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Analysis of Students' Mathematical Connections Ability on HOTS Questions Based on Jambi Culture in View of Personality Types

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Abstract: This study aims to analyze students' mathematical connections ability in solving Higher Order Thinking Skills (HOTS) problems based on Jambi culture, viewed from judging and perceiving personality types as categorized by the Myers-Briggs Type Indicator (MBTI). A total of 21 twelfth-grade students from SMA Negeri 3 Sungai Penuh participated in the MBTI test for personality identification. Based on the highest scores in each category, four students (two with judging and two with perceiving personalities) were purposefully selected for detailed analysis. A qualitative case study approach was employed, utilizing HOTS problems with local cultural stimuli, specifically the Kajang Leko traditional house and Padamaran cake, along with structured interview guidelines. Data were analyzed through the stages of reduction, presentation, and conclusion drawing. The results revealed that students with judging personality types had higher scores (average 75%, high category) in mathematical connections ability compared to those with perceiving types (62.5%, moderate category). This difference can be attributed to the characteristics of judging individuals, who tend to be more systematic, structured, and consistent in constructing problem-solving steps, allowing them to connect mathematical concepts more logically. In contrast, perceiving students as flexible and spontaneous tended to be less organized, resulting in difficulties establishing comprehensive conceptual relationships. The novelty of this study lies in its integration of local Jambi culture as contextual stimuli in assessing mathematical connection ability based on personality types. The findings potentially diverge from previous studies, which suggested that perceiving types were more adept at making conceptual connections. This research indicates that local cultural contexts may influence students' cognitive performance according to personality, highlighting the importance of incorporating cultural factors and individual characteristics into the design of mathematics instruction.

Keywords: judging personality, perceiving personality, mathematical connections ability, HOTS questions, jambi culture.

▪ INTRODUCTION

Mathematics is an arithmetic science that is very important in life. As a basic science, mathematics plays a crucial role in various aspects of daily life (Banerjee & Bhat, 2025; Hodaňová & Nocar, 2016a; Sharma, 2021). In addition, mathematics also contributes significantly to various fields of science and technological development (Li et al., 2024; Shurygin et al., 2024). Through mathematics learning, students are expected to understand and apply mathematical connections, both in everyday life and in other disciplines (García-García, 2024; Rodríguez-Nieto et al., 2024; Ledezma et al., 2024)

According to the National Council of Teachers of Mathematics (NCTM, 2000), there are several essential skills to master in learning mathematics, including problem solving, reasoning and proof, communication, connection, and representation. To ensure the learning process is effective, students need to develop these skills, especially connection skills (Dunlap, 2005; Medeshova et al., 2016; Roper, 2007)(Nevgi et al., 2006) (Leikin & Levav-Waynberg, 2007). (Dost, 2024; Drageset & Ell, 2024; Santos-

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Trigo, 2024) defines mathematical connections as the ability to link various mathematical concepts with other disciplines. Meanwhile, Heng & Sudarshan (2013) emphasized that connection is a key element in understanding mathematical concepts and is essential for building a strong foundation in learning new mathematical concepts.

To assess students' ability to determine mathematical connections, it can be done by solving problems classified as HOTS (Higher Order Thinking Skills). To help students develop their HOTS effectively, they need to be introduced to various activities related to HOTS, including the development of mathematical connections skills. Based on research conducted by Zhou et al. (2023), it was found that when working on HOTS-based problems, students with low mathematical connections ability were only able to understand the facts. Meanwhile, students with moderate mathematical connections ability had difficulty in understanding both facts and concepts. On the other hand, students with high mathematical connections ability only experienced difficulties in the aspect of metacognitive knowledge.

In designing HOTS questions, stimuli were often used. These stimuli can be sourced from various global issues, such as information technology, as well as social, economic, health, and educational issues. In addition, stimuli can also come from problems that exist around the environment of the education unit, including culture, customs, and regional characteristics that vary in each region (Yen & Halili, 2015). Education and culture are two essential elements in everyday life. Cultural elements, in particular, have a close relationship with mathematics, as many of its aspects are relevant to mathematics learning (Al-Tarawneh, 2024; Singleton, 1974; Eccles & Wigfield, 2024; Beltrán-Grimm, 2024). Through integrating culture, especially Jambi culture, in mathematics learning, students can more easily understand the material and feel pleasure in learning (Wandari et al., 2018; Putra et al., 2024).

Jambi is one of the provinces in Indonesia that is rich in culture. Jambi citizens have a variety of interesting mathematical ideas to be studied as a source of contextual mathematics learning (Sutrimo et al., 2019). In the process of integrating learning, Jambi culture can be utilized as a medium or object related to flat-sided spaces, such as the kajang leko traditional house and padamaran cake that characterizes the region. The selection of this material is essential, considering that many students have difficulties in solving problems that are relevant to everyday life, because they tend to rely only on formulas. By incorporating the cultural context of Jambi, the learning process can become more meaningful and relevant in every activity carried out (Vrasetya & Nasution, 2024).

Cultural elements have an equal position with mathematical aspects. In this context, Jambi culture is presented in the question as a stimulus. Stimulus is one of the important requirements in making HOTS (Higher Order Thinking Skills) questions (Vrasetya & Nasution, 2024). This integration utilizes Jambi culture as a medium or object related to mathematics problems, especially in flat-sided space building material. The Jambi culture chosen includes the Kajang Leko Traditional House and the distinctive *Padamaran* Cake, because both have a strong relevance to the material of flat-sided spaces.

