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Logical Thinking in Idealist and Rational Students

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Abstract: The purpose of this study is to describe students' logical thinking based on Keirsey's personality types, specifically the Idealist and Rational types, within the topic of social arithmetic. The research adopts a descriptive qualitative approach. Data collection involves three techniques: MBTI (Myers-Briggs Type Indicator) surveys, logical thinking written tests, and semi-structured interviews. The study participants consist of students from classes VII A, VII B, and VII C at SMP Muhammadiyah 9 Watukebo. The research subjects include four students: two with Idealist personality types and two with Rational personality types according to Keirsey's classification. The findings indicate that none of the research subjects fully meet the three logical thinking indicators, which are grouped into six points. However, there is one indicator that all subjects were able to achieve: the first indicator related to coherence of logical thinking (point B), which involves expressing the general steps used in problem-solving. On the other hand, there are indicators that none of the research subjects were able to fulfill completely. These include the second indicator concerning argumentation ability (point A), which involves articulating the logical reasons for using general steps in problem-solving, and point C, which pertains to expressing the logical reasons behind the correct final answer. Among the research subjects, the subject who successfully fulfills the good logical thinking indicator is the second subject with a rational personality type according to Keirsey's classification.
Keyword: logical thinking, keirsey personality types, idealist, rasional

INTRODUCTION

The introduction contains background, problems, and literature review. In addition to the literature review, references can be in the form of relevant research. How to write the source in the text needs to indicate the source citation, in the form of the author's name, year of publication, and the page where the manuscript is located.

The purpose of mathematics education is to assist students in developing their mathematical potential. Mathematics has an impact in all fields, so students are strongly encouraged to further develop their mathematical potential (Subrahmayam, 2021). Furthermore, Minister of National Education Regulation Number 22 of 2006 states that the purpose of mathematics learning is to develop reasoning abilities. Reasoning is the process of thinking or an activity aimed at drawing conclusions or creating new statements based on existing evidence and facts (Sumartini, 2015). When a student is able to draw conclusions, it can be said that their reasoning ability is functioning. The ability of mathematical reasoning is the capacity for logical thinking to derive conclusion (Kartono & Shora, 2020). Reasoning abilities are closely related to logical thinking. Logical thinking ability is an individual's capacity to solve problems not only based on existing procedures but also with a strong foundation of truth underlying those procedures (Syawahid, 2015).

Logical thinking ability is an endeavor to prepare and equip students at the primary and secondary education levels. By studying mathematics in school, students are expected to enhance their reasoning abilities, which will subsequently support their logical thinking skills (Nursuprianah & Fitriyah, 2012). Students who possess strong mathematical reasoning abilities will achieve better learning outcomes in mathematics (Adegoke & Benson, 2013). Mathematical knowledge is acquired through reasoning, not through experimental or observational reasoning (Erdem, 2015). One of the topics covered in the formal mathematics curriculum for junior high school (SMP/MTs) is social arithmetic. Within the realm of social arithmetic, various story problems align with real-

life situations. Social arithmetic also delves into financial calculations related to trade, which are commonly encountered in daily life. The content of social arithmetic includes concepts such as discounts, profits, losses, gross, net, and more. According to Inayah (2018), by presenting word problems closely tied to everyday life, it will train students' abilities in logical thinking and reasoning, thereby strengthening their mastery of mathematical concepts. Additionally, it will assist students in drawing conclusions.

The diverse logical thinking abilities of students also lead to variations in their answers during problem-solving processes. Students who can develop their logical thinking abilities will be able to solve problems easily (Sumarsih, dkk., 2018). Apart from students' reasoning abilities, another factor influencing successful problem-solving is students' character. Different characteristics among students necessitate the teacher's attention, which ultimately enhances the effectiveness of learning and teaching, particularly concerning students' personality traits. According to Muryati (2016), an individual's characteristics are closely related to their personality. Personality, as defined by Atkinson, encompasses behavioral patterns and distinctive ways of thinking that determine an individual's adaptation to their environment. The term "distinctive" implies behavioral consistency, indicating that people tend to act or think in specific ways across various situations. The multitude of behavioral differences among individuals gives rise to various personality types. One such personality classification is the Keirsey personality type.

