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Mathematical problem solving proficiency of students with musical and kinesthetic intelligence

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ABSTRACT

The aim of this study was to analyse the ability of students with musical and kinesthetic intelligence to solve mathematical problems. This qualitative research involved one student with musical intelligence and one student with kinesthetic intelligence. The results indicate that students with musical intelligence exhibit a lower ability to solve problems. The students' inability to obtain and comprehend information hinders their ability to express a clear problem-solving plan. Additionally, they often fail to write down complete solutions and instead recalculate only the final step. It is worth noting that students with kinesthetic intelligence tend to excel in problem-solving. The students' ability to solve mathematical problems is evident from their capacity to express the given information and the question in their own words. However, they struggle to articulate the steps required to solve the problem. Instead, they write down the given information and the question in full. After completing the problem, they review their work by checking and recalculating their answers.

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INTRODUCTION

Mathematics is a fundamental discipline that serves as a foundation for the advancement of science and technology. As a consequence, it is included in the formal curriculum of educational institutions, ranging from elementary schools to universities. In the realm of mathematics education, the inclusion of problem-solving exercises holds significant values as it facilitates the advancement and maturation of students' cognitive abilities. Hence, the utilization of an appropriate method is important in the process of solving a mathematical problem (Hafni et al., 2020).

Problem solving is a multifaceted cognitive process that encompasses several procedures and tactics. By engaging in problem-solving activities, students can enhance their thinking abilities and become more proficient in resolving mathematical issues. The acquisition of problem-solving skills is not solely a desired outcome in the study of mathematics, but, rather, it is the primary focus that lies in the development of effective problem-solving strategies (Wang & Chiew, 2010).

The problem-solving proficiency of individuals in the domain of mathematics exhibits significant variability as cognitive capacities differ among individuals. There are numerous elements that contribute to this phenomenon, with one of the underlying causes being the manifestation of a person's dominant intelligence. The subject matter under consideration pertains to the concept of multiple intelligences. According to Gardner's theory, there exist eight distinct types of intelligence, namely: (1) Linguistic intelligence, (2) Logical-mathematical intelligence, (3) Visual-spatial intelligence, (4) Musical intelligence, (5) Bodily-kinesthetic intelligence, (6) Interpersonal intelligence, (7) Intrapersonal intelligence, and (8) Naturalistic intelligence (Syarifah, 2019; Ardiana, 2022).

It is probable that the eight intelligences are present among the students in the class instructed by the teacher. Among the various classifications of multiple intelligences, three specific categories of intelligence are associated with the acquisition and comprehension of mathematical concepts. These are logical-mathematical intelligence, linguistic intelligence, and visual-spatial intelligence. According to A'isyah (2018), there is a significant impact of logical-mathematical intelligence, linguistic intelligence, and visual-spatial intelligence on the mathematical problem-solving skills of students. According to Milsan and Wewe (2018), a notable correlation was found between mathematical logic intelligence and the academic achievement of pupils in the field of mathematics. The study conducted by Hasibuan (2019) investigated the correlation between linguistic intelligence and the academic achievement of students in the field of mathematics. The researcher, Hasibuan, reached the conclusion that there exists a statistically significant positive correlation between students' language intelligence and their learning outcomes. This implies that as linguistic intelligence increases, so does the level of achievement in mathematics. In the study conducted by Damayanti *et al*. (2022), it was shown that there exists a positive correlation between visual-spatial intelligence and students' creativity with their mathematical problem-solving abilities. However, it is important to note that there are additional elements beyond the scope of this study that may also exert an influence on mathematical problem-solving abilities.

The primary objective of this study is to examine the problem-solving abilities of students with musical intelligence and kinesthetic intelligence. Researchers have noted that these two forms of intelligence are not typically associated with mathematical intelligence. However, it is important to investigate the presence of symbols within musical and kinesthetic intelligence that may not directly correspond to mathematical learning. Musical intelligence pertains to an individual's capacity to comprehend, generate, and exhibit innovative responses to music. In the realm of cognitive abilities, kinesthetic intelligence pertains to an individual's capacity to regulate and manipulate bodily motions, hence enabling them to successfully utilize their physicality in real-world contexts. The utilization of musical intelligence in the process of solving mathematical issues can potentially facilitate an individual's comprehension of numerical patterns and mathematical procedures. Individuals with exceptional musical abilities may possess the aptitude to discern patterns within numerical sequences or mathematical algorithms, subsequently employing this cognitive skill to effectively tackle intricate mathematical difficulties. In addition, kinesthetic intelligence enables individuals to employ physical or bodily movements as a means to visualize and effectively address challenges. Individuals with a pronounced kinesthetic intelligence possess the ability to mentally conceptualize mathematical structures and employ tangible models or manipulatives as aids in resolving mathematical quandaries.

According to Sari and Oktariani (2019), individuals possessing kinesthetic intelligence demonstrate the capacity to employ various body parts or the entirety of their body in order to address challenges or generate novel innovations. Individuals tend to acquire knowledge more efficiently when exposed to visual aids such as photographs, models, drawings, diagrams, and three-dimensional representations, among other forms. Individuals with musical intelligence possess the capacity to identify auditory stimuli and effectively engage in the creation of musical elements such as notes, rhythms, and patterns, which can be utilized for the purpose of musical performance or composition. Individuals possessing a high degree of musical intelligence typically exhibit a propensity for effectively absorbing educational content through means such as lectures or engaging with songs and musical compositions. In their study, Setiawan and Nisa (2018) propose that musical intelligence exerts a significant influence on human emotions as well as the acquisition of mathematical skills and other scientific aptitudes.

Polya proposed one of the concepts related to issue solving, highlighting a set of four sequential phases for effectively solving mathematical problems. These steps include: (1) comprehending the problem, (2) formulating a strategy, (3) implementing the chosen strategy, and (4) reflecting on the process and outcomes (retrospection). The Polya technique provides a systematic approach for solving mathematical problems, employing well-structured and well-organized procedures. Therefore, the application of Polya's problem-solving processes can enhance our problem-solving efficiency and effectiveness. Polya's proposed phases in the problem-solving process are characterized by their simplicity, while the actions associated with each phase are notably lucid.