Kajang Leko is a traditional house from Jambi province, featuring a stilt house design with a triangular prism-shaped roof. The selection of Padamaran cake as an object of study is based on the shape of its container, which resembles a flat-sided space, namely a block, which is very familiar to students' daily lives. This issue is addressed to stimulate students' thinking ability and involve other skills (Vrasetya et al., 2024). The reasoning

Figure 1. *Kajang Leko* traditional house in Jambi

Figure 2. Typical *Padamaran* cake of Jambi

process begins by observing the existing cake containers. From this observation, it is expected that students can determine how to analyze the intent of a problem and develop their ideas to communicate effectively.

To understand students' mathematical connections skills in solving HOTS questions based on the Jambi culture, it is important to evaluate their personality types (Khoiriah, 2018). One method that can be used to identify personality types is the MBTI test (Vrasetya et al., 2024). The test, which is based on Carl Jung's theory, categorizes personality into four scales (Vrasetya & Gunawan, 2024); (Kamid et al., 2018), which form four dimensions of personality types, namely: (1) extrovert vs introvert, (2) sensing vs intuition, (3) thinking vs feeling, and (4) judging vs perceiving. There is a continual flow of papers, often in technical journals, reporting how MBTI types behave in a wide variety of work contexts, though they are often difficult to access. The following are some of these published over the past decade (Amirhosseini et al., 2025; Cerkez et al., 2021; Choong & Varathan, 2021; Goby, 2006)

In this study, we will examine two personality types, namely Judging and Perceiving. Judging (J) and Perceiving (P) are concepts that describe the way individuals interact and respond to their surroundings in everyday life (Salam, 2025; Setiawan et al., 2021; Vorauer et al., 2025a). In contrast, those with the Perceiving type are usually more open, adaptable, and flexible in their decision-making (Effendy, 2025). Understanding students' personality types, particularly the Judging/Perceiving (J/P) dimension, is crucial to examining how they construct mathematical connections and apply their higher-order thinking skills (HOTS) within the cultural context of Jambi. According to Situated Cognition theory, mathematical thinking is inseparable from the socio-cultural context and individual characteristics that shape how students face and solve learning challenges. This research is relevant because it highlights the role of personality in the development of learning strategies that can be tailored to the needs of individual students, in order to support their mathematical connectivity progress. Therefore, the focus of this study is on students with Judging and Perceiving personality types.

Several studies on mathematical connections have delved deeper into students' ability to solve problems, especially in solving HOTS problems. Research conducted by Hariri et al. (2025) and Göktepe Körpeoğlu et al. (2025) showed that the level of students' mathematical connectivity affects the way they formulate problem-solving strategies, where each level of connectivity has a different approach. In addition, Asare et al. (2025) and Johar et al. (2025) found that students with a high level of mathematical connectivity tend to have better problem-solving skills. Furthermore, Septiahani et al. (2020) reported that when solving HOTS problems, students showed a moderate level of mathematical connectivity. This can be seen from the connection between various processes in mathematical concepts, representations of these concepts, and their application in conceptual procedures. The connection between subjects can be seen in the calculation process and in determining the answer, while the connection between mathematics and daily life can be seen from the final results obtained by students.

Several studies have shown that the REACT model, adapted from the ethnomathematics of Kudus local culture, can be an effective alternative in improving junior high school students' mathematical connections skills, as revealed by A'dadiyyah & Malasari (2023). In addition, research by Ningsih (2024) produced an ethnomathematics-based students' worksheet specifically designed to support students' mathematical connections skills in the triangle topic in the seventh grade.

Several studies have examined the Judging and Perceiving personality types in relation to students' mathematical connections ability. For instance, Yıldız-Feyzioğlu & Kıran (2022) explored mathematical connections and disposition skills through the lens of Keirsey's personality types in the context of Model Eliciting Activities (MEA), finding that students with a Judging type tend to struggle in understanding relationships between concepts, which often leads to inaccurate conclusions. Similarly, Khoiriah (2018) found that students with a Perceiving type demonstrated stronger mathematical connections ability compared to their Judging counterparts. However, other studies suggest that Judging-type students may excel in planning and perseverance when tackling complex tasks-skills that could support HOTS in a more structured and systematic way.

These conflicting findings raise a critical question: Is it true that Perceiving-type students are always superior in making mathematical connections and solving problems, or do cultural context and task characteristics also play a decisive role in shaping how each personality type performs? To date, few studies have explicitly examined the interplay between Judging/Perceiving personality types, mathematical connections ability, and HOTS within a local cultural framework such as the Jambi cultural context.

This absence of contextual perspective reveals a significant gap in the literature, especially given that Situated Cognition theory emphasizes that cognitive abilities are inseparable from the socio-cultural environment in which learning takes place. Therefore, a deeper investigation is needed to understand how these three variables interact within culturally responsive mathematics instruction.

Research by Wandari et al., (2018) showed that using Jambi culture-based teaching materials can make teachers and students view math subjects as fun, easy to learn, and interesting. In addition, research by Kamid et al. (2020) highlighted the importance of ethnographic elements and forms of flat geometry found in Jambi culture, such as the structure of the Pondok Tinggi Grand Mosque in Sungai Penuh City. These findings can be used as a reference for developing local culture-based math learning resources. The application of this approach not only aims to introduce and preserve local culture, but also helps students in understanding flat-sided geometry more easily, while providing a deep impression and meaning in mathematics learning.

