

Sensing and Intuition Thinking Styles in Mathematical Problem Solving Among Vocational Students

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Abstract

Mathematical problem-solving ability is a critical competency for students' academic achievement and professional readiness in the digital era. Cognitive characteristics, particularly *sensing* and *intuition* thinking styles within the *Myers-Briggs Type Indicator* framework, are often assumed to influence how students approach mathematical problems. However, empirical findings regarding this relationship remain inconclusive. This study aimed to examine the relationship between *sensing* and *intuition* thinking styles and mathematical problem-solving ability among vocational high school students and to derive pedagogical implications for mathematics instruction. Employing a quantitative correlational design, the study involved 49 students enrolled in the Software Engineering program at a Vocational High School. Data on thinking styles were collected using the *Myers-Briggs Type Indicator* instrument, while mathematical problem-solving ability was measured through a test assessing four indicators: understanding problems, planning solutions, implementing solution strategies, and evaluating results. Data were analyzed using *point-biserial correlation* and the coefficient of determination. The findings revealed a weak negative relationship between thinking styles and mathematical problem-solving ability ($r = -0.278$), with a contribution of only 7.77%. Correlation analyses across all problem-solving indicators also ranged from very weak to weak. These findings suggest that thinking style differences are not a dominant factor influencing mathematical problem-solving ability. Therefore, mathematics instruction should emphasize the development of comprehensive problem-solving skills rather than differentiated learning based solely on *sensing* and *intuition* preferences.

INTRODUCTION

Mastery of mathematical problem-solving skills is an essential foundation in mathematics education for developing students' logical, analytical, and adaptive thinking. This competency requires students not merely to memorize formulas, but to apply a deep conceptual understanding to solve a variety of

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problems using diverse strategies. In line with the findings of [Sari et al., \(2022\)](#), mathematical problem-solving skills have the potential to foster students' creativity in generating new ideas. This perspective aligns with the vision of the National Council of Teachers of Mathematics [Mathematics, \(2000\)](#), which is to broaden and deepen students' conceptual understanding of mathematics. Therefore, the development of mathematical problem-solving skills has become critically important in light of the increasing demands for 21st-century competencies and students' readiness for the workforce, particularly in vocational education.

However, mathematical problem-solving skills remain a major challenge for many students because they involve complex cognitive stages, ranging from understanding information, planning strategies, carrying out procedures, to reflecting on solutions ([Polya, 2014](#)). In practice, not all students are yet able to navigate all these stages optimally. [Wahidaturrahmi & Baidowi, \(2022\)](#) suggest that students' difficulties stem not only from the difficulty level of the material but also from teaching approaches that do not yet accommodate students' cognitive characteristics in processing information and structuring their thought processes. This situation indicates that individual differences in thinking strategies play a significant role in the achievement of mathematical problem-solving skills; therefore, mathematics instruction should ideally be designed with these variations in thinking characteristics in mind.

One theoretical framework that explains these variations in information processing is the theory of sensing and intuition thinking strategies in the Myers-Briggs Type Indicator (MBTI). This framework distinguishes students' personality tendencies in receiving and processing information. Students with a sensing thinking strategy tend to focus on facts, concrete details, and step-by-step procedures based on given examples, whereas students with an intuitive thinking strategy are more interested in general patterns, abstract concepts, and exploring various alternative solutions ([Arfia & Handican, 2024](#); [Jayanti et al., 2024](#)). The differences in problem-solving patterns between these two groups indicate significant potential for integrating Myers-Briggs Type Indicator (MBTI) thinking strategies into the design of mathematics instruction.

