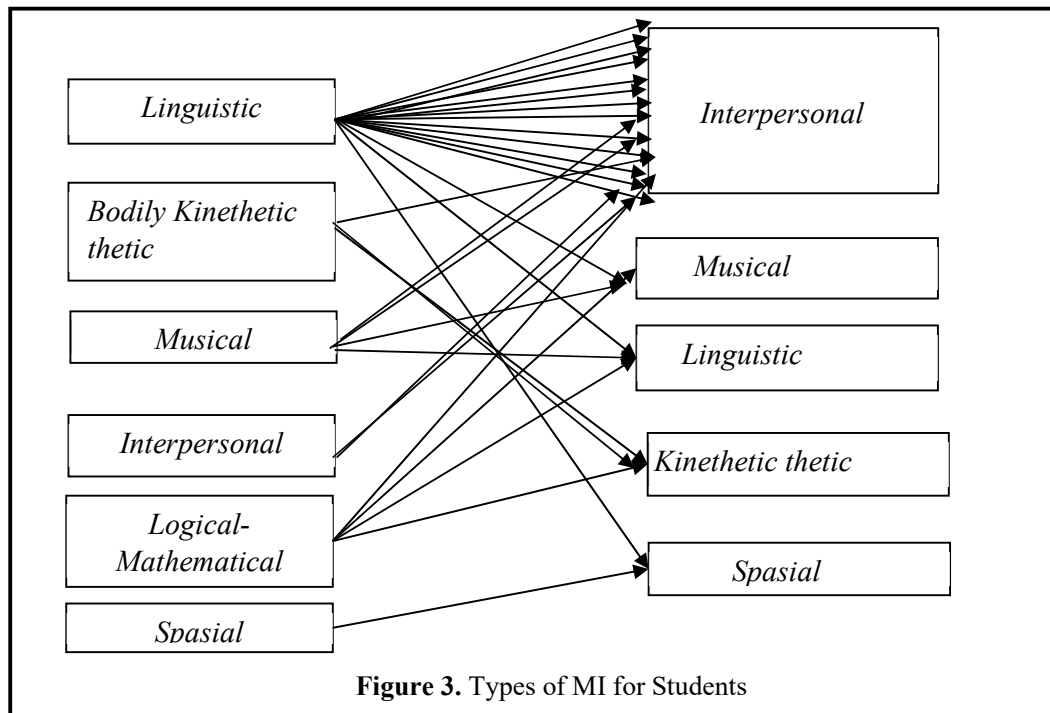
**Result and Discussions**

The following are the findings from a study on the classification of students' intelligence types. Based on Figure 3, it can be seen that the most popular of MI was linguistic, Bodily Kinesthetic, Interpersonal, Musical, Interpersonal, Logical-Mathematical, spatial. Additionally, this intelligence is related to interpersonal, musical, linguistic, and thetic kinesthetic intelligence.

*Analyses of the Results of Students' Critical Thinking Tests*

At the elementary level of clarification, the initial students are “ASDR” that have level 4 (very critical). The ASDR students focus on research questions in order to ascertain the existence of existing questions or problems. Additionally, students can brainstorm potential responses. After that, students can draw conclusions from the presented problems. As can be seen, the questions concern one-variable algebraic forms and inequalities. Students can consider the answers to the prerequisite material they are studying, namely algebra and inequalities, as a starting point for

the decide stage. Then, students observe the questions and the procedures used to plan the obtained results. The results of students' task is in this figure 4.



Based on the Figure 4, students' respond in accordance with the questions. Then add the two terms with two variables together. It can be noticed that students group the similar variables and constants together. When grouping, however, pupils do not put down the symbol of a number, thus the multiplication form is visible. According to the image above, pupils respond in accordance with the questions. Then add the two terms with two variables together. It can be noticed that students group the similar variables and constants together. When grouping, however, pupils do not put down the symbol of a number, thus the multiplication form is visible.

**Figure 4.** The Task Results by Students' with inisial "ASDR"

Students can consider the achievement of results and determine whether their responses are consistent with the questions during the Inference stage. As evidenced by interviews with ASD students, these students frequently double-check their responses. Advanced clarification stage, during which ASD students with extremely high multiple intelligences can infer the outcomes of their responses, particularly with terms, and treat the final outcomes as assumptions. The

final stage, Supposition and integration, encourages students with autism spectrum disorders to consider the reasons or assumptions underlying dubious responses. When making decisions, ASD takes into account thinking ability and character. The results of the justification demonstrate that students are capable of identifying problems, explaining them, utilizing appropriate evidence, drawing conclusions, providing additional explanations, and incorporating decision making into the mathematical problem-solving process. Thus, students with a high level of multiple intelligence, as well as those with a level 4 category pattern, are extremely critical when solving problems.