There are some significant differences between previous studies that address students' mathematical connections in solving HOTS problems based on Jambi culture. Some focus on the impact of local culture on students' mathematical understanding, while others explore the role of personality type in the context of mathematical connections.

▪ METHOD

Participant

The research data were collected from 21 twelfth-grade students at SMA Negeri 3 Sungai Penuh. The MBTI personality test results indicated that several students had Judging and Perceiving personality types, which served as the initial basis for selecting research subjects. A purposive sampling technique was employed to ensure alignment with the research objectives. The selection procedure involved two stages: first, identifying students with clearly dominant Judging or Perceiving traits based on MBTI scores; second, applying additional criteria such as similar academic performance (based on mathematics grades and teacher recommendations), effective communication skills (to support the interview process), and active participation in classroom activities. These additional considerations were intended to control for external factors so that the observed differences could be more accurately attributed to personality type. Only two students were selected to represent each personality type (Judging and Perceiving), resulting in a total of four participants. This limited number of subjects is acknowledged as a constraint; however, it is justified given the exploratory nature of the study, which aims to gain in-depth insights rather than produce generalizable findings. The small sample allows for rich, detailed analysis of individual cases, which is consistent with the goals of qualitative research. As the main instrument in this qualitative inquiry, the researcher was actively involved in the processes of data collection, analysis, and interpretation. The researcher's background as a mathematics education lecturer enabled a reflective and context-sensitive approach to interpreting students' learning behavior. To address potential bias, the researcher engaged in continuous reflexivity throughout the study. Furthermore, to ensure credibility, several validation strategies were implemented, including source triangulation (comparing interview, observation, and documentation data), member checking (confirming findings with participants), and peer debriefing (consulting with experts or academic peers). These procedures were applied to maintain the trustworthiness and rigor of the findings, while recognizing the study's limitations in scope and generalizability.

The students involved in this study were from a high school where mathematics instruction was still predominantly conventional, with limited integration of local cultural contexts into the curriculum. Although they had been briefly introduced to the concept of ethnomathematics through general school activities, most of them had never experienced formal instruction involving culturally rooted mathematical tasks. As such, the use of cultural elements such as *Kajang Leko* traditional houses and *Padamaran* cakes within the HOTS problems was relatively novel to them. Nevertheless, these cultural elements were not entirely foreign to students, as they were generally familiar with them in everyday life through local traditions and community events.

Research Design and Procedures

This research used a qualitative case study approach. By considering Judging and Perceiving personality types, the purpose of this study is to identify students' ability to connect mathematical concepts when solving HOTS problems. Direct observation, analysis of diagnostic test results, and structured interviews with the research subjects were used to construct this description. The research procedure adopted in this study refers to the method proposed by Moleong (2014), which consists of three stages: the pre-field stage, the field research stage, and the data analysis stage. The research process involved several stages. First, students completed the MBTI questionnaire to determine their personality type. Based on the results, students were categorized into Judging and Perceiving groups. Two Judging (J) and two Perceiving (P) students were selected for further examination of their mathematical connections ability test results. The selection was made using purposive sampling, ensuring that the chosen participants represent distinct personality types for an in-depth comparative analysis. In the next step, they were given a mathematical connections ability test, during which they were encouraged to verbalize their thought processes (think-aloud protocol). Their responses were recorded and transcribed for further analysis, such as their connection ability category, their performance in every connection ability indicator, and the connection ability patterns between Judging and Perceiving students

Instruments

The research instrument is a crucial element in this qualitative process. In addition, supporting instruments used in this study included an MBTI-based subject selection questionnaire, a mathematical connections ability test in the form of a task sheet involving HOTS problems embedded in the context of Jambi culture, and an interview guideline aimed at exploring students' mathematical connections. In addition, the supporting instruments used in this study include an MBTI subject selection questionnaire, a connection ability test in the form of a task sheet to solve HOTS problems rooted in Jambi culture, and an interview guideline that aims to explore students' connection abilities. The interview was conducted after the students completed the task, using retrospective questions and probing questions to explore information more deeply.

In this study, the researcher acted as the main instrument responsible for the design, implementation, and data analysis. In addition, this study also used several supporting instruments, namely questionnaires, tests, and interviews. The questionnaires used have been referred from sources that have proven to be valid and reliable and in accordance with the context of this study. The MBTI questionnaire utilized in this study is an established and validated instrument, adapted from Aryanto (2019) and originally based on the Myers-Briggs Type Indicator developed by Myers and Briggs. It includes 40 paired-choice items, with 10 items allocated to each of the four personality dimensions: Extroversion-Introversion, Sensing-Intuiting, Thinking-Feeling, and Judging–Perceiving. The MBTI's validity has been widely supported by earlier research Myers, (1985) and Myers (2003), making further reliability or validity testing unnecessary for this study. Its proven track record ensures dependable and accurate classification of personality types. The use of this well-established instrument provides a solid foundation for analyzing students' personality traits within the framework of previous psychological and educational studies.

Interview guidelines were developed based on ability indicators that had been tested for validity, to ensure the relevance and accuracy of the questions asked. Some examples of interview questions to understand how to explore students' thinking processes are: "How do you transform the given problem in the question into mathematics?", "What is the first thing you need to do to solve the given problem?", "Explain the solution steps from your answer!", and "Did you not try to find another way to solve the given problem?".