Based on the aforementioned description, the researcher conducted a more in-depth analysis of the mathematical problem-solving proficiencies exhibited by students possessing musical intelligence

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and children possessing kinesthetic intelligence. The problem-solving capacity is contingent upon the problem-solving procedures outlined by Polya.

METHOD

The research methodology employed in this study is descriptive-qualitative. This study was undertaken with the purpose of analyzing students' problem-solving abilities in the context of mathematics problem-solving. The study was carried out at an Islamic private school in Palu, Central Sulawesi, Indonesia. The study was conducted during the school period in the second semester of the academic year 2022/2023.

The participants of the study comprised students enrolled in the tenth grade majoring in mathematics and science classes. The selection of the research participants considered important factors such as the accessibility of the required information and the ability to effectively articulate one's thoughts. Two students were selected for the study, with one student possessing musical intelligence and the other possessing kinesthetic intelligence. The rationale behind selecting two students is to examine the problem-solving approaches exhibited by individuals with distinct types of intelligence, specifically those with musical intelligence and kinesthetic intelligence.

The identification of the research participants in this study involved the selection of two students as research subjects. This selection was accomplished by administering a multiple intelligence test to all students. The administration of the multiple intelligence test consists of two distinct stages, wherein each stage employs a unique instrument. The initial phase used measurement tools devised by Gunawan and Hermiyati (2015), whereas the subsequent phase utilized instruments produced by Winarto and Hermiyati (2015).

The process of subject selection involved administering the stage I and stage II multiple intelligence exams to the students. The initial stage of testing was undertaken in order to categorize the level of intellect exhibited by each student. Students who are eligible to advance to the stage II examination must meet the following criteria: they must achieve a minimum score of 7 in musical intelligence, while scoring at least 2 points higher than their scores in other types of intelligence. Additionally, they must obtain a score of 7 or higher in kinesthetic intelligence, while maintaining a minimum difference of 2 points among their scores in other types of intelligence. Subsequently, a stage II intelligence assessment was conducted to examine the coherence of the data pertaining to the responses provided by students exhibiting musical intelligence and those demonstrating kinesthetic intelligence. In order to qualify as research subjects, individuals must attain a minimum score of 35 in both musical intelligence and kinesthetic intelligence, while ensuring that their scores in other intelligence domains are at least 10 points lower than these aforementioned scores. The rationale behind administering the test in two phases is to identify pupils who exhibit a pronounced aptitude for either musical intelligence or kinesthetic intelligence. The questionnaire pertaining to the multiple intelligences test for Phase I is available for reference in Appendix 1, while the questionnaire corresponding to the multiple intelligences test for Phase II may be found in Appendix 5.

Following the administration of the test, the researcher proceeded to summarize the outcomes of the multiple intelligence assessment that had been conducted, with the aim of examining the individual performance of each student across several intelligence domains. Two students are selected, one with musical intelligence and the other with kinesthetic intelligence.

The primary instrument employed in this study is the researcher themselves. This limitation arises from the inherent nature of qualitative research, wherein researchers are unable to delegate their representation to others. The utilization of researchers as research instruments is a strategic approach aimed at acquiring reliable and accurate data, with the specific objective of addressing research inquiries. The researcher serves as the primary instrument in shaping the research process, since they play a direct role in identifying the study goal, selecting the research site and timeframe, picking the participants, and collecting and interpreting the data. In addition to employing the researcher as the primary instrument, this study also incorporates supplementary instruments. The tools employed in this study encompassed talent tests, namely those assessing multiple intelligences, to identify the participants for the research, as well as problem-solving tests to evaluate the problem-solving capabilities of the students. The problem-solving test entails the presentation of description questions that necessitate validation prior to their utilization.

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The data utilized in this study are qualitative in nature, specifically in the form of descriptive information. The utilized data comprise written exam outcomes and interview findings. These data consisted of students' written work in solving mathematical problems using the Polya stages. Additionally, data were obtained through interviews conducted with students, capturing their dialogues during the process of solving math issues.

The data collection methodology employed in this study involved administering problem-solving exams and conducting in-depth interviews. The objective is to acquire comprehensive data or data from the research participants pertaining to student actions during the phases of problem comprehension, plan formulation, plan execution, and reevaluation of settlement outcomes. The instrument employed for conducting interviews in this study is a voice recorder, which serves the purpose of capturing and storing all interview data in an audio format.

Prior to analysis, it is imperative to subject the acquired data to a credibility assessment. According to Sugiyono (2013), there are three methods for conducting tests to assess the authenticity of data: source triangulation, technical triangulation, and time triangulation. In the present investigation, the employed methodology only entailed the utilization of temporal triangulation, specifically involving the administration of problem-solving assessments and conducting in-depth interviews on separate occasions. When data is gathered consistently, it is considered to be credible.

The present study conducted data analysis by employing the qualitative data analysis approach proposed by Miles, Huberman, and Saldana (2014). The focus of this discussion pertains to activities related to the examination of data. (1) The process of data condensation. Data condensation is the act of choosing, extracting, summarizing, or modifying data in a manner that represents the entirety of a given collection of field notes, written notes, interview transcripts, documents, and other empirical materials. The topic of discussion is data display, specifically focusing on the methods and techniques used to visually represent data. Following the process of data reduction, the subsequent stage involves the presentation of the data. The data provided exhibits a narrative characteristic. By means of data presentation, the data will be systematically grouped and structured in a coherent pattern, facilitating comprehension and enabling the formulation of informed decisions and future planning based on the acquired understanding. (3) Drawing Conclusions. The purpose of drawing conclusions is to derive final judgments based on the process of interpretation and evaluation. Drawing conclusions represents the ultimate revelation of the outcomes derived from a certain course of activity.

RESULTS AND DISCUSSION

In this section, the researcher provides an account of the research data pertaining to individuals exhibiting musical intelligence and kinesthetic intelligence. The presentation is structured in accordance with Polya's problem-solving framework, which encompasses four key steps: problem comprehension, problem-solving strategy development, problem-solving execution, and evaluation of the obtained outcomes.