Nevertheless, before concluding whether the MBTI's theories of sensing and intuition thinking strategies can be used to design mathematics instruction, research is needed to determine whether these two variables are indeed related. The majority of studies examining sensing and intuition preferences in mathematical problem-solving are still limited to qualitative-exploratory studies with relatively small sample sizes. While these studies do document differences in descriptive patterns, the extent of the statistical relationship and the factual contribution of these differences in thinking strategies to problem-solving ability have not yet been quantitatively tested on a more representative sample. According to [Santrock, \(2021\)](#), testing the relationship between variables that are theoretically suspected to be related through empirical-quantitative methods is a crucial step in proving the strength of that relationship before drawing valid pedagogical implications.

To fill this research gap, this study employs a methodologically complementary approach specifically, a shift from qualitative exploration to a quantitative correlational approach to empirically test the strength of the relationship between the "sensing" and "intuition" thinking strategies and the mathematical problem-solving abilities of vocational high school students (particularly those in the Software Engineering program). This study evaluates four indicators of mathematical problem-solving according to the NCTM

(2000), namely: i) constructing new mathematical knowledge through problem-solving; ii) solving problems in both mathematical and non-mathematical contexts; iii) applying and adapting appropriate strategies; and (iv) reflecting on the mathematical problem-solving process.

Through this approach, the study aims to address three main research questions: i) a description of students' mathematical problem-solving abilities using sensing and intuition thinking strategies; ii) the relationship between sensing versus intuition thinking strategies and mathematical problem-solving abilities; and iii) the resulting pedagogical implications. Both theoretically and practically, this study offers important implications for determining whether MBTI-based differentiated instruction is empirically proven to be absolutely necessary, or whether instructional practices should instead be shifted to directly and comprehensively strengthen mathematical problem-solving skills for all students, regardless of their thinking strategy preferences.

METHODS

This study employed a non-experimental quantitative method with a correlational design. The sample consisted of 49 vocational high school students enrolled in the Software Engineering program, selected using purposive sampling; therefore, it should be understood that the study's findings can only be generalized to the study subjects and other subjects with characteristics similar to those of the study subjects. The instruments used in this study consist of two types: a questionnaire to identify thinking strategies, developed based on the indicators of sensing and intuition thinking strategies according to (Engkizar et al., 2018, 2026; Kasheem et al., 2025; Myers & Myers, 2010; Syafril et al., 2021) and a test of mathematical problem-solving ability, developed based on indicators according to the (Mathematics, 2000). The data obtained consisted of the results of the identification of sensing thinking strategies, coded as 0, and intuition thinking strategies, coded as 1, while the data from the students' mathematical problem-solving ability test took the form of scores on a scale of 0–52. Therefore, in this study, the data will be analyzed using descriptive statistics to describe students' ability levels, and the point-biserial correlation test will be used to examine the relationship between the thinking strategies of sensing (0) versus intuition (1) and students' overall mathematical problem-solving scores as well as scores by indicator (Alatise & Akinfolarin, 2025; Glass, 2004). The point-biserial correlation technique was used because the thinking strategies of “sensing” and “intuition” are dichotomous variables coded with two fixed values: 0 and 1. The following is the test instrument rubric used to determine students' mathematical problem-solving ability scores.

Table 1. Test Blueprint for Students' Mathematical Problem-Solving Skills

Ability Indicator	Question Number	Difficulty Level	Cognitive Level	Question Type
1. Constructing new mathematical knowledge through problem solving	2	Moderate	C5	A/B
	4	Easy	C4	A/B
	5	Moderate	C5	A/B
2. Solving problems that arise in mathematical and non-mathematical contexts	6	Difficult	C6	A/B

Ability Indicator	Question Number	Difficulty Level	Cognitive Level	Question Type
3. Applying and adapting appropriate strategies to solve problems				
4. Reflecting on the mathematical problem-solving process	1	Moderate	C5	A/B
	3	Easy	C4	A/B
	7	Difficult	C6	A/B
Total Number of Questions		7		

The following is a questionnaire outline for identifying sensing and intuition thinking strategies in students.