*Analyses of the Interview of Students' Critical Thinking Tests*

According to the interview results, it was determined that the subject correctly answered the question. Then multiply the two terms together by the two variables. As can be seen, students classify variables and constants according to their similarity. Students frequently work in a logical manner from beginning to end and then double-check their answers. As a result, the output is accurate. The subject "ASD" justifies the problem-solving stage. By posing a related question, the subject of "ASD" confirmed the issue. The subject "ASDR" provides justification for the data collected via questions and formulas. Additionally, the subject "ASD" justifies the method by which the subject will respond to the question. The term "ASDR" refers to the procedures followed during the implementation stage. Additionally, the subject of "ASD" justifies the solution he devised. The subject of "ASD" rationalizes his actions in resolving the first problem by relying on logic rather than on trial and error or on information obtained solely through perception. This can be determined by examining the researcher's interactions with students regarding problem-solving steps application.

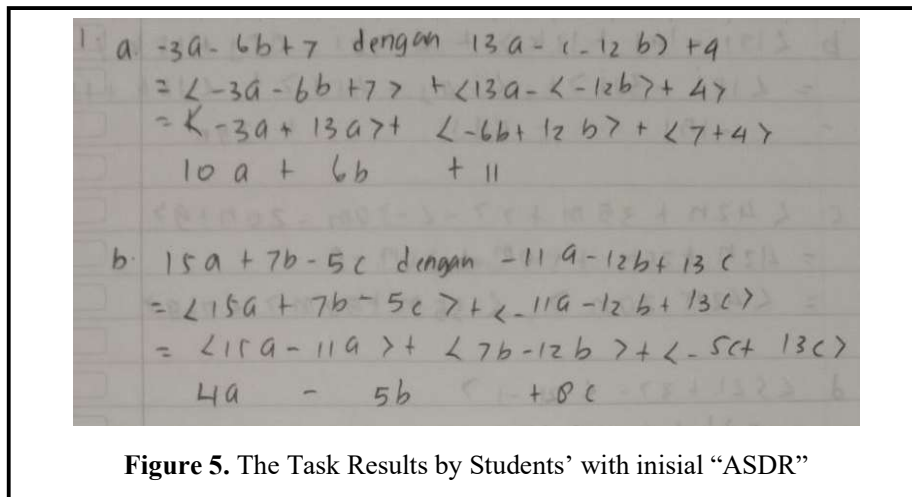


Figure 5. The Task Results by Students' with inisial "ASDR"

ASDR subjects implement MI in problem solving. The following is the data on the results of written tests and interviews with ASDR subjects in the MI stage. The PE is researcher and ASDR is students' inisial.

- 1PE1 : OK... ASDR has read the questions and worked on the questions given...?  
What did you get from the number question? one you have worked on?
- 1ASDR1 : The problem given is addition
- 1PE2 : Is there a practical form or formula that not will use?
- 1ASDR2 : No... just go ahead, sir, by adding up
- 1PE3 : Okay...Next...based on this question. What is not get more information?

- 1ASDR3 : Ehm... looks like there's no other information, sir?  
(ASDR believes that there is no additional information in the problem)
- 1PE4 : What about the steps that ASDR has used?
- 1ASDR4 : Here are the steps sir (not shows answer steps)
- 1PE5 : Are your steps correct for all questions number 1?
- 1ASDR5 : Yes sir... I'm not sure yet... (Nothing is a little unsure of the answer)
- 1PE6 : Try checking the results again, okay? (Not check the answer result)
- 1ASDR6 : I think I'm sure, sir, with this answer... (ASDR is confident in the results of the work)

Based on Figure 5 and data from interviews with ASDR subjects, that ASDR uses the appropriate steps, it can be seen from the results of the work for numbers 1a and 1b. GA works on the problem in a direct way, but ASDR works by combining variables a, b, and c, as well as constants. The final result that ASDR did was correct.

### *Analyses of the Technical Triangulation*

The technical triangulation is shown in table 2.