The procedure for the subject selection in this study, as outlined in section III, involved the administration of various IQ tests in two distinct phases. The initial phase of the various intelligences assessment was conducted on Monday, April 10th, 2023. Following the administration of the initial phase of the intelligence assessment, a review was conducted on the outcomes of the responses provided by the pupils.

According to the findings presented in table 1, it is evident that among the participants who underwent the stage I intelligence exam, a total of 15 students exhibited musical intelligence, whereas 8 students demonstrated kinesthetic intelligence. Moreover, based on the findings of the initial phase of intelligence assessment, a subset of students was chosen to advance to the subsequent phase of multiple intelligence testing. This selection process entailed specific criteria, wherein students who obtained scores in musical intelligence or kinesthetic intelligence were required to achieve a minimum score of 7. Conversely, scores in other intelligence domains were mandated to be at least 2 points lower than the aforementioned threshold. A total of 8 children were chosen to participate in the second stage of the multiple intelligence assessment. Specifically, this group consisted of 5 students who demonstrated musical intelligence and 3 students who exhibited kinesthetic intelligence.

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The second phase of the multiple intelligences assessment was administered on May 5, 2023. Following the administration of the second phase of the intelligence assessment, a retrospective analysis was conducted on the data obtained from the students who participated as research subjects.

Table 1. Results of the Phase I Multiple Intelligences Test

No	Test Sheet Code	Name Initial	Multiple Intelligences Test Scores								Conclusion
			I	II	III	IV	V	VI	VII	VIII	
1	2	NY	2	3	3	8	5	7	7	2	Musical
2	10	SR	4	1	3	8	1	7	5	4	Musical
3	11	MW	2	2	3	5	7	6	6	5	Kinesthetic
4	12	NO	6	4	3	9	5	7	7	4	Musical *)
5	21	FZ	7	7	6	10	4	4	7	3	Musical *)
6	22	AA	7	6	6	8	5	4	6	6	Musical
7	24	AA	4	5	5	6	8	6	5	1	Kinesthetic *)
8	31	NM	4	3	3	7	6	4	1	4	Musical
9	33	AK	5	4	6	8	6	5	5	3	Musical *)
10	35	AC	3	3	4	9	6	5	7	2	Musical *)
11	43	GP	5	5	6	7	8	7	7	6	Kinesthetic
12	46	AA	2	1	2	7	8	6	4	2	Kinesthetic
13	48	VN	5	2	2	7	8	7	5	4	Kinesthetic
14	52	AS	1	2	3	7	6	6	4	2	Musical
15	66	NP	5	6	2	7	3	3	6	2	Musical
16	68	MT	5	4	4	6	8	7	7	2	Kinesthetic
17	70	ZS	2	2	2	3	7	3	4	1	Kinesthetic *)
18	75	AH	3	5	2	7	6	3	4	4	Musical
19	78	NL	2	3	6	7	3	5	6	3	Musical
20	81	KP	2	2	2	7	2	4	6	3	Musical
21	86	MF	1	2	5	7	4	4	5	1	Musical *)
22	90	SS	4	5	4	4	8	3	5	5	Kinesthetic *)
23	93	MR	6	5	4	9	8	7	2	5	Musical

Based on the findings presented in the stage II multiple intelligences test results table, the selection of research subjects will be based on specific criteria. Specifically, students who have attained scores of 35 or higher in musical intelligence or kinesthetic intelligence will be considered eligible. Conversely, for other types of intelligence, a minimum score of 10 below the highest score will be required for inclusion as research subjects. The table reveals that there are two pupils who satisfy the established requirements for potential research participants. Specifically, these individuals are denoted by the initials FZ, possessing musical intelligence, and SS, exhibiting kinesthetic intelligence.

Table 2. Results of the Phase II Multiple Intelligences Test

No	Test Sheet Code	Name Initial	Multiple Intelligences Test Scores								Conclusion
			I	II	III	IV	V	VI	VII	VIII	
1	12	NO	34	30	39	32	40	37	40	34	
2	21	FZ	26	30	22	22	43	21	30	23	Musical*)
3	24	AA	32	34	28	37	29	42	36	37	
4	33	AK	27	29	25	30	23	23	30	27	
5	35	AC	28	28	23	32	30	25	23	23	
6	70	ZS	32	29	31	32	26	38	33	24	
7	86	MF	30	30	34	34	26	27	27	27	
8	90	SS	27	27	29	42	28	30	24	23	Kinesthetic*)

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FZ Subject Data Analysis (Musical Intelligence) in Solving Problems

This section will demonstrate the problem-solving approaches employed by the FZ subject, via a combination of reduced test results and interviews. The findings are presented as follows:

Understanding the Problem Phase

During the initial phase of problem comprehension, researchers conducted interviews as a means of gathering pertinent information. The subsequent passage presents a segment of the researcher's interview with the person who experienced diminished frontal zygomatic activity (FZ) during the phase of comprehending the M1 challenge.

FZ M1 25 Q : Do you understand the problem?
FZ M1 26 S : Yes
FZ M1 27 Q : How many times did you read the problem until you understood it?
FZ M1 28 S : three to five times
FZ M1 29 Q : why do you read silently?
FZ M1 30 S : So that it doesn't bother you, ma'am, so read it silently.
FZ M1 31 Q : Then, from the questions you have read, what information did you get?
FZ M1 32 S : this is about SPLTV
FZ M1 33 Q : what is all the information you got?
FZ M1 34 S : the first number is five more than the other numbers, the first information. The second number is equal to four times the sum of the other numbers. That's ma'am.
FZ M1 35 Q : Just two bits of information?
FZ M1 36 S : three
FZ M1 37 Q : which one else?
FZ M1 38 S : determine the third number
FZ M1 39 Q : If you define the third number, what is it?
FZ M1 40 S : Question ma'am
FZ M1 41 Q : Is that all the information you have?
FZ M1 42 S : (Students pay attention to the question again) oh yes
FZ M1 43 Q : what?
FZ M1 44 S : there is the first maam. The sum of three numbers is 75
FZ M1 45 Q : OK, you mean what is known?
FZ M1 46 S : it is known that the sum of the three numbers is 75, then the first number is five more than the sum of the other numbers. The second number is equal to four times the sum of the other numbers.