Agustin (2018) states that Keirsey's personality is a personality that classifies his personality type based on the pattern of visible behavior but more on how a person thinks. The tendency in thinking based on this personality type which later researchers will link to students' logical thinking ability. Logical thinking of a person will vary according to what is considered true or believed to be true based on reasoning or certain logics. Through these differences, researchers believe that there are differences that appear in students' logical thinking abilities according to personality type, one of which is Keirsey's personality type. Keirsey's personality type is divided into 4, namely guardian, artisan, rational and idealist (Keirsey & Bates, 1985). This type of grouping is based on temperament sorter. Temperament sorter is a personality instrument that is widely used to find out a person's personality through strong questions to help individuals find a person's personality (Keirsey & Bates, 1984). This study will discuss the idealist and rational personality types.

Sumarmo, et al (2012) state seven abilities used to measure logical thinking skills, namely; 1) Draw conclusions or make, estimates and interpretations based on appropriate proportions. 2) Draw conclusions or make estimates and predictions based on chance. 3) Draw conclusions or make estimates or predictions based on the correlation between two variables. 4) Determining the combination of several variables. 5) Analogy is drawing conclusions based on the similarity of two processes 6) Conducting proof. 7) Compile analysis and synthesis of several cases. The same thing was also stated by Andriawan (2014) where there are 3 characteristics in logical thinking skills, namely (1) order of thinking, in the form of students being able to determine the steps of solving a given problem from start to finish until a conclusion is obtained (2) argumentative ability, in the form of students being able to provide logical arguments based on existing facts or information regarding problem planning and problem solving that will be used (3) conclusion drawing, in the form of students being able to draw a conclusion from a problem based on the problem solving process that has been carried out. Based on the three characteristics above, it becomes a reference for researchers to be used as indicators of logical thinking.

<div align="center">Table 1. Logical Thinking Indicators</div>

No	Logical thinking indicators	Description
1.	Logical thinking order	Students can mention all the information obtained from the problem (known and asked). Students can express in general the steps that will be used in problem solving
2.	Argumentation skills	Students can express logical reasons for all the solution steps that will be used from the beginning to the correct conclusion. Students can solve the problem correctly at each step and can provide arguments for each step used in problem solving. Students express logical reasons for the correct final answer.
3.	Drawing conclusions	The student draws accurate conclusions at each step of the solution. The student arrives at a precise conclusion for the final answer.

The idealist personality type is characterized by students who are interested in materials related to ideas. This type tends to prefer working on tasks independently rather than in groups. Idealists particularly enjoy activities such as reading and writing. They also favor smaller class sizes over larger ones, as larger classes can be distracting to their learning activities. Personality types classified as idealists include ENFJ (Extrovert, Intuitive, Feeling, Judging), INFJ (Introvert, Intuitive, Feeling, Judging), ENFP (Extrovert, Intuitive, Feeling, Perceiving), and INFP (Introvert, Intuitive, Feeling, Perceiving).

The rational personality type is characterized by individuals who appreciate explanations based on logic. This type enjoys learning about science, mathematics, and philosophy. Preferred learning models for this type include experiments, exploratory discoveries, and solving complex problems. Rationals like to explore books they have not studied before as they enjoy acquiring new knowledge or information. They tend to disregard unnecessary materials that they perceive as time-wasting. Personality types classified as rationals within the Keirsey personality framework include ENTJ (Extrovert, Intuitive, Thinking, Judging), INTJ (Introvert, Intuitive, Thinking, Judging), ENTP (Extrovert, Intuitive, Thinking, Perceiving), and INTP (Introvert, Intuitive, Thinking, Perceiving).

METHOD

The research conducted by the researchers was using a qualitative approach. In this study, the researchers analyzed the logical thinking of seventh grade students of Muhammadiyah 9 Watukebo Middle School on the subject of social arithmetic based on Keirsey's personality. The data that will be obtained from this study are data on Keirsey's personality type which can be obtained through the distribution of questionnaires. The provision of social arithmetic problems is intended to measure the logical thinking of seventh-grade students in the selected research subjects based on the Keirsey personality types. The final step is to interview students who are selected in each Keirsey personality type, namely idealist, and rational.

The next step following the interview process with mathematics teachers is the administration of a questionnaire in the form of the Myers-Briggs Type Indicator (MBTI) personality test. Through the questionnaire, the classification of students' personalities based on the Keirsey personality types will be revealed. Subsequently, two students with idealist personality types and two students with rational personality types will be selected. The questionnaire used is the MBTI (Myers-Briggs Type Indicator) test. By administering the MBTI test, the dominant aspects of students' personalities in terms of

extroversion (E) or introversion (I), sensing (S) or intuition (N), thinking (T) or feeling (F), and judging (J) or perceiving (P) will be identified.