The Jambi culture-based HOTS questions were designed through a systematic evaluation process and involved four stages of testing: Expert Review, One-to-One, Small Group, and Field Test. Prototype 1, which has been developed, was submitted to the expert review and One-to-One stages simultaneously to obtain input and initial improvements. In the Expert Review, experts assessed the quality and relevance of the questions, while in the One-to-One stage, the questions were tested individually to evaluate the clarity and understanding of the participants. After that, Prototype 1 was tested in a small group to evaluate the interaction in the group and the suitability of the questions to the context. The last stage, the Field Test was conducted by applying HOTS questions based on Jambi culture in a wider and real-world context. The purpose of this evaluation process is to collect data on the effectiveness and suitability of the questions, as well as to ensure that the designed questions are valid, reliable, and effective before being applied in research. Experts confirmed that 85% of the questions effectively integrated Jambi cultural elements with mathematical concepts and suggested improvements in problem complexity for three items to better align with HOTS criteria. Small group evaluation with 26 participants showed effective collaborative problem-solving for culturally-embedded questions, with an 80% completion rate. The field test conducted resulted in a satisfactory reliability coefficient (α = 0.89) and successful differentiation between HOTS levels.

Figure 3. HOTS problem in the context of *Kajang Leko* traditional house

Figure 4. HOTS problem of typical Jambi *Padamaran* cake

Data Analysis

Data analysis techniques in this research were carried out interactively and continuously at each stage until a complete conclusion was reached. The analysis process involved several key activities: data reduction, data display, data analysis, and conclusion drawing. During the data reduction phase, the data was selected and identified for its relevance to the research questions, then coded to trace its source. In the data display stage, the information was classified and organized into categories to facilitate interpretation, with each category directly linked to components of mathematical connections ability. The overall analysis process included systematically searching and organizing data obtained from students' written responses, interview transcripts, field notes, and documentation. These data were categorized, broken down into units, synthesized, and arranged in patterns to highlight the most critical findings and formulate conclusions that were clear and accessible. Interview data played a central role in this process, serving not only to confirm what was observed in the students' written answers but also to explain the reasoning behind their responses or, in some cases, to challenge initial interpretations. Through this triangulation process, the researcher was able to integrate multiple sources of evidence to strengthen the credibility of the findings. The integration of interviews with written work provided more profound insight into students' mathematical connections ability, especially in the context of solving HOTS problems rooted in Jambi culture, by revealing thought processes that were not always evident in the written responses alone. The scoring guidelines for the mathematical connections ability test, following the explanation given by Rawa & Sutawidjaja (2016), are as follows in Table 2.

Table 1. Categories of mathematical connections ability

Connection Capability Percentage	Category
$0 < x < 50\%$	Low
$50\% < x \leq 70\%$	Medium
$70\% < x \leq 90\%$	High
$70\% < x \leq 90\%$	Very High

Table 2. Scoring rubric for mathematical connections ability

Indicator	Score 1 (Low)	Score 2 (Fair)	Score 3 (Good)	Score 4 (Excellent)
1. Connecting mathematical concepts	Shows no connection between concepts	Shows a basic but inaccurate or unclear connection	Demonstrates logical and relevant connections between concepts	Demonstrates deep and complex interconnections between multiple concepts
2. Connecting concepts to procedures	Uses procedures without understanding the underlying concepts	Connects some procedures to concepts in a limited way	Clearly and logically links procedures with the appropriate concepts	Thoroughly explains procedures based on strong conceptual understanding
3. Connecting multiple representations (verbal, symbolic, visual)	Uses only one representation with no conversion	Uses two representations but inconsistently	Uses multiple representations and shows logical connections among them	Integrates various representations coherently and supportively
4. Connecting mathematics to real-world or cultural contexts (ethnomathematics)	Makes no connection between mathematical concepts and cultural context	Makes a surface-level or limited connection to context	Establishes relevant connections between mathematical ideas and cultural elements	Provides a deep and reflective explanation linking mathematics and cultural context

▪ RESULT AND DISSCUSSION

MBTI Personality Test Results

The first data collection was done by giving the MBTI personality test to 21 students. The purpose of this test was to identify research subjects who have judging and perceiving personality types. The test consists of 15 objective questions, each with two answer choices, namely a and b, which are designed according to the characteristics of judging and perceiving type students. Based on the test results given to 21 students, the data obtained are presented in Table 3.

Table 3. Student personality test results

Personality	Total	Percentage
Judging	13	62%
Perceiving	8	38%
Total	21	100%

The selection of research subjects was based on the MBTI personality test results with the highest scores, using a purposive sampling technique. Details of this selection process can be seen more clearly through the highest questionnaire score presented in Table 4 below:

Table 4. Student personality categorization

No	Student Name	Score	Personality
1	Subject *Judging* 1 (J1)	12	*Judging*
2	Subject *Judging* 2 (J2)	11	*Judging*
3	Subject *Perceiving* 1 (P1)	10	*Perceiving*
4	Subject *Perceiving* 2 (P2)	10	*Perceiving*

Test Results of Jambi Culture-Based Higher Order Thinking Skills Problem-Solving Task Sheet

Furthermore, the research subjects were given a test sheet containing Jambi culture-based HOTS questions. The results of solving the two questions showed variations among the research subjects. The details of the results are presented below:

Problem One: Understanding Flat-Sided Space in the Context of The Kajang Leko Traditional House

The first question discusses the traditional house of Jambi *Kajang Leko*, which is a flat-sided space. Table 5 presents the scores of students' mathematical connections ability.