Based on the findings derived from the conducted interviews, it was observed that the participant with FZ had the ability to comprehend M1 through repeated reading (FZ M1 26 S) (FZ M1 28 S). FZ possesses the ability to discern the accessible information, although the omission of a specific piece of information (FZ M1 34 S). However, with a renewed focus on the issue at hand (FZ M1 42 S), FZ ultimately manages to enumerate all pertinent information, encompassing both the known and the requested (FZ M1 46S).

The Planning Phase

During the phase of formulating a problem-solving strategy, researchers conducted interviews as a means of gathering pertinent information. The subsequent dialogue presents the researcher's conversation with the participant who has been assigned the label "reduced FZ" during the initial phase of formulating the M1 plan:

FZ M1 51 P : okay, then how do you plan to solve this problem?
FZ M1 52 S : do the substitution
FZ M1 53 Q : what is substituted?
FZ M1 54 S : uh not a substitution ma'am, still looking for eee eee three variables
FZ M1 55 Q : so what?
FZ M1 56 S : continue to determine the fourth variable

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FZ M1 57 Q : hmm? Why is there a fourth variable?
FZ M1 58 S : (student is confused about expressing a solution plan and think longer)
FZ M1 59 Q : What is the first step you want to take to work on this problem?
FZ M1 60 S : hmm how is it? (Student thinks for a long time)
FZ M1 61 Q : How?
FZ M1 62 S : it's using elimination substitution.

Based on the findings of the interview, it can be inferred that FZ devoted considerable time to articulate the problem-solving strategy he intended to employ in formulating the M1 solution plan (FZ M1 58 S). FZ experienced a state of cognitive dissonance when attempting to articulate the sequential procedures for the resolution of the problem (FZ M1 60 S). However, it is evident that FZ possessed a comprehension of the approach required to accomplish the M1 task, although was unable to articulate the specific procedural procedures involved (FZ M1 62 S).

Stage of Executing the Plans

During the implementation phase, the researcher administered problem-solving assessments and conducted interviews. The outcomes of the examination for the FZ topic during the implementation of the decreased M1 problem-solving strategy are presented below.

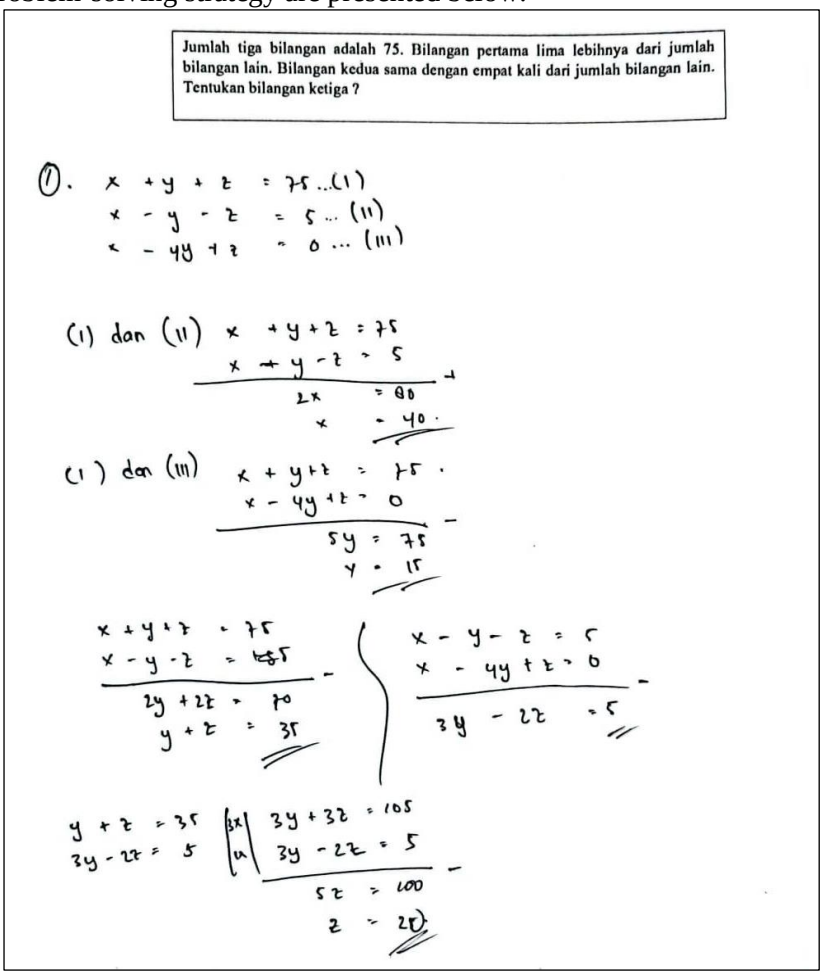

Figure 1. FZ Subject Test Results Implementation Plan Stage

Based on the findings presented in Figure 4.1, it was observed that subject FZ consistently employed the elimination method throughout the problem-solving process. However, it is noteworthy that subject FZ did not document the given information and the problem statement in the initial step, despite verbally expressing comprehension of the problem. The outcomes of the settlement conducted by FZ reveal an error committed by FZ in the conversion of the third piece of information into a mathematical representation. The second number can be expressed as four times the quantity of the other integers. FZ transforms this expression into the form x – 4y + z = 0. Alternatively, it can be represented

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as y = 4 (x + z) or 4x – y + 4z = 0. During the solution process, FZ also seeks to determine the values of x and y in the second and third steps, respectively. Subsequently, FZ proceeds to determine the value of z. In the concluding phase, FZ neglected to document the findings derived from the executed settlement. Despite the initial inability to disclose the plan during the planning phase, FZ's entity successfully executed the issue-solving strategy. However, a few errors were made in the process of translating the problem into a mathematical formulation, resulting in an inaccurate end outcome.