The questionnaire will be given a time limit of 40 minutes (one class period). The questionnaires will be distributed to each student to be filled out based on their own beliefs, as there are no incorrect answer options. After completion, the questionnaires will be collected or returned to the researcher. Subsequently, the researcher will conduct corrections to determine the personality type based on students' responses to the MBTI (Myers-Briggs Type Indicator) personality questionnaire.Following the correction of the MBTI personality test questionnaires by the researcher, four letters corresponding to the responses will be formed, indicating the students' personalities. These four letters will be classified into two Keirsey personality types, including idealist and rational. Next, the four selected students will work on problems related to social arithmetic. The written responses of the students, once checked, will be associated and adjusted with three logical thinking indicators. This process aims to determine the extent of the students' logical thinking based on the achievement of logical thinking indicators.

RESULT AND DISCUSSION
1. **Idealist Personality Type**
   a. **Subject 1**
      Written Test Results Subject ID1

The following is an excerpt from the interview with ID1
Here is the translation in English for a scientific article:

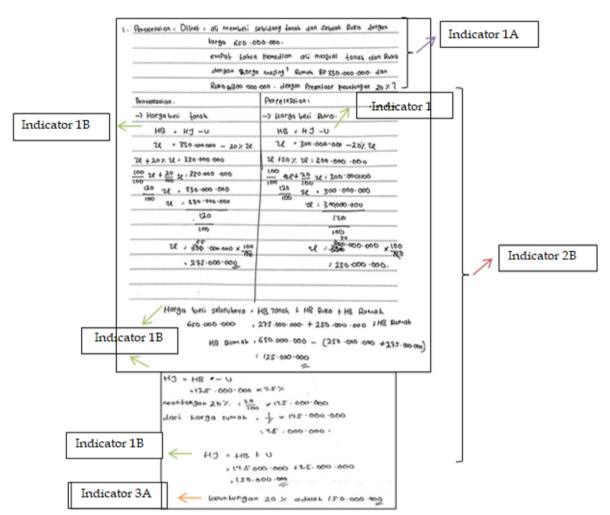P003 : "In reading the question, can you comprehend the presented problem?"
ID1004 : "Yes, ma'am, I understand."
P005 : "Then, what are the things that are known in question number 1?"
ID1006 : "It is known that the price of 3 assets is Rp. 650,000,000.00, then four years later the shop was sold for Rp. 330,000,000.00 and the land was sold for Rp. 300,000,000.00."
P007 : "Next, what is asked in question number 1?"
ID1008: : "The selling price of the house if it gets a 20% profit."
P09 : "Why didn't you write 20% profit in the part that was asked? You only wrote the selling price of the house?"
ID1010 : "Oh, yes, I missed writing that."
P011 : "Please review it more carefully, even though it's a small detail, as it is also important information that you need to write."
ID2012 : "Yes, ma'am."
P013 : "What steps can you take to solve question number 1?"
ID1014 : "Find the purchase price of the shop, land and house, then from the known purchase price of the house, the selling price can be found by adding the purchase price with a 20% profit."
P015 : "What logical reasons support the correctness of the solution steps you took?"
ID1016 : "In my opinion, based on the information given in the question and what is asked, the correct solution step is to find the purchase price of the three assets first, ma'am."
P017 : "Why didn't you write down the logical reason on the answer sheet as a reinforcement of the general solution step that you chose?"
ID1018 : "Hehe, I didn't know that I had to write it down. As far as I know, I just have to write down the steps."
P019 : "Do you think the solution step that you wrote down is correct?"
ID1020 : "Yes, ma'am, it's correct."
P021 : "Are you sure that the answer you got is correct?"
ID1022 : "Sure, ma'am, I didn't make any mistakes in calculation."
P023 : "Did you encounter any difficulties in solving problem number 1?"
ID1024 : "No, ma'am, because I already got the material from the math teacher."
P025 : "What conclusion did you get after working on problem number 1?"
ID1026 : "So, the selling price of the house with a 20% profit is 150,000,000.00"
P027 : "What logical reason underlies you getting the final answer?"
ID1028 : "That's based on my answer explanation that the purchase price of the shop is Rp. 250,000,000.00 then the purchase price of the land is Rp.275,000,000.00 so the purchase price of the land can be known, which is Rp.125,000,000.00 then because it is sold with a 20% profit, the selling price of the house is Rp.150,000,000.00."