Table 2. Questionnaire Outline for Identifying Sensing and Intuition Thinking Strategies

Dimension	Indicator	Statements		Total
		Positive	Negative	
Sensing	1. Relies on concrete facts when solving problems.	1, 2	9, 20	4
	2. Clearly remembers or accurately observes information.	14, 10	16	3
	3. Relies on experience rather than theory.	5	11, 7	3
Intuition	1. Develops knowledge into more complex concepts.	8, 6	4, 18	4
	2. Is interested in new things.	3, 17	15	3
	3. Relies on inspiration rather than experience.	12, 19	13	3
Total		10	10	20

RESULT AND DISCUSSION

An Overview of Students' Mathematical Problem-Solving Skills Using Sensing and Intuition Thinking Strategies

Based on Table 3, the group of students using the sensing thinking strategy had a higher average score than the intuition group, specifically 20.00, meaning that students using the sensing thinking strategy achieved a higher average score on mathematical problem-solving skills. The median score for the sensing group was also 20, while that for the intuition group was 15.00. The median score indicates that approximately half of the students in each group scored below that value and the other half scored above it. The highest score achieved by the sensing group was 41, while the intuition group achieved a highest score of 30 out of a maximum score of 52, indicating that the sensing group achieved a higher maximum score compared to the intuition group.

Table 3. Descriptive Statistics of Students' Problem-Solving Skills

Thinking Strategy	Frequency	Mean	Median	Standard Deviation	Score		
					Lowest	Highest	Maximum
Sensing	28	20.00	20.00	7.866	5	41	52
Intuition	21	15.24	15.00	8.83	4	30	

Meanwhile, Figure 1 presents students' achievement levels in the "sensing" and "intuition" thinking strategies for each indicator of mathematical problem-solving ability. This provides information on students' proficiency levels for each indicator. Figure 1 shows that the second and third indicators have the lowest percentages compared to the other indicators. The achievement percentages for each thinking strategy on the second indicator were 29.67% and 34.52%, while those on the third indicator were 15.48% and 22.99%. Furthermore, students' achievement levels in the "intuition" category were consistently lower than those in the "sensing" category across all indicators. However, these findings still indicate that achievement levels vary among students in both the "sensing" and "intuition" categories.

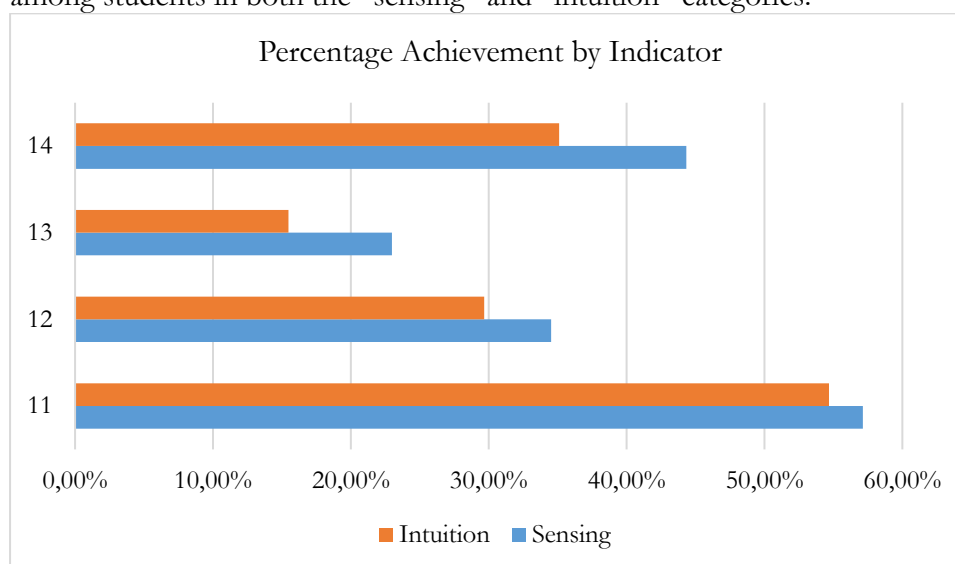


Fig 1. Percentage of Achievement by Mathematical Problem-Solving Ability Indicator