Furthermore, the researcher conducted interviews in order to obtain more in-depth information related to the results of the written test of subject FZ, the following is the result of the researcher's interview with subject FZ at the stage of implementing the reduced M1 problem solving plan:

FZ M1 63 P : OK, now let's try to do the problem!
FZ M1 64 S : (Student works on questions for quite a long time)
FZ M1 65 Q : Are you done?
FZ M1 66 S : already Maam
FZ M1 67 Q : So what's the answer?
FZ M1 68 S : The third number is 25
FZ M1 69 Q : Try to explain the steps for solving it, step by step
FZ M1 70 S : hmmmm. . . (Student is confused to explain the steps for solving it)
FZ M1 71 Q : First step?
FZ M1 72 S : ee determine equations 1, 2, 3
FZ M1 73 P : equation one is obtained from?
FZ M1 74 S : from the questions, the sum of the three numbers is 75,
FZ M1 75 P : mean?
FZ M1 76 S : means x + y + z = 75
FZ M1 77 Q : OK, so what?
FZ M1 78 S : and the second number, uh, the second equation x – y – z = 5, because here it says the first number is five more than the other numbers.
FZ M1 79 P : okay
FZ M1 80 S : then the second number is equal to four times the sum of the other numbers.
FZ M1 81 Q : So?
FZ M1 82 S : So the equation is x – 4y + z = 0
FZ M1 83 Q : So what's the next step?
FZ M1 84 S : The next step is elimination
FZ M1 85 P : okay, how?
FZ M1 86 S : elimination 1 and 2. x + y + z = 75, x – y – z = 5, eliminated the result is 2x = 80, then reduce it to x = 40
FZ M1 87 P : okay, continue
FZ M1 88 S : after that, eliminate again 1 with equation 3. x + y + z = 75, x – 4y + z = 0. The result is 5y = 75. Reduced to y = 15. After that, we substitute eee equation one and two.
FZ M1 89 Q : substituted?
FZ M1 90 S : elimination x + y + z + 75, x – y – z = 5. After that, subtract the result 2y + 2z = 70. Eee reduce it again y + z = 35
FZ M1 91 P : okay, so what?
FZ M1 92 S : after that we eliminate equations 2 and 3 again. x – y – z = 5, x – 4y + z = 0. The result is 3y – 2z = 5
FZ M1 93 P : finished it?
FZ M1 94 S : after that ee eliminate the results from equations 1 and 2, and equations 2 and 3
FZ M1 95 P : okay
FZ M1 96 S : because here it takes the top and bottom numbers to be the same, so the numbers y + z = 35 we multiply 3 the result is 3y + 3z = 105. The equation below remains multiplied by 1. So 3y + 3z = 105, 3y – 2z = 5 we subtract the result 5z = 100 so the result is z = 25
FZ M1 97 Q : okay, any questions?
FZ M1 98 S : determine the third number
FZ M1 99 Q : So what is the third number?

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FZ M1 100 S : the third number is 25
FZ M1 101 Q : you got this z from this and this ? (Showing the completion of Steps 1 and 2 which results in x and y values) What's the point of you looking for that?
FZ M1 102 S : to know all the numbers
FZ M1 103 Q : for what purpose?
FZ M1 104 S : just so it's more complete Ma'am

Based on the results of the interviews, information was obtained that at the stage of compiling a plan, FZ could not reveal the plan to be carried out, but he could carry out the problem-solving plan properly. Even though FZ carried out the problem-solving plan well, at the beginning of the interview FZ was also confused about explaining the steps for solving the problem that FZ had done (FZ MI 70 S) but over time FZ was able to reveal the steps for solving the problem that he had done well. FZ can change all the information in the problem into a mathematical form, even though there is an error changing one information in the problem, namely the second number is equal to four times the number of other numbers, FZ changes it to x - 4y + z = 0 which should be y = 4 (x+z) or 4x – y – 4z = 0. FZ reveals the final solution result, namely "'the third number is 25" (FZ MI 98 S) (FZ M1 100 S) but FZ does not write it down on the answer sheet. In the completion step, FZ also looks for the x and y values in the second and third steps, after that FZ looks for the value of z even though to find the z value you don't need to look for the x and y values first, but FZ says that all numbers are obtained (FZ M1 102 S) and more complete finishing steps (FZ M1 104 S).

Re-Checking Phase

During the step of re-examination, the researcher conducted interviews in order to gather information. The subsequent passage presents a segment of the researcher's interview with the person who experienced reduced frontal zeta (FZ) activity. This interview occurred during the phase of reviewing the outcomes obtained from resolving the M1 problem:

FZ M1 105 P : okay, are you sure about your answer?
FZ M1 106 S : sure not sure, but must be sure
FZ M1 107 Q : eee how do you make sure that your final answer is correct?
FZ M1 108 S : hmmm how about that. . (student thinks) 25 is me times 5
FZ M1 109 P : 25 multiplied by 5 is the result?
FZ M1 110 S : 125. uh something went wrong, wait wait (student is working on the final result again)
FZ M1 111 Q : how much?
FZ M1 112 S : 20 Ma'am, because 100 divided by 5 is 20
FZ M1 113 P : so the result?
FZ M1 114 S : z = 20
FZ M1 115 Q : are you sure?
FZ M1 116 S : yes it is

Based on the results of the interviews, it appears that subject FZ re-checked the results of his work by simply multiplying the final result by the division in the previous step, namely 5z = 100, then z = 20, FZ re-checked his answer by multiplying 20 by 5 (FZ M1 108 S). However, before FZ multiplied again, the final result that FZ obtained was 25 (FZ M1 110 S), so FZ corrected the final result that FZ obtained after FZ re-examined the results of his work (FZ M1 114 S).

Analysis of SS Subject Data (Kinesthetic Intelligence) in Solving Problems

This section will show how SS subjects solve problems through reduced test results and interviews. The results are as follows:

Understanding the Problem Phase

During the initial phase of comprehending the problem, researchers conducted interviews in order to acquire pertinent information. The subsequent passage presents a segment of the researcher's interview with the participant who has been assigned a decreased sample size (SS) and is currently in the phase of comprehending the M1 issue. This stage is characterized as follows.