**Table 2.** Technical Triangulation based Subject Results "ASDR"

<b>Critical Thinking in Mathematics</b>	<b>Test Results</b>	<b>Results of Observaton</b>	<b>Results of Interview</b>
1. <i>Elementary clarification</i>	Subject "ASDR" doing step of <i>Elementary clarification</i> ,	a. Speed reading research questions	The subject answered according to the question. Subject groups the same variables as well as constants, as can be seen. Subjects usually work in a logical order from start to finish, then double-check their answers. As a result, the resulting answer is correct. The subject "ASDR" justifies the troubleshooting stage. The subject of "ASDR" justifies the problem based on the questions expressed by the subject. The information obtained from the questions and formulas is justified by the subject "ASDR." The subject of "ASDR" also justifies the steps that the subject will take to answer the question.
2. <i>The basis for the decision</i>	<i>clarification, The basis for the decision,</i>	b. Record biodata on the answer sheet	
3. <i>Inference</i>	<i>Inference, Advanced clarification,</i>	c. Read the questions from question one to question five in its entirety.	
4. <i>Advanced clarification</i>	<i>Supposition and integration</i>	d. Asking the researcher about unclear questions.	
5. <i>Supposition and integration</i>	1. In the <i>Elementary clarification</i> step, "ASDR" focus on identifying of questions that is questions review with did not variable showing.	e. Reread the first question several times.	
	2. At the basis for the decision stage, the subject "ASDR" guesses the steps that will be used to solve the problem.	f. Students write down what they know and what questions they have about	
	3. In the Inference stage, the subject "ASDR"	g. Students start working on the questions given on the answer sheet	
		h. Before answering I wrote down the question. Students rewrite the information learned from the previous question.	



Critical Thinking in Mathematics	Test Results	Results of Observaton	Results of Interview
	explains and considers the answers that have been generated. 4. At the Advanced clarification stage, the subject of "ASDR" identifies the steps from the results that have been carried out. 5. At the stage of supposition and integration, the subject of "ASDR" makes assumptions about the answer by re-checking, the solution is in accordance with the request for the question that has been completed and correctly done.	i. For the next numbered question, and another unclear question asked again. j. Students focus on the next question. k. On the scribble sheet, students write down the answers to the questions they know. l. Determine the variable that will be known as the inequality variable m. Looking for a comprehensive solution n. Fill in the blanks on the answer sheet with the results. o. Re-examine the results of his work on numbers one to five.	The subject of "ASDR" justifies the steps taken during the implementation phase. The subject of "ASDR" also supports his accepted solution. The justification for the subject of "ASDR" in solving the first problem is rational because it uses logic rather than trial and error or information based on mere perception. This can be determined by identifying the researcher's conversation with students about the application of the steps used in problem solving.
Conclusions	<ol style="list-style-type: none"> <li>Subjects can identify problems, explain them, use correct evidence, draw conclusions, provide additional explanations, and integrate decision making in solving mathematical problems.</li> <li>The subject directs the answer, starting with the specific and continuing to the general.</li> <li>The subject has a strong mathematical critical thinking pattern.</li> <li>Mathematical critical thinking patterns are usually inductive.</li> </ol>		

According to technical triangulation, subjects can identify problems, explain them, use appropriate evidence, draw conclusions, provide additional explanations, and integrate decision making when solving mathematical problems; (2) subjects provide direct answers, beginning with specifics and progressing to generals; (3) the subject possesses a strong mathematical critical thinking pattern; and (4) the mathematical critical thinking pattern is typically inductive.

*The Effectiveness of Mathematical Critical Thinking Ability Patterns based on MI Combining Ennis and Gardner's Theories in Teaching and Learning*

Each child has a unique learning style that is not always consistent. Numerous activities can be used to facilitate learning. A subject can be interpreted in a variety of ways. These techniques demonstrate the various functions of intelligence. Children with linguistic intelligence can easily learn about nature and its inherent characteristics through stories or lectures from teachers. He may struggle with number problems ( $2 + 3 = ?$ ), or even with algebraic addition and subtraction, but he understands when problems are presented in narrative form.

2. a.  $2a - 3 - 6 + 10 + 4n + 7n - 8 = 1 + 11n - 8m.$

b.  $15a + 7b - 5c - 11a - 12b + 13d$   
 $= 15a - 11a + 7b - 12b - 5c + 13d = 4a - 5b - 5c + 13d$

Figure 6. The Results Task by “ASD” Students in Second Task

Children with logical mathematical intelligence may struggle with a series of letters, but readily engage with and enjoy counting numbers. Children with this intelligence acquire knowledge through mathematics and reason logically. They acquire knowledge by categorizing, classifying, and noting similarities and differences between objects in their environment. As a result, children learn in a variety of ways, and a teaching material should allow children to engage in a variety of activities that are both appropriate and in demand. Interpersonally intelligent children will quickly pick up new skills through verbal interaction with their teachers or peers.