Based on the above results, it can be concluded that the logical reasoning skills at point A involve students being able to state all the information obtained in the question (known and asked), and the argumentation skills at point A involve students expressing logical reasons for all the solution steps to be used from the beginning to the correct conclusion. Argumentation skills at point B involve students being able to solve the problem correctly at each step and provide arguments for each step used in problem-solving. Argumentation skills at point C involve students expressing logical reasons for

the correct final answer. Drawing conclusions indicates that students arrive at a conclusion accurately in the final result of the answer.

b. **Subject 2**
   Written Test Results Subject ID2

The following is an excerpt from the interview with ID2

P003 : "From reading the question, can you understand the presented problem?"
ID2004 : "Yes, ma'am, I understand."
P005 : "Next, mention what information is known in question number 1?"
ID2006 : "It is known that the purchase price of three assets is Rp. 650,000,000. Then, four years later, the shop is sold for Rp. 330,000,000, and the land is sold for Rp. 300,000,000."
P007 : "What is asked in question number 1?"
ID2008 : "The selling price of the house when a 20% profit is obtained."
P009 : "You mentioned what was asked, but why didn't you write it completely in your answer sheet?"
ID2010 : (looking at the answer sheet) "Oh, yes, ma'am. I wrote it continuously; it should have been on the next line and with an explanation that it was being asked."
P011 : "What steps can you take to solve question number 1?"
ID2012 : "First, find the purchase price of the three assets, and then calculate the selling price of the house by adding a 20% profit."
P013 : "What logical reasons support the correctness of the solution steps you

		provided?"
ID2014	:	"In my opinion, considering the questions at hand, it appears to be accurate as it is."
P015	:	"Why didn't you write down the logical reason on the answer sheet as a reinforcement of the general solution steps that you chose?"
ID2016	:	"I don't know, ma'am, if I have to write it down, because I usually never write it down."
P017	:	"Do you think the solution steps and answers you wrote are correct?"
ID2018	:	"Yes, ma'am, correct."
P019	:	"Did you encounter any difficulties in solving problem number 1?"
ID2020	:	"No, ma'am, because I have done it in class with the teacher."
P021	:	"What conclusion did you get after working on problem number 1?"
ID2022	:	"So, the selling price of the house with a 20% profit is 150,000,000.00"
P023	:	"What logical reason underlies you getting the final answer?"
ID2024	:	"Because the purchase price of the house is 125,000,000, so the selling price with a 20% profit is 150,000,000."
P025	:	"Why didn't you write it down on the answer sheet?"
ID2026	:	(while looking at the answer sheet) "Oh yes, ma'am, I forgot, I was in a hurry hehe."

Based on the results above, it can be concluded that the logical thinking sequence at point A is that students can mention all the information obtained from the problem (known and asked), the logical thinking sequence at point B is that students express in general the steps that will be used in problem solving. Argumentation ability at point A is that students can express logical reasons for all the solution steps that will be used from the beginning to the correct conclusion, argumentation ability at point B is that students can solve the problem correctly at each step and can provide arguments for each step used in problem solving, argumentation ability at point C is that students express logical reasons for the correct final answer. Conclusion drawing is that students get a correct conclusion at the final answer.

2. Rational Personality Type
a. Subject 1

The following is an excerpt from the interview with RA1

P003	:	"From reading the question, can you understand the question that has been presented?"
RA1004	:	"Sure thing, ma'am, got it."
P005	:	"Then, what are the things that are known in question number 1?"
RA1006	:	"It is known that the purchase price of 3 assets is Rp. 650,000,000.00, then four years later the shop was sold for Rp. 330,000,000.00 and the land was sold for Rp. 300,000,000.00."
P007	:	"Then, what is asked in question number 1?"
RA1008	:	"The selling price of the house if it gets a 20% profit."
P009	:	"You can talk about what's being asked, but why don't you write it down completely on the answer sheet?"
RA1010	:	(looking at the answer sheet) "Oops, yeah, ma'am, I forgot to write