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SS M1 09 P : OK, now try to read this question until you understand it!
SS M1 10 S : (Student reads the questions silently)
SS M1 11 Q : already?
SS M1 12 S : Yes
SS M1 13 Q : How many times did you read the questions until you understood them?
SS M1 14 S : 3 to 4
SS M1 15 Q : why do you read silently?
SS M1 16 S : let me go straight in, Ma'am because if I speak directly like this it sounds again and again in my ear.
SS M1 17 Q : okay, then after you read this question, what information did you get?
SS M1 18 S : total 75
SS M1 19 P : continue
SS M1 20 S : the first number is 5 more than all of the other numbers, while the second number is 4 times more than the other numbers. Look for the third number because you don't know yet.
SS M1 21 Q : OK, so from this question, how do you differentiate between what is known and what is being asked?
SS M1 22 S : distinguish it. . . It's already stated directly in the problem, ma'am
SS M1 23 Q : yes, how do you tell the difference?
SS M1 24 S : read and pay close attention to which ones indicate questions and other information

Based on the results of the interviews, it was found that SS subjects could understand the problem by reading the questions repeatedly (SS M1 14 S), SS could concentrate on understanding the questions by reading them silently, to be more focused (SS M1 16 S). SS can identify all available information and can explain it again using their own language (SS M1 18 S) (SS M1 20 S). SS can also distinguish information that is known from what is asked properly by reading it carefully (SS M1 24 S).

The Planning Phase

During the phase of formulating a problem-solving strategy, researchers conducted interviews in order to gather pertinent information. The subsequent dialogue presents the researcher's conversation with the participant who has been assigned a reduced sample size (SS) during the initial phase of formulating the M1 plan:

SS M1 25 Q : OK, after you have read the questions, how do you plan to solve them?
SS M1 26 S : use elimination
SS M1 27 Q : continue
SS M1 28 S : (student thinks long enough) to find the third number

Based on the findings derived from the conducted interviews, it can be deduced that the SS participant exhibited an inability to articulate the proposed settlement plan desired by SS. The individual known as SS engaged in a period of contemplation upon being questioned by the researcher on their intended course of action with regards to the settlement plan. The individual, referred to as SS, initially provided an explanation of the preferred approach, specifically the process of elimination (SS M1 26 S). Subsequently, SS experienced confusion and engaged in extensive contemplation. Following this period of reflection, SS promptly articulated the desired outcome of the problem, namely the identification of the third number (SS M1 28 S).

Stage of Executing the Plans

During the implementation phase, the researcher administered problem-solving assessments and conducted interviews. The subsequent findings pertain to the SS subject examination conducted during the implementation phase of the reduced M1 solution plan.

Based on the findings presented in Figure 2, it was seen that the SS subject effectively executed the issue-solving plan. The SS subject demonstrated a comprehensive comprehension of the situation by accurately documenting the given information and the desired outcome. The completion steps were effectively executed by SS, despite the inability to provide a comprehensive breakdown of the procedures during the problem-solving plan preparation stage.

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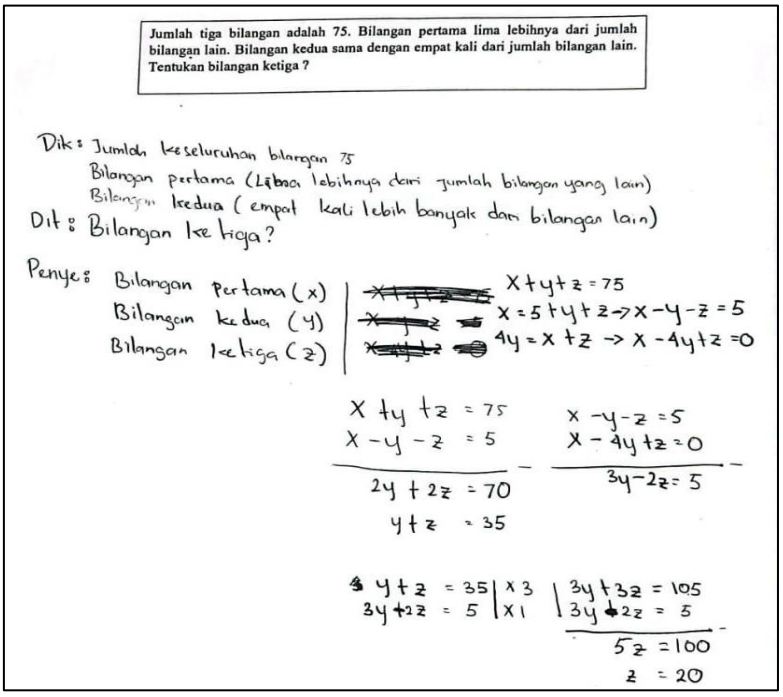

Figure 2. SS Subject Test Results Implementation Phase Solution Plan

Furthermore, the researcher conducted interviews in order to obtain more in-depth information related to the results of the SS subject's written test. The following are the results of the researcher's interview with the SS subject at the stage of implementing the reduced M1 problem solving plan:

SS M1 29 P : okay, then you try to do the problem!
SS M1 30 S : (Students work on the problems given)
SS M1 31 P : OK, so what are the results?
SS M1 32 S : 20
SS M1 33 P : try to explain your solution from the beginning!
SS M1 34 S : from here ma'am? (point to known problem solving)
SS M1 35 F : yes
SS M1 36 S : it is known that the total number of numbers is 75, the first number is 5 more than the number of other numbers, the second number is four times more than the other numbers. asked for the third number.
SS M1 37 Q : so what?
SS M1 38 S : the solution for the first number is x, the second number is y, and the third number is z
SS M1 39 P : okay then?
SS M1 40 S : the total number is 75 so x + y + z = 75
SS M1 41 P : okay then
SS M1 42 S : the first number is 5 more than the other numbers, so x = 5 + y + z is changed to x – y – z = 5
SS M1 43 Q : so what?
SS M1 44 S : the second number is 4 times more than the other numbers. 4y = x + z changed to x – 4y + z = 0
SS M1 45 Q : continue Next steps?
SS M1 46 S : The next step is to take the first and second equations, x + y + z = 75 equals x – y – z = 5, just less results in 2y + 2z = 70, simplified again so y + z = 35
SS M1 47 F : okay
SS M1 48 S : then take the second and third equations, namely x – y – z = 5 equals x – 4y + z = 0 then subtract and get the result 3y–2z=5
SS M1 49 Q : ok next?