Table 5. The score of students' mathematical connection ability on problem 1

No	MBTI Type	Score	Category Score
1	Subject *Judging* 1 (J1)	4	VH
2	Subject *Judging* 2 (J2)	3	VH
3	Subject *Perceiving* 1 (P1)	2	L
4	Subject *Perceiving* 2 (P2)	3	H

Table 5 shows the individual performance on question number 1, which addresses the traditional house of Jambi (Kajang Leko) in a flat-sided space context. Among the four participants, one Judging-type student (J1) achieved the Very High (VH) category with a maximum score of 4, demonstrating exceptional ability to apply mathematical concepts in solving HOTS-oriented problems related to Jambi local culture. Two students (J2 and P2) scored 3 points each, placing them in the High (H) category, indicating good mathematical connections ability. One Perceiving-type student (P1) scored 2 points, categorizing the performance as Low (L). The results suggest that while Judging-type students showed a tendency toward higher performance, individual variation exists within each personality type, indicating that mathematical connections ability in cultural contexts may be influenced by factors beyond the J/P personality dimension alone.

Problem Two: Understanding Flat-Shape in the Context of The Padamaran Cake

The topic of the second question focuses on padamaran cake, a typical Jambi food that has a flat shape. The following are the results obtained from students' answers:

Table 6. Scoring results of students' mathematical connections ability on problem 2

No	MBTI Type	Student ID	Score	Category
1	Judging	J1	4	VH
2	Judging	J2	4	VH
3	Perceiving	P1	1	L
4	Perceiving	P2	1	L

Based on Table 6, question number 2, which measures the application of mathematical concepts in Jambi Padamaran cakes, shows distinct performance patterns between personality types. Both Judging-type students (J1 and J2) achieved the maximum score of 4 points, placing them in the Very High (VH) category as they successfully applied mathematical concepts to solve the cultural context problem. In contrast, both Perceiving-type students (P1 and P2) scored only 1 point each, categorizing their performance as Low (L), indicating difficulties in establishing mathematical connections within the Jambi cultural context.

Comparison Judging and Perceiving Type Student on the Mathematical Connections Indicator

Indicator 1. Identifying relationships between different representations of concepts and procedures

In the first mathematical connections ability indicator, which involves identifying relationships between different representations of concepts and procedures, some students were able to organize their understanding and procedures well and provided on answer sheets. Subjects Judging 1 (J1) and Judging 2 (J2) showed that they successfully connected mathematical ideas with local cultural representations, such as in the problem that related the shape of a triangular prism with the roof of the Kajang Leko traditional house. On the other hand, P1 and P2 showed inappropriate understanding of the concept and often made mistakes in the procedure, so their answers were not entirely accurate.

The differences in findings between this study and previous research can be explained through the lens of the local cultural context, which was an integral part of the problem design. In the problem that connected the shape of a triangular prism with the roof of the Kajang Leko traditional house, it was found that students with a strong connection to their local culture were more likely to make accurate representational connections. This suggests that using socially and emotionally familiar contexts can facilitate enhancing mathematical understanding, in contrast to previous studies that employed more general or neutral contexts. Additionally, there is an interaction between the type of contextual problem and students' personality types, judging students more open to exploring culturally rich content, which could contribute to their success in making mathematical connections. Therefore, the use of local cultural contexts should not be seen merely as an optional variation but rather as a central component in the design of mathematics learning and assessment, as it provides authentic opportunities for constructing meaning and conceptual connections.

This is in line with the findings of Widiyawati et al. (2020), who observed that students often provide answers without deep understanding or following systematic steps. Students must be able to connect concepts and procedures that have been learned in order to solve contextual problems (García & Flores, 2018). The assessment of the first indicator shows that students with a judging personality have a better tendency to build concept connections compared to perceiving type students. This is consistent with research Hakim et al. (2023), which states that perceiving type students often process information with a flexible approach, but do not always produce accurate modeling.

Indicator 2. The ability to understand relationships between topics in mathematics

The second mathematical connections ability indicator is the ability to understand relationships between topics in mathematics. J1 and J2 showed a fairly strong understanding. They were able to relate various mathematical topics such as surface area, volume, and modeling the spatial structure of Jambi traditional houses. In contrast, P1 and P2 faced challenges in connecting various topics. Students often just copied the problem into a mathematical modeling format without successfully applying other concepts correctly. The average percentage of student completion in the first problem was 75%, indicating that there were still some students who had not achieved complete mastery of inter-topic connection skills.

This finding is in line with the study of Putri & Nasution (2023); Vrasetya & Gunawan (2024) and Indriani & Noordyana (2021) that state many students still have difficulty understanding the relationship between topics because they forget the previous material. This is exacerbated by students' tendency to memorize formulas without understanding their conceptual meaning (Rusliah et al., 2021; Arwadi et al., 2021). Therefore, it is important to develop learning that encourages students to think reflectively and link topics meaningfully.