The fact that students with a "sensing" thinking style consistently demonstrate higher levels of mathematical problem-solving ability than those with an "intuition" style can be understood through the characteristics of sensing thinking strategies, which tend to process information based on available facts, in a systematic and meticulous manner, and by relying on experience (Novitasari & Masriyah, 2021). These characteristics align with the demands of mathematical problem-solving tasks, which require students to identify information in the problem, formulate a solution strategy, carry out the solution procedure, and reflect on the results (Arico & Wahyudi, 2021). Therefore, the tendency toward sensing thinking enables students to follow the stages of problem-solving in an organized manner.

Both groups of students those with sensing and intuition thinking strategies faced difficulties with indicators 2 and 3, specifically when they had to solve mathematical problems by adapting their strategies. Students with sensing thinking strategies tend to follow familiar procedures that have been taught to them. They rely on example problems that are similar to the ones they are currently working on (Arfia & Handican, 2024). Consequently, sensing students often do not attempt alternative solutions when faced with problems requiring skills beyond what they have been taught. Meanwhile, students with an intuition-based thinking strategy tend to solve problems by grasping the problem's overall structure based on the relationships between ideas and concepts; as a result, they often explore new strategies they consider more efficient (Rosmayanthi et al., 2021). However, problems arise when intuition-oriented students use new strategies that are incorrect or deviate from the

required concepts, and when students lack sufficient concepts or ideas to connect into a pattern (Indah & Fadiana, 2021).

The Relationship Between Sensing vs. Intuition Thinking Strategies and Mathematical Problem-Solving Ability

Table 4. Results of the Point-Biserial Correlation Test for Overall Scores

r_{pb}	KD	Category	r_{table}	Interpretasi
-0.278	7.77%	Weak Correlation	0.281	Not Significant

Based on Table 4, the point-biserial correlation coefficient of -0.278 indicates that the relationship between differences in sensing and intuition thinking strategies and mathematical problem-solving ability is not significant, falling into the category of a weak correlation. This finding suggests that the differences in sensing and intuition thinking strategies are not yet strong enough to produce a trend in the variation of mathematical problem-solving ability among students in the Software Engineering (RPL) vocational program at the Vocational High School. Furthermore, the differences in sensing and intuition thinking strategies contribute only 7.77% to mathematical problem-solving ability, while the remaining 92.23% is attributed to other factors.

Table 5. Correlation Coefficients and Coefficients of Determination by Indicator

Indicator	Correlation Value	Interpretation	Coefficient of Determination (CD)
1	0.172	No Correlation	2.95%
2	0.216	Weak Correlation	4.67%
3	0.241	Weak Correlation	5.83%
4	0.383	Weak Correlation	14.70%

The results of the correlation analysis between the differences in sensing and intuition thinking strategies and each indicator of mathematical problem-solving ability also show the same pattern. Table 5 shows that the correlation coefficients fall within the range interpreted as no correlation to low correlation. Meanwhile, the coefficient of determination for each indicator is also low, meaning that both overall and for each indicator the variation in mathematical problem-solving ability cannot be explained by differences in sensing and intuition thinking strategies.

The findings indicate that the mathematical problem-solving skills of vocational high school students in the Software Engineering program are multidimensional in nature and cannot be explained solely by differences in sensing and intuition thinking strategies. According to Polya, (2014), mathematical problem-solving ability develops through learning experiences and problem-solving practice. In addition, the quality of instruction also contributes to the development of students' problem-solving abilities. Furthermore, the NCTM (2000) explains that students' mathematical problem-solving ability is built through the development of ways of thinking, perseverance, curiosity, and self-confidence when facing unfamiliar situations. Thus, it can be understood that differences in sensing and intuition thinking strategies are not the primary factors influencing the mathematical problem-solving skills of vocational high school students in the Software Engineering program; therefore, mathematics instruction should focus on developing students' skills across each competency indicator through factors that are more likely to have an impact.