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SS M1 50 S : the result of the two numbers y + z = 35 and 3y - 2z = 5, multiply so that the coefficients are the same. So y + z = 35 multiplied by 3, while 3y – 2z = 5 multiplied by 1, which produces 3y + 3z = 105, then 3y – 2z = 5 then reduced and produces 5z = 100, simplified and the result is 20.

Based on the findings derived from the conducted interviews, it was observed that SS shown a proficient ability to effectively execute the problem-solving plan. The author provides a comprehensive explanation of the existing knowledge and the specific inquiries addressed in the context of SS M1 36 S. Upon successfully solving the M1 problem, the SS subject demonstrated the ability to articulate the phases of the solution process in their own words. However, during the initial stage of formulating a problem-solving plan, the SS subject encountered difficulty in elucidating the sequential actions to be undertaken.

Re-Checking Phase

At the re-examining stage, the researcher conducted interviews to obtain information. The following is an excerpt of the researcher's interview with the reduced SS subject at the stage of re-examining the results of solving the M1 problem, described as follows:

SS M1 51 P : okay, are you sure about your answer?
SS M1 52 S : Yes
SS M1 53 Q : how do you make sure you are sure about your answer?
SS M1 54 S : by looking at it, and also calculating again whether it is correct and you can be sure that it is the answer
SS M1 55 P : okay, thank you very much

DISCUSSION

This section contains a discussion of the results of the study in the form of the results of the analysis of mathematical problem solving based on the Polya stages in terms of musical intelligence and kinesthetic intelligence.

Musical Intelligence (FZ) Subject Problem Solving

In order to address the issue pertaining to musical intelligence, it is recommended to engage in a process of repeated reading of the problem at hand, as this can aid in enhancing one's comprehension of the situation. Individuals with a musical intelligence aptitude possess the ability to accurately discern the known elements within a given problem and effectively identify the specific information being requested, even in instances where a particular detail may have been overlooked. By attentively reviewing the questions and revisiting the provided command sentence, individuals with musical intelligence can successfully articulate all pertinent information. This aligns with the viewpoint expressed by Nahdataeni (2015), who asserts that students possess a cognitive framework for distinguishing between known information and the specific inquiry posed in a given problem. According to this framework, students are able to identify what is already known based on the information provided in the statement sentence, while the question sentence guides them in identifying the specific aspect being asked about in the problem.

During the initial phase of the task, students possessing musical intelligence may have difficulties in articulating their problem-solving strategies. Individuals who possess musical intelligence may experience difficulty articulating the specific actions or procedures that will be undertaken. However, individuals possessing musical intelligence possess a deep understanding of their preferred approach, yet struggle to effectively articulate it. This aligns with the perspective put forth by Dwianjani *et al*. (2018), which asserts that the capacity to identify an appropriate resolution method is the primary determinant of problem-solving proficiency. This implies that in instances where students encounter difficulties in devising a solution strategy, their progress to the subsequent stage, namely the execution of their plans, becomes impeded, ultimately leading to suboptimal development of their problem-solving skills.

During the phase of executing the problem-solving strategy, individuals with musical intelligence demonstrate proficiency, despite their limited ability to articulate a comprehensive, step-by-step plan

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during the phase of formulating the problem-solving strategy. During the implementation phase of the problem-solving process, individuals with musical intelligence tend to omit the step of documenting the known information and the questions being asked. However, it is worth noting that during the problem comprehension stage, individuals with musical intelligence typically provide comprehensive explanations of the known information and the questions at hand. Individuals that possess musical intelligence tend to refrain from formulating conclusions based on the outcomes of their problem-solving endeavors. According to Fidayanti *et al.* (2019), it is imperative for students to adhere to the selected solution plan during the problem-solving step in order to effectively address the identified issues. In the event that the plan does not align with the selected approach, students have the option to employ an alternative methodology.

During the stage of re-examination, individuals with a musical intelligence tend to engage in recalculating processes mostly towards the last stages of task completion. Individuals that possess musical intelligence do not engage in a systematic process of re-evaluating their work, starting from the first stages and progressing towards its completion. Polya suggests two approaches for reviewing the outcomes of a task: firstly, meticulously scrutinizing each stage of the completed work, and secondly, using alternative methodologies to verify the findings gained through the initial approach. According to Dwianjani *et al*. (2018), it is necessary to conduct a re-examination phase to rectify students' work and assess the accuracy of their answers to the presented questions.

Kinesthetic Intelligence (SS) Subject Problem Solving

The utilization of kinesthetic intelligence in problem-solving, particularly during the phase of comprehending the problem, involves the repetitive quiet reading of the questions. Individuals that possess kinesthetic intelligence possess the ability to identify the known elements within a problem and effectively discern the specific inquiry being made, utilizing their own language in a manner that aligns with the provided command sentence. This finding demonstrates that those with kinesthetic intelligence possess accurate knowledge of the material presented in the challenge. According to Dwianjani *et al*. (2018), it is said that the capacity to recognize and identify difficulties is a crucial attribute that aids in the achievement of effective problem-solving. Failure to identify the problem will result in the inability to ascertain the appropriate tactics to be employed.

During the phase of formulating a problem-solving strategy, individuals with kinesthetic intelligence may encounter difficulties in devising an executable plan for problem resolution. Individuals exhibiting kinesthetic intelligence provided a concise overview of their intended course of action, specifically outlining the initial step and the desired outcome, which involved a process of elimination until the third numerical value was ascertained. According to Dwianjani *et al*. (2018), the planning phase significantly impacts an individual's capacity to solve mathematical problems. For instance, when one is capable of effectively exploring and selecting appropriate strategies, the process of solving mathematical problems becomes more manageable due to the prior preparation of problem-solving plans.

During the implementation phase of the problem-solving process, individuals with kinesthetic intelligence demonstrate proficiency in problem solving. At this stage, the student records a comprehensive account of the known information and the problem statement using their own language, aligning with the comprehension achieved during the problem understanding phase. Individuals who possess kinesthetic intelligence demonstrate proficiency in executing the necessary steps for task completion. However, it is worth noting that individuals with kinesthetic intelligence may encounter difficulty in articulating the specific processes involved in formulating a problem-solving plan. According to Nuraini *et al*. (2019), the problem-solving stage heavily relies on students' experiences in order to enhance their creativity in formulating solutions to problems.