Based on the analysis of students' personality types, it was found that students with Judging personality (J1 and J2) showed a good ability to connect various mathematical topics when solving problems. They tend to plan the solution steps in a structured and organized manner, so that their thought process and solution procedures are reflected on the answer sheet. On the other hand, students with the Perceiving type were also able to solve the problem well, although their approach was more flexible. They manage information based on facts that have been learned and follow the solution steps systematically, although with a style that is more open to changes in strategy. This finding supports the results of research (Faradilla & Nasution, 2024), which states that students with judging personality type tend to have good ability in connecting various topics and identifying relevant information in solving math problems.

In the second indicator, students with perceiving personality (P1 and P2) faced challenges in understanding the mathematical relationship between the concepts of flat buildings and the shape of the Padamaran cake. This difficulty was caused by their inability in the early stages to identify the relationship between the shape of the cake and the relevant geometry properties. This led to their inaccurate answers when explaining the relationship between the topics mathematically. On the other hand, students with the judging personality were able to build the connection between concepts more effectively, so they showed better understanding in this indicator.

Indicator 3. Apply mathematical concepts to other fields

Meanwhile, in the third indicator that assesses students' ability to apply mathematical concepts to other fields, the results shown in Table 5 are quite satisfactory. All students can relate the problems given to other disciplines, such as science, economics, or the context of everyday life. They also managed to transform the contextual problem into an appropriate mathematical model, as well as develop the next steps of the solution effectively. This ability reflects good conceptual understanding and higher-order mathematical thinking skills (Anggraini & Fauzan, 2020). Research by Widyatma & Ramadhani (2024) showed that students who can represent problems in the form of mathematical models tend to have no difficulty in understanding the context of the problem, especially those related to real situations. Thus, the integration of concept understanding and cross-field application is an important indicator in assessing students' readiness to think mathematically holistically.

In terms of personality type, both judging and perceiving students showed similar abilities in connecting mathematics with other disciplines (Faradilla & Nasution, 2024; Ramayudha, 2021). This finding is consistent with the results of research (Vrasetya & Nasution, 2024); (Qonitah & Kusaeri, 2024), which states that students' ability to connect topics systematically is highly depend on their understanding of the integration of mathematics with other fields. Figures 5 and 6 present examples of answers from students with the Judging and Perceiving personality type.

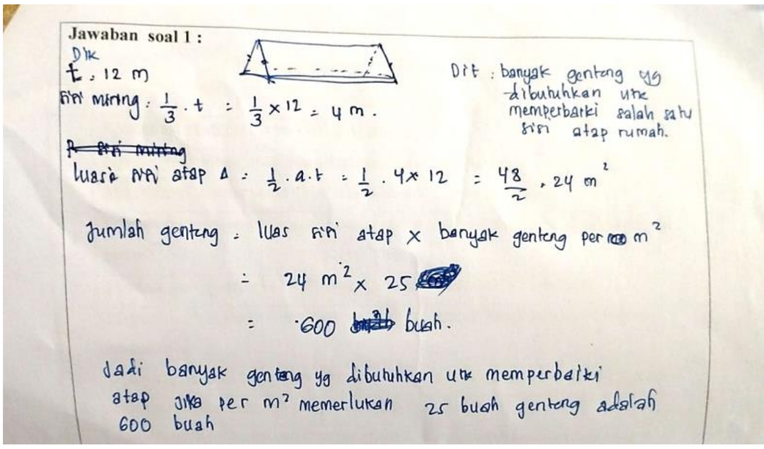

Figure 5. Student answers on judging personality

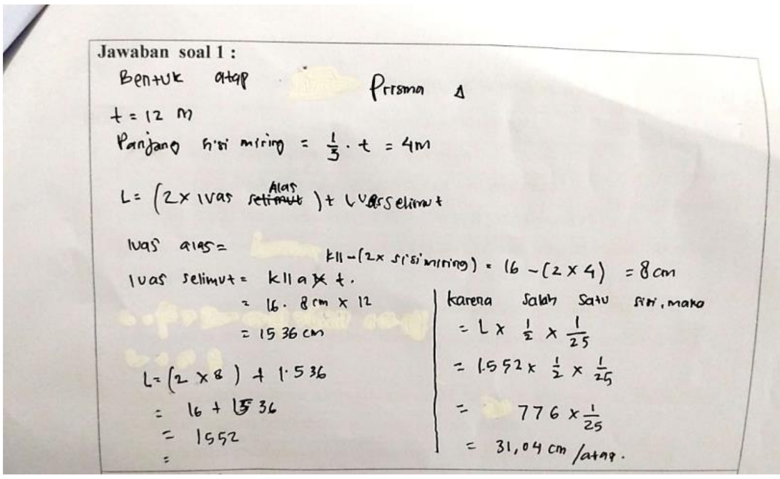

Figure 6. Answers of students with perceiving personality

In Figure 5, it can be seen that students with Judging personality showed better results in solving the problem of connecting the typical Jambi Padamaran cake with mathematical concepts, as reflected in their total score. In the first indicator, students with a perceiving personality type had difficulty connecting the concept of Padamaran cake with flat shapes. This can be seen from the answers of Perceiving 1 and Perceiving 2

Subjects, where they only wrote down the shapes and calculated without providing a logical explanation of the relationship between flat shapes and the required calculations. Although both subjects tried to find the relationship, the explanations given were inappropriate and less systematic.