Pedagogical Implications

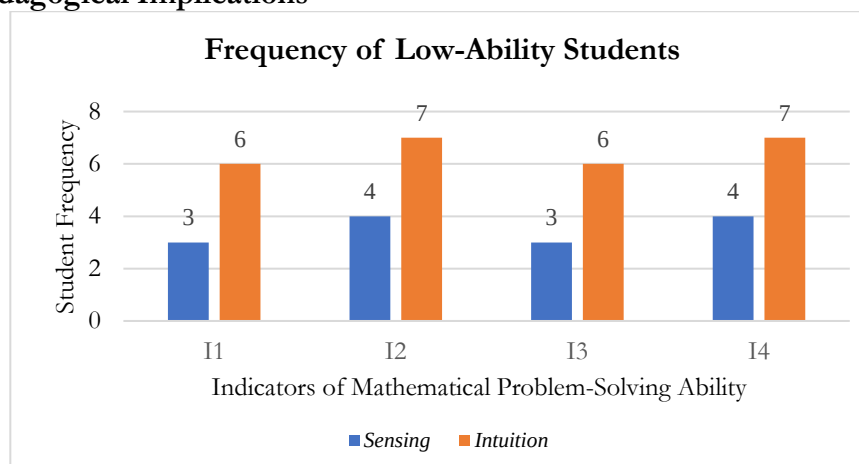


Fig 2. Distribution of Low-Achieving Students Across Each Indicator

Based on this study, students with different thinking strategies still have relatively equal opportunities to demonstrate mathematical problem-solving skills. This is based on the finding that variations in mathematical problem-solving skills are not determined by differences between the “sensing” and “intuition” thinking strategies. These findings suggest that instruction does not need to rigidly differentiate treatment based on these thinking strategies. Furthermore, Figure 2 shows that there are still low-performing students across every indicator of mathematical problem-solving ability. The presence of low-performing students highlights the need for instructional approaches that can improve student performance. Therefore, mathematics instruction should be designed to develop every aspect of each indicator of mathematical problem-solving ability rather than being rigidly tailored to accommodate the “sensing” and “intuition” thinking strategies.

Providing Diverse Representations for Understanding Problems

The research results show that the ability to construct mathematical knowledge through mathematical problem-solving is the indicator with the highest achievement among both sensing and intuition students, at 57.14% and 54.67%, respectively (Figure 1). These findings indicate that students can develop an understanding of problems through different approaches. According to [Polya, \(2014\)](#), mathematics instruction that effectively guides students toward understanding problems involves presenting a sequence of understanding. In every lesson, students should be encouraged to build understanding through questions that lead them to identify key information and formulate the problems that need to be solved. Furthermore, given the finding that each student tends to be able to develop an understanding of a problem despite differences in their thinking styles, instruction should present problem-solving questions that offer diverse representations of the problem in various forms, such as pictures, tables, diagrams, etc. This is because, according to [Ramadhani, \(2021\)](#), presenting diverse problem representations in questions can develop students’ ability to understand the problems they are facing.

Facilitating the Use of Diverse Problem-Solving Strategies

The achievement percentages for students in the “sensing” and “intuition” categories on Indicator 3 were lower than those for other indicators. For the indicator regarding adapting various appropriate strategies to solve problems, each student group achieved a percentage of 22.99% and 15.48%, respectively. This indicates that students still face challenges and difficulties in solving the problems they encounter. Furthermore, the presence of students with low proficiency on this indicator warrants attention, as

mathematics instruction needs to accommodate the development of students' ability to adapt problem-solving strategies to solve mathematical problems.