During the stage of re-examination, individuals with kinesthetic intelligence engage in a process of reviewing and reassessing the outcomes of their work. This involves carefully observing and recalculating the obtained answers, with the aim of ensuring the accuracy and correctness of the final solution. According to Nuraini *et al*. (2019), re-examination operations involve the utilization of specialized inspections at each stage of completion, as well as broad inspections to identify overall issues.

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CONCLUSION

Students who possess musical intelligence may face difficulties in problem-solving, especially during the initial stage where they may overlook crucial information. However, they can eventually comprehend the problem's requirements through focused reading. Despite being proficient in executing problem-solving tasks, they often struggle to provide comprehensive documentation of their processes, which can lead to errors in the final answer. On the other hand, students who possess kinesthetic intelligence excel in problem-solving. They are able to effectively articulate problem requirements and employ strategies such as elimination. Although they may face difficulties in planning, they meticulously transcribe information and engage in thorough re-examination to ensure accuracy. However, errors may still occur due to challenges in converting narrative problems into mathematical formats..

REFERENCES

A'isyah, S. (2018). Pengaruh Kecerdasan Lingusitik, kecerdasan Logismatematis, dan Kecerdasan Spasial Terhadap Kemampuan Pemecahan Masalah Matematika Peserta Didik SMP/Mts di Kecamatan Cerme. http://eprints.umg.ac.id/3143

Ardiana, R. (2022). Pembelajaran berbasis kecerdasan majemuk dalam pendidikan anak usia dini. *Murhum : Jurnal Pendidikan Anak Usia Dini*, *3*(1), 1-12. https://doi.org/10.37985/murhum.v3i1.65

Damayanti, W. F., Iskandar, R. S. F., & Safitri, P. T. (2022). Pengaruh Kecerdasan Visual-Spasial Dan Kreativitas Siswa Terhadap Kemampuan Pemecahan Masalah. *Seminar Nasional Pendidikan Matematika UMT*, *33*, 22–29. https://jurnal.umt.ac.id/index.php/cpu/article/view/6849

Dwianjani, N., Candiasa, I, M., Sariyasa. (2018) Indentifikasi Faktor-faktor yang Mempengaruhi Kemampuan Pemecahan Masalah Matematika. Numerical: *Jurnal Matematika dan Pendidikan Matematika*, Vol 2 No. 2. https://doi.org/10.25217/numerical.v2i2.276

Firdayanti, S. R., Artharina, F. P., & Purnamasari, V. (2019). Keefektifan Model Pembelajaran Problem Posing Terhadap Pemecahan Masalah Matematika. *Thinking Skills and Creativity Journal*, *2*(2), 57-62. https://doi.org/10.23887/tscj.v2i2.20710

Hafni, R.N., Herman, T., Nurlaelah, E., & Mustikasari, L. (2020). The importance of science, technology, engineering, and mathematics (STEM) education to enhance students' critical thinking skill in facing the industry 4.0. *Journal of Physics: Conference Series* 1521 042040. https://doi.org/10.1088/1742-6596/1521/4/042040

Hasibuan, M. F. (2019). Hubungan Kecerdasan Linguistik Dengan Hasil Belajar Matematika Siswa Kelas Xi Sma Taman Siswa Lubuk Pakam. *Journal Of Computer Networks, Architecture and High Performance Computing*, *1*(1), 41–48. https://doi.org/10.47709/cnapc.v1i1.44

Hermiyati, Y. E., Rizal, M., & Rochaminah, S. (2015). Proses Berpikir Siswa Smk Dengan Kecerdasan Musikal [Thinking Processes os Senior Vocational School Students with Musical Intelligence]. *Jstt*, 49–58. http://jurnal.untad.ac.id/jurnal/index.php/JSTT/article/view/6928/5567

Miles, M. B., & Huberman, A. M. (2014). Qualitative Data Analysis, A Methods Sourcebook, Edition 3. In *News.Ge*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Milsan, A. L., & Wewe, M. (2018). Hubungan Antara Kecerdasan Logis Matematis [Relation between Logical and Mathematical Intelligences]. *Journal of Education Technology*, *2*(20), 65–69. https://doi.org/10.23887/jet.v2i2.16183

Nahdataeni, S. S.,& Linawati. (2015). Proses Beroikir Siswa dalam Memecahkan Masalah Sistem Persamaan Linear Duan Variabel dengan Langkah Polya Ditinjau dari Gaya Belajar Kelas X SMA Negri 2 Palu. *Aksioma*, 4(2), 203–215. https://doi.org/10.22487/aksioma.v4i2.114

Nuraini, Maimunah, & Roza, Y. (2019). Analisis Kemampuan Pemecahan Masalah Siswa Kelas VIII SMPN 1 Rambah Samo Pada Materi Bangun Ruang Sisi Datar. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, *3*(1), 63–76. https://doi.org/10.25217/numerical.v3i1.477

ISSN 2356-2684 (print), ISSN 2477-1503 (online)

Sari, N., & Oktariani. (2019). Mengenal dan Mengidentifikasi Kecerdasan Majemuk Pada Anak. *Seminar Nasional Hasil Pengabdian Kepada Masyarakat 2019*, 334–337. http://dx.doi.org/10.30700/sm.v1i1.601.

Setiawan, D., & Nisa, K. (2018). Kajian Kecerdasan Majemuk pada Beberapa Model Pembelajaran Kooperatif. *Semdikjar 2*, 215–222. http://conference.unpkediri.ac.id/

Sugiyono. (2013). *Metode Penelitian Kuantitaif,Kualitatif dan R&D*. In Alfabeta (Issue 465).

Syarifah, S. (2019). Konsep Kecerdasan Majemuk Howard Gardner. *SUSTAINABLE: Jurnal Kajian Mutu Pendidikan, 2*(2), 176–197. https://doi.org/10.32923/kjmp.v2i2.987

Wang, Y., Chiew, V. (2010). On the cognitive process of human problem solving. Cognitive Systems Research. 11(1) 81-92. https://doi.org/10.1016/j.cogsys.2008.08.003

ISSN 2356-2684 (print), ISSN 2477-1503 (online)