		down what was asked."
P011	:	"Alright, you're aware of your shortcomings. Moving forward, you need to be more meticulous and not rush when working on it. So, what steps can you take to solve question number 1?"
RA1012	:	"Finding the purchase price of the three assets, ma'am, then later the selling price of the house can be determined by adding the purchase price with a 20% profit."
P013	:	"What logical explanations underpin the accuracy of the solution steps you have written?"
RA1014	:	In my perspective, it's more convenient to initially determine the purchase prices of the three assets, considering that the known information includes their purchase prices, and the question concerns the selling price after 4 years with a 20% condition, ma'am."
P015	:	"Why didn't you write down this logical reason on the answer sheet as a reinforcement for the general solution steps you chose?"
RA1016	:	"Hehe, I wasn't aware it had to be written, ma'am, as typically, only the steps along with their explanations are usually necessary."
P017	:	"Alright, please pay more attention in the future. In your opinion, are the solution steps and answers you provided correct?"
RA1018	:	"Yes, ma'am, it's correct."
P019	:	"Did you encounter any difficulties in solving problem number 1?"
RA1020	:	"No, ma'am, because it has been discussed in class with the teacher."
P021	:	"What conclusion did you get after working on problem number 1?"
RA1022	:	So, the selling price of the house with a 20% profit is 150,000,000.00"
P023	:	"What logical reason underlies you getting the final answer?"
RA1024	:	"Because the purchase price of the house is 125,000,000 and calculated with a 20% profit results in an additional money of RP 25,000,000.00 so the total selling price is Rp. 150,000,000."
P025	:	"Why didn't you write it down on the answer sheet?"
RA1026	:	"I wrote it down, ma'am, above the conclusion, only not in the form of a sentence. Please take a look again."
P027	:	"Okay, I didn't pay attention to the details. Thank you."
RA1028	:	"Okay, ma'am, you're welcome."

Based on the results above, it can be concluded that the logical thinking sequence at point A is that students can mention all the information obtained from the problem (known and asked), the logical thinking sequence at point B is that students express in general the steps that will be used in problem solving. Argumentation ability at point A is that students can express logical reasons for all the solution steps that will be used from the beginning to the correct conclusion, argumentation ability at point B is that students can solve the problem correctly at each step and can provide arguments for each step used in problem solving, argumentation ability at point C is that students express logical reasons for the correct final answer. Conclusion drawing is that students get a correct conclusion at the final answer.

b. **Subject 2**
   Written Test Results Student No. RA2

The following is an excerpt from the interview with RA2:

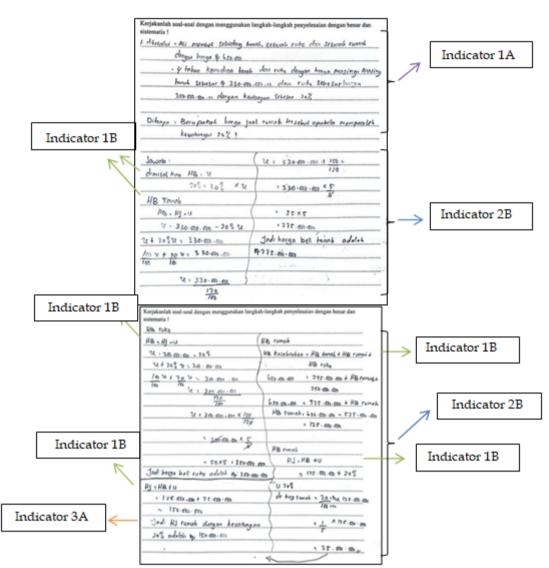P003 : "From reading the question, can you understand the question that has been presented?"

RA2004 : "Yes, ma'am, I understand."

P005 : "Then, what are the things that are known in question number 1"

RA2006 : "It is known that the purchase price of 3 assets is Rp. 650,000,000.00, then four years later the shop was sold for Rp. 330,000,000.00 and the land was sold for Rp. 300,000,000.00."

P007 : "Then, what is asked in question number 1?"

RA2008 : "The selling price of the house if it gets a 20% profit."

P009 : "Then what steps can you take to be able to solve question number 1?"

RA2010 : "Find the purchase price of the three assets, ma'am, then the selling price of the house can be found by adding the purchase price with a 20% profit."

P011 : "Then what kind of logical reason supports the solution steps that you have written are correct?"