However, during the learning process, the teacher always pays attention to this level of intelligence, as each student has a unique intelligence. This will be extremely effective if the teacher instructs the students in this manner. According to research Abdi et al. (2013), students who were educated using multiple intelligences and project-based intelligence were more successful than students who were educated using traditional teaching methods. This means that intelligence plays a significant role in classroom learning as well.

### Conclusion

The analysis's findings indicate that students are capable of identifying the steps involved in developing mathematical critical thinking skills. Therefore, it is more critical in solving problems and appears to be correct while working on the problem. Students begin by directing their responses toward specific items and then toward the general. Mathematical critical thinking patterns are frequently inductive. Each child has a unique learning style that is not always consistent. A subject can be interpreted in a variety of ways. The pattern of mathematical critical thinking abilities is extremely effective in assisting students with multiple intelligences.

This study is limited to examining the pattern of characteristics associated with students' multiple intelligences in relation to mathematical critical thinking. To serve as a reference for classifying students during the mathematics learning process.

### Acknowledgement

The research data was provided by SMPN 29 Bandar Lampung, and we express our sincere gratitude to them. Then, to Universitas Negeri Semarang for support our Doctoral Program.

### Bibliography

- Abdi, A., Laei, S., & Ahmadyan, H. (2013). The Effect of Teaching Strategy Based on Multiple Intelligences on Students' Academic Achievement in Science Course. *Universal Journal of Educational Research*, 1(4), 281–284.
- Abrahamson, D., & Trninic, D. (2015). Bringing forth mathematical concepts: Signifying sensorimotor enactment in fields of promoted action. *ZDM*, 47(2), 295–306.

- Barnhart, T., & van Es, E. (2015). Studying teacher noticing: Examining the relationship among pre-service science teachers' ability to attend, analyze and respond to student thinking. *Teaching and Teacher Education*, 45, 83–93. <https://doi.org/10.1016/j.tate.2014.09.005>
- Baroody, A. J. (2003). The development of adaptive expertise and flexibility: The integration of conceptual and procedural knowledge. *The Development of Arithmetic Concepts and Skills: Constructive Adaptive Expertise*, 1–33.
- Cramer, K. A., & Post, T. R. (2002). Initial fraction learning by fourth-and fifth-grade students: A comparison of the effects of using commercial curricula with the effects of using the rational number project curriculum. *Journal for Research in Mathematics Education*, 33(2), 111–144. <https://doi.org/10.2307/749646>
- Fatimah, A. T. (2021). Mathematical Reasoning of Vocational High School Students on Mathematical Tasks in the Law of Demand Context. *AlphaMath: Journal of Mathematics Education*, 7(2), 101–113. <https://doi.org/10.30595/alphamath.v7i2.10585>
- Gardner, H. (1991). Intelligence in seven steps. *Creating the Future. Perspective on Educational Change*, 395–406.
- Gardner, H. (1995). 'Multiple Intelligences' as a Catalyst. *The English Journal*, 84(8), 16–18.
- Hamidah, K., & Suherman, S. (2016). Proses Berpikir Matematis Siswa dalam Menyelesaikan Masalah Matematika di tinjau dari Tipe Kepribadian Keirsey. *Al-Jabar: Jurnal Pendidikan Matematika*, 7(2), 231–248.
- Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding it Up: Helping Children Learn Mathematics. Washington, DC: Mathematics Learning Study Committee. *Center for Education, Division of Behavioral and Social Sciences and Education, National Research Council, National Academy Press*.
- Lestari, W., Selvia, F., & Layliyyah, R. (2019). Pendekatan Open-ended Terhadap Kemampuan Metakognitif Siswa. *At-Ta'lim: Jurnal Pendidikan*, 5(2), 184–197. <https://doi.org/10.36835/attalim.v5i2.263>
- Maitrianti, C. (2021). Hubungan antara kecerdasan intrapersonal dengan kecerdasan emosional. *Jurnal MUDARRISUNA: Media Kajian Pendidikan Agama Islam*, 11(2), 291–305.
- Matondang, K., Hasratuddin, H., & Armanto, D. (2020). Pengembangan Model Pembelajaran RME Berbantuan ICT untuk Meningkatkan Kemampuan Komunikasi dan Berpikir Kritis Matematis Siswa. *Edumaspul: Jurnal Pendidikan*, 4(1), 2218-241.
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2018). *Qualitative data analysis: A methods sourcebook*. Sage publications.
- Muhali, M. (2019). Pembelajaran inovatif abad ke-21. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, 3(2), 25–50.
- Mujib, M. (2019). Penjenjangan Kemampuan Berpikir Kritis Matematis Berdasarkan Teori Bloom Ditinjau Dari Kecerdasan Multiple Intelligences. *Desimal: Jurnal Matematika*, 2(1), 87–103.
- Mujib, M., & Mardiyah, M. (2017). Kemampuan Berpikir Kritis Matematis Berdasarkan Kecerdasan Multiple Intelligences. *Al-Jabar: Jurnal Pendidikan Matematika*, 8(2), 187–196.
- Mutjah, M. (2011). Kolaborasi Pendekatan Pembelajaran Matematika Problem Solving, Pendekatan Pembelajaran Matematika Realistik dan Pendekatan Pembelajaran Matematika Open-Ended. *INSANIA: Jurnal Pemikiran Alternatif Kependidikan*, 16(2), 187–204.
- Nahdi, D. S., & Jatisunda, M. G. (2020). Analisis literasi digital calon guru SD dalam pembelajaran berbasis virtual classroom di masa pandemi covid-19. *Jurnal Cakrawala Pendas*, 6(2).