Further support from interview data revealed that the difficulties experienced by students with a perceiving personality type were not solely due to carelessness, but rather rooted in a conceptual misunderstanding. For example, Subject P1 explained during the interview that they perceived the Padamaran cake only as a whole object without associating its parts with basic geometric shapes. This indicates a lack of understanding in decomposing real-world objects into mathematical components. Similarly, Subject P2 stated that they were unsure how to relate the calculation to the shape's dimensions, revealing confusion about the properties of two-dimensional figures. These findings highlight that the students' incorrect or incomplete written responses were influenced more by misconceptions than by inattention, thus reinforcing the importance of connecting visual representations with formal geometric understanding in culturally contextualized problems.

In contrast, students with judging personality types, such as Judging 1 and Judging 2 Subjects, successfully connected the concept of flat shapes with the procedure for calculating the dough needed to make padamaran cakes. Their answers seemed more systematic, detailed, and logical in explaining the concept relationships used. This shows that students with a judging type can process information with a more structured approach, in accordance with their personality characteristics.

The results in the third indicator also show a similar pattern. Students with a judging personality gave more precise and systematic answers compared to perceiving type students. The relationship between the three indicators shows that if the achievement on the initial indicator is not substantial, then the achievement on the next indicator will also be affected. Analysis of the answer sheets showed that Perceiving 1 and 2 had difficulty in compiling logical solution steps, so their understanding of the relationship between concepts was hampered. This has a direct impact on their ability to apply mathematical concepts to real-life contexts, such as calculating the ingredients needed to make traditional food. The example of a student's answer with a perceiving and judging personality type is presented in Figures 8 and 9, respectively.

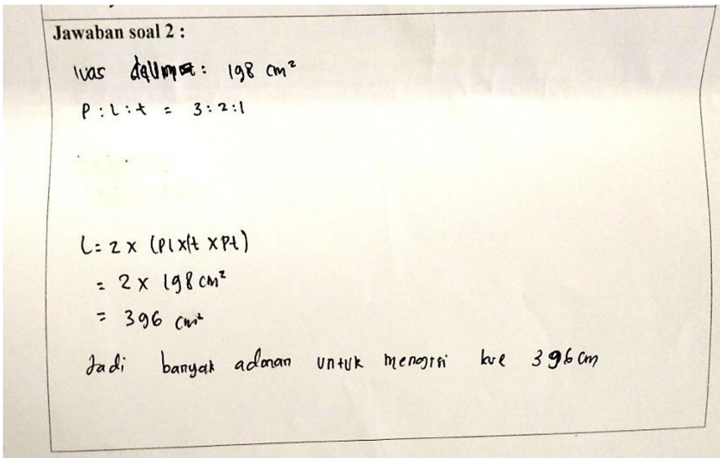

Figure 8. Students' answers with perceiving personality

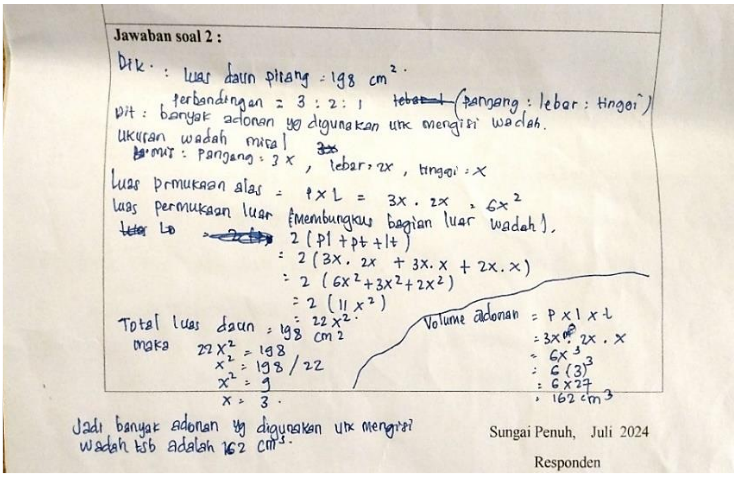

Figure 9. Students' answers with judging personality

Analysis of the answer sheets showed that students with a perceiving personality tended to handle the problems with a spontaneous and flexible approach, but less systematic, so there were often errors in connecting concepts. They also did not conduct an in-depth evaluation of the data presented in the problem, which led to inaccuracies in the conclusions made. In contrast, students with judging personalities were more careful and systematic in solving the problems, which had an impact on the accuracy of their work.

Research by Ade (2022) and Faradilla & Nasution (2024) shows that students with a judging personality type tend to see data systematically and arrange problem-solving based on concrete information that has been learned, so they are more accurate in connecting mathematical concepts. In contrast, students with the perceiving type do have flexibility in thinking, but lack depth of analysis and regularity of solution steps. This finding supports the theory that students with a judging type process data based on structured and planned procedures. In contrast, students with a perceiving type are more reactive and often rely on intuition in solving problems (Khodriyah et al., 2019).

The results of this study are also different from the findings of Ramayudha (2021), which states that the mathematical connections ability of judging type students is higher than the perceiving type. This difference can be caused by the local cultural context used in the problem, the learning approach, as well as the different characteristics of the research sample (Vrasetya & Nasution, 2024). In the context of Jambi culture, such as the Kajang Leko traditional house and Padamaran cake, a systematic and realistic approach seems to be more beneficial for students with judging personalities. A deeper analysis is needed to determine whether students' familiarity with these cultural objects influenced their performance. Subjects J1 and J2 were more familiar with the structure of the Kajang Leko house or had prior experience in making or observing the padamaran cake, which could have provided them with a cognitive advantage in translating these cultural representations into mathematical models. This familiarity has made it easier for them to decompose the real-world objects into geometric elements, thus facilitating stronger connections between representations and procedures. Therefore, the role of cultural familiarity emerges as a potential confounding variable that should be acknowledged in interpreting the results. Future studies need to control for this factor by assessing students' prior exposure to the cultural context used in the tasks.