RA2012 : "In my opinion, because the purchase price is known and the selling price is asked after 4 years with a 20% condition, it is easier to find the purchase price

		of the three assets first, ma'am."
P013	:	"Why didn't you write down the logical reason on the answer sheet as a reinforcement of the general solution steps that you chose?"
RA2014	:	"Hehe, I didn't realize it was necessary to put it in writing, ma'am, since usually, I just record the steps along with their explanations."
P015	:	"Sure, keep a closer eye on it in the future. In your opinion, are the solution steps and the answer you wrote correct?"
RA2016	:	"Yes, ma'am, it's correct."
P017	:	"Did you encounter any difficulties in solving problem number 1?"
RA2018	:	"No, ma'am, because it has been discussed in class by the teacher."
P019	:	"What conclusion did you get after working on problem number 1?"
RA2020	:	"So, the selling price of the house with a 20% profit is 150,000,000.00"
P021	:	"What logical reason underlies you getting the final answer?"
RA2022	:	"Because the purchase price of the house is 125,000,000 and calculated with a 20% profit resulting in an additional money of RP 25,000,000.00 so the total selling price is Rp. 150,000,000."
P023	:	"Why didn't you write it down on the answer sheet?"
RA2024	:	"I didn't pay enough attention, ma'am, and that's why I forgot to write it down."
P025	:	"Okay, keep a closer eye on that in the future. Thanks a lot."
RA2026	:	"Okay, ma'am, you're welcome."

Based on the results above, it can be concluded that the logical thinking order for point A involve students being able to state all the information obtained from the question (both known and asked). For point B, the logical thinking requirement is that students express, in general terms, the steps that will be used in problem-solving. Argumentation skills for point A involve students being able to articulate logical reasons for all the solution steps used, from the beginning to the correct conclusion. Argumentation skills for point B involve students being able to solve the problem accurately at each step and provide arguments for each step used in the problem-solving process. Argumentation skills for point C involve students expressing logical reasons for the correct final answer. Drawing conclusions entails students arriving at a precise conclusion for the final answer.

CONCLUSION

Based on the initial indicator of logical thinking, focusing on the clarity of thought and comprising two aspects, point 1A indicates that Keirsey idealists 1 and 2 have not met the requirement of expressing all information presented in the problem. Keirsey rational 1 has not fulfilled this criterion, whereas rational 2 has successfully met it. The second aspect of the logical thinking indicator, denoted as 1B and concerning the clarity of logical thinking, involves articulating the general steps used for the solution. Both Keirsey idealists 1 and 2 can meet this requirement, as well as Keirsey rational 1 and rational 2.

In connection with the second indicator for logical thinking, which focuses on argumentative abilities and is divided into three points, point 2A requires the articulation of the logical reasons behind the general steps used. It can be asserted that Keirsey idealists 1 and 2 have not met this requirement, and the same holds true for Keirsey rationals 1 and 2. Regarding the second aspect, identified as 2B and addressing argumentation skills, it necessitates precise completion accompanied by detailed steps in each solution. It is noted that students embodying the Keirsey idealist 1 personality can fulfill this requirement, whereas idealist 2 has not been able to do so. Keirsey rational. Rational 1 has not fulfilled this requirement, whereas rational 2 has successfully met it. The third point within the logical thinking indicator, denoted as 2C and concerning argumentation skills, requires expressing the logical reasons for identifying the correct

final answer. It is mentioned that both Keirsey idealists 1 and 2, as well as Keirsey rationals 1 and 2, have not been able to meet this particular criterion.

Based on the third indicator of logical thinking, focusing on drawing conclusions and encapsulated in one point, 3A involves drawing conclusions about the correct final answer. It can be stated that Keirsey personality type Keirsey idealist 1 is able to fulfill this criterion, while idealist 2 has not been able to do so. Keirsey rational 1 has not fulfilled this criterion, whereas Keirsey rational 2 has successfully met it.

For further research suggestion, researchers might delve into exploring how various indicators, including logical thinking, emotional intelligence, and creativity, interplay to form a more comprehensive understanding of cognitive abilities specific to each Keirsey personality type. By adopting this holistic approach, a more nuanced and enriched perspective on problem-solving could emerge. This examination would go beyond isolated assessments and unveil the intricate dynamics between different cognitive facets, shedding light on how they collectively contribute to effective problem-solving. Finally, these research directions aspire to enhance our comprehension of logical thinking within the context of Keirsey personality types, providing valuable insights applicable to personal development and the formulation of effective educational strategies.

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