- Prihatami, E. (2020). POGIL Berpengaruh terhadap Kemampuan Berpikir Kritis Matematis? *AlphaMath: Journal of Mathematics Education*, 5(2), 15–26. <https://doi.org/10.30595/alphamath.v5i2.7342>
- Rejeki, S., & Isharyanti, L. (2020). Hubungan Kemampuan Berpikir Kritis dengan Kecerdasan Intrapersonal Siswa di SDN 2 Jontlak Kabupaten Lombok Tengah. *CIVICUS: Pendidikan-Penelitian-Pengabdian Pendidikan Pancasila Dan Kewarganegaraan*, 8(1), 70–75.
- Setiawan, R., & Mardapi, D. (2020). Multiple Intelligences-Based Creative Curriculum: The Best Practice. *European Journal of Educational Research*, 9(2), 611–627.
- Suherman, S., Prananda, M. R., Proboningrum, D. I., Pratama, E. R., Laksono, P., & Amiruddin, A. (2020). *Improving Higher Order Thinking Skills (HOTS) with Project Based Learning (PjBL) Model Assisted by Geogebra*. <https://doi.org/10.1088/1742-6596/1467/1/012027>
- Suherman, S., & Vidákovich, T. (2022). Assessment of Mathematical Creative Thinking: A Systematic Review. *Thinking Skills and Creativity*, 101019. <https://doi.org/10.1016/j.tsc.2022.101019>
- Sulistiani, E., & Masrukan, M. (2017). Pentingnya berpikir kritis dalam pembelajaran matematika untuk menghadapi tantangan MEA. *PRISMA, Prosiding Seminar Nasional Matematika*, 605–612.
- Verschaffel, L., Torbeyns, J., De Smedt, B., Luwel, K., & Van Dooren, W. (2007). Strategy flexibility in children with low achievement in mathematics. *Educational and Child Psychology*, 24(2), 16–27.
- Wulandari, N. P., Tiro, M. A., & Sanusi, W. (2018). Pengaruh kecerdasan interpersonal, kemampuan berpikir kritis, dan efikasi diri terhadap hasil belajar matematika dan sikap terhadap matematika siswa kelas VIII di sekolah menengah pertama di kota makassar. *Prosiding Seminar Nasional Venue Artikulasi-Riset, Inovasi, Resonansi-Teori, Dan Aplikasi Statistika (VARIANSI)*, 1(1), 56–73.
- Yasin, M., Huda, S., Septiana, R., & Palupi, E. K. (2020). Mathematical critical thinking ability: The effect of scramble learning model assisted by prezi in islamic school. *Journal of Physics: Conference Series*, 1467(1), 012007. <https://doi.org/10.1088/1742-6596/1467/1/012007>
- Yunita, N. W., Hobri, H., Oktavianingtyas, E., Sunardi, S., & Yudianto, E. (2018). Analisis Kemampuan Berpikir Kritis Siswa dalam Menyelesaikan Soal Aritmetika Sosial dalam Pembelajaran Berbasis Lesson Study For Learning Community Ditinjau dari Kecerdasan Logis Matematis. *Kadikma*, 9(3), 1–10.