According to [Polya, \(2014\)](#), to develop students' ability to adapt problem-solving strategies, students need to be accustomed to learning that encourages them to identify the main problem in a question. One such form of stimulation involves connecting the problem at hand with relevant mathematical concepts so that students can identify the key idea for solving the problem. This aligns with NCTM (2000), which states that students must learn "to pose problems based on situations they have" meaning students should be continuously guided to identify the problem within a question and propose solutions. It is understood that the ability to determine problem-solving strategies should be guided and facilitated before students solve problems independently, using forms of stimulation that foster students' understanding. Furthermore, [Arico & Wahyudi, \(2021\)](#) explain that problems capable of developing students' ability to determine problem-solving strategies are those that facilitate students in trying various problem-solving strategies.

Developing Reflective Activities in Mathematical Problem Solving

The research results show that the achievement levels of students with sensing and intuition learning styles on the indicator of reflecting on the mathematical problem-solving process were in a fairly high range. Sensing students achieved a percentage of 44.35%, while intuition students achieved a percentage of 35.11%. This indicates that students' ability to reflect on the problem-solving process is already evident, thus requiring further development. The fact that both sensing and intuition students demonstrate the ability to reflect on problems aligns with the tendencies of these two strategies. Sensing students tend to evaluate solutions based on the accuracy of procedures, facts, and the consistency of steps ([Saraswati et al., 2022](#)). Conversely, intuition students reflect on problems based on relationships between concepts, possible alternative solutions, and patterns that emerge from the problem-solving process ([Francis & Village, 2022](#)).

The coefficient of determination for the fourth indicator reached 14.70% (Table 5), indicating that students' thinking strategies play a significant role in their achievement on that indicator. Since the implications of the research findings do not suggest that mathematics instruction needs to employ two distinct approaches for each thinking strategy, instruction should focus on developing students' abilities related to the "reflection" indicator. According to [Polya, \(2014\)](#), the stage of reflecting on the problem-solving process needs to be incorporated into mathematics instruction. One way to do this is through "verification," which involves confirming understanding by asking questions such as "Can you check the result?" Furthermore, the NCTM (2000) explains that activities involving reflection on the mathematical problem-solving process aim to build and deepen students' understanding of the strategies used. Therefore, future research may consider examining trends in students' mathematical comprehension abilities in light of differences between the "sensing" and "intuition" thinking strategies.

CONCLUSION

This study addresses three main objectives regarding the mathematical problem-solving abilities of vocational high school students in the Software Engineering program, as viewed through the lens of sensing and intuition thinking strategies. First, the profile of students' mathematical problem-solving abilities shows variation across each indicator; the highest achievement was found in the "building new understanding" indicator (57% for sensing and

54.67% for intuition), while the lowest achievement was in the “applying and adapting strategies” indicator (22.99% for sensing and 15.48% for intuition), with the sensing group tending to perform slightly better due to the test instrument’s focus on concrete, procedural steps. Second, the relationship between sensing vs. intuition thinking strategies and mathematical problem-solving ability was relatively weak ($r = -0.278$, $KD = 7.77\%$), proving that Myers-Briggs Type Indicator thinking style tendencies are not the primary determinants of students’ problem-solving achievement.

Third, the resulting pedagogical implications confirm that mathematics instruction for vocational high school students in the RPL program need not be grouped based on sensing or intuition types, but should instead focus directly on comprehensively strengthening each problem-solving indicator such as presenting various problem representations, facilitating a variety of solution strategies, and fostering reflective activities. For future research, it is recommended to develop test instruments or student worksheets that are more balanced in terms of intuition characteristics, as well as to examine the relationship between Myers-Briggs Type Indicator thinking strategies and more relevant cognitive variables, such as mathematical comprehension skills.

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DECLARATIONS

Author contribution

Agus Hikmat Syaf: data curation, writing-original draft preparation and editing, conceptualization, **Annisa Salsa Khinanti:** methodology, validation, visualization, **Rikrik Nurdiansyah:** supervision, software.

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