Overall, this difference in results confirms the importance of considering the learning context, student characteristics, and instructional approaches in assessing students' mathematical connections ability. This research confirms that personality type influences the way students process information, structure solution steps, and connect mathematical concepts, especially in the context of local culture. Therefore, culture-based learning that considers students' personality differences can be an effective approach to improve students' overall mathematical connections ability.

Pedagogically, mathematics teachers are encouraged to design learning activities that integrate local cultural contexts to make abstract mathematical concepts more relatable and meaningful. Additionally, teachers should consider varying their instructional strategies to accommodate both judging and perceiving personality types, for example, by providing structured problem-solving frameworks for students who prefer order, while allowing more open-ended, exploratory tasks for those who thrive with flexibility. Diagnostic tools or informal assessments can also be used early on to identify students' personality tendencies and familiarity with cultural elements, enabling teachers to tailor scaffolding and support accordingly. These steps can foster deeper conceptual understanding and ensure that all students, regardless of personality type, have equitable opportunities to connect mathematics with their lived experiences.

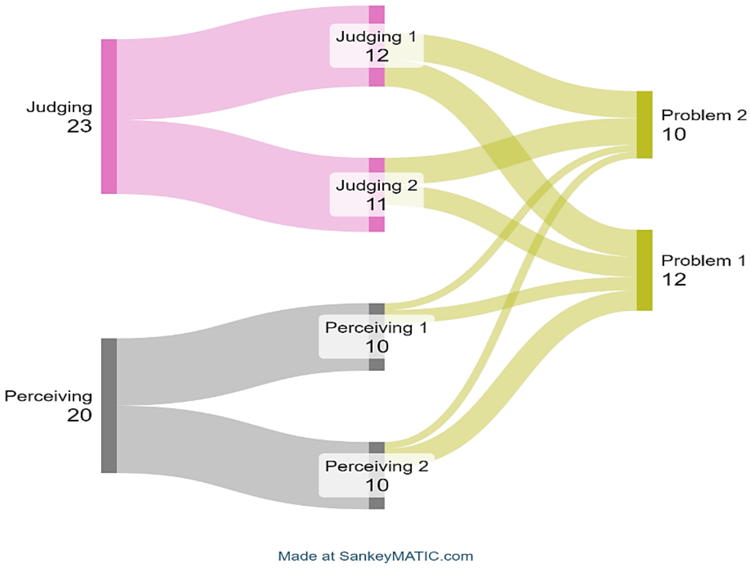

Figure 10. Illustrates the relationship between MBTI types

The characteristics of students with the types of Perceiving (P) and Judging (J) can be directly attributed to the Sankey diagram shown in Figure 10. The diagram indicates that students with the Perceiving type, which is divided into Perceiving 1 and Perceiving 2, possess mathematical connections ability, as evidenced by scores of 2 and 3 in problem 1 and 1 in problem 2, respectively. Although the number of participants from Perceiving was significant, the flow to Problems 1 and 2 from this group was not as substantial as the flow from the Judging group, which had scores of 4 and 3 on Problem 1 and a score of 4 on Problem 2, respectively. The diagram shows that the Judging flow on both problems is thicker than the Perceiving flow. The Judging group shows a strong and directed stream, which supports the argument that this type tends to be more organized and systematic, thus being better able to relate mathematical concepts to local cultures accurately.

This is in line with the findings in the discussion that students with the Perceiving type tend to have a flexible but less systematic approach, so they are less successful in compiling structured answers or connecting mathematical concepts with cultural contexts (such as the shape of a padamaran cake with geometric concepts). In Sankey's diagram, their contributions were evenly divided and relatively smaller than the Judging group's, illustrating their lack of consistency and depth of understanding in solving both types of problems.

▪ CONCLUSION

This study demonstrates that personality type significantly affects students' mathematical connections ability, particularly when solving HOTS problems embedded in culturally contextualized settings. Students with a judging personality type tend to exhibit more structured, logical, and systematic reasoning when connecting mathematical concepts to real-life contexts, as seen in tasks related to Jambi cultural objects such as the Kajang Leko traditional house and the Padamaran cake. In contrast, students with a perceiving personality type, while generally more open and flexible, often lacked a coherent structure in their problem-solving process, which hindered their ability to make meaningful conceptual connections. These findings underscore the critical role of both personality traits and cultural relevance in shaping students' mathematical thinking, highlighting the need for more personalized and context-sensitive approaches in mathematics education to enhance students' higher-order cognitive skills.

The implications of this study suggest that mathematics educators should not only integrate local cultural contexts into instruction but also adapt teaching strategies based on the personality characteristics of their students to maximize engagement and understanding. However, this study is limited by its relatively small sample size, which may affect the generalizability of the findings. Future research should involve larger and more diverse student populations across multiple cultural settings to validate and expand upon these results. Additionally, future studies could explore how instructional design can be differentiated more systematically to align with various personality types in culturally meaningful ways. Effective mathematics learning must go beyond abstract formulas; it must also resonate with students' cultural identities and psychological profiles to truly unlock their cognitive potential.

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