Journal of Posthumanism
2025
Volume: 5, No: 7, pp. 863–881
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i7.2848

How is Students' Proportional Reasoning Based on Idealist Personality Type in Senior High School?

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Abstract

Proportional reasoning and personality types play a vital role in mathematics education, as they relate to both science and mathematical learning across all grade levels. Understanding students' personality types early on offers valuable insights that can guide tailored instructional strategies. However, there remains a lack of research specifically examining the relationship between proportional reasoning and idealist personality types. This research investigates how students with idealist personality traits apply proportional reasoning when solving problems involving trigonometric ratios. Employing a case study methodology with a qualitative descriptive framework, the participants were selected according to carefully defined criteria aligned with the study's aims. Data processing involved applying proportional reasoning, drawing from both the subjects' task performance and task-based interviews. Valid data were systematically analyzed through classification, reduction, presentation, interpretation, and conclusion stages. The findings revealed that students with an idealist personality type were capable of solving mathematical problems and comprehending concepts such as covariation, ratios, proportions, and cross-multiplication strategies. A calculation error occurred during the procedure, resulting in a correct final answer despite an inaccurate initial step. Idealist personality type can solve proportional problems even if there are incorrect steps. There are still proportional reasoning activities that are not yet visible. Next, these findings can offer valuable insights for future studies focusing on the design of targeted learning approaches, the selection of innovative teaching models and learning media tailored to the characteristics of idealist students, specific mathematical topics, and the development of learning strategies for other personality types.

Keywords: *Proportional Reasoning, Idealist Personality Type, Senior High School.*

Introduction

Mathematics and reasoning are both essential and closely interconnected. According to Misnasanti et al. (2017), mathematics is required at all educational levels because it serves as a foundational science and a benchmark for advancements in science and technology. Additionally, mathematics helps cultivate important skills such as logical, systematic, critical, careful, and creative reasoning necessary for effective problem-solving. At the same time, reasoning ability is a key indicator of students' mathematical proficiency, as it plays a crucial role in grasping mathematical concepts and content. Mathematics is inherently interconnected, with its concepts closely linked and integrated with other subjects as well as real-world contexts. This interconnectedness fosters the development of more structured reasoning skills (Sholli et al., 2020). Furthermore, mathematics is a fundamental component of the core curriculum in early education across the globe (Yapatang & Polyiem, 2022). As such, mathematics should be

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prioritized as a central discipline that supports and enhances learning in other scientific fields.

Proportional reasoning, as one of several reasoning types, plays a fundamental role in the elementary mathematics curriculum and serves as a critical foundation for mastering more advanced mathematical skills such as algebra, geometry, trigonometry, and statistics. This aspect of mathematics is commonly experienced in daily life; for instance, if a recipe calls for one cup of sugar to serve two people, then four people would require two cups of sugar (Vanluydt et al., 2021). Furthermore, Callingham & Siemon (2021) highlight, based on empirical evidence, the critical role of proportional reasoning in linking mathematical reasoning levels with multiplicative thinking (Al-Taie & Khattak, 2024).The goal is to design lessons that equip teachers with foundational tools to foster a thorough conceptual understanding of mathematical ideas throughout the discipline. Proportional reasoning plays a vital role in mathematical growth (Vanluydt et al., 2021). Those who think proportionally demonstrate an ability to comprehend covariation and effectively compare quantities (Fielding-Wells et al., 2014; Hilton & Hilton, 2018). Proportional reasoning underpins several key mathematical concepts, including value, inverse relationships, comparison, covariation, ratio, and proportion. This study specifically concentrates on students' understanding of covariation, ratio, and proportion, alongside examining certain personality types. As Lamon (2020) explains, proportional reasoning problems generally fall into two categories: comparison problems and problems involving known quantities with missing or unknown values. In this research, proportional reasoning tasks are linked to covariation, ratio, and proportion, as well as the application of particular strategies to solve these problems.

Proportional reasoning requires students to have a solid grasp of fundamental concepts such as multiplication, division, and fractions (Hilton et al., 2016). To fully comprehend the challenges students face in proportional reasoning, it is essential to consider multiple factors that affect their problem-solving abilities (Akatugba & Wallace, 2009). Moreover, personality type plays a significant role in shaping how individuals approach mathematical tasks, thereby influencing their proficiency in proportional reasoning (Ramlan et al., 2025). When teachers recognize and understand their students' unique personality traits, students tend to feel supported and engage in learning more freely, without feeling pressured (Darling-Hammond et al., 2020). Additionally, proportional reasoning appears to be influenced by these personality types.

Research integrating reasoning skills with psychological factors remains limited; this study addresses this gap by combining proportional reasoning with the idealistic personality type to better understand their suitability for solving mathematical problems. According to Keirsey & Bates (1984), individuals with an idealist personality type are drawn to lessons that focus on ideas, values, and fundamental problems, enabling them to engage deeply in problem-solving. This personality type is also among the more prevalent types at the secondary school level where this research was conducted, compared to other personality types as classified by Keirsey's theory.

Proportional reasoning and personality types warrant careful attention from both teachers and learners. Proportional reasoning is closely linked to essential skill areas such as fraction learning (Schadl & Ufer, 2023). Furthermore, the concept of proportional reasoning has wide-ranging applications within mathematics education (Acikgul, 2021). Therefore, this research can serve as a valuable reference for designing mathematics instruction specifically, as well as learning strategies across other subjects more broadly. Learning tools can be effectively developed by understanding students' general reasoning abilities, with a specific focus on their proportional reasoning skills. Determining effective learning strategies, models, approaches, and methods is essential to facilitate successful knowledge construction among students. This study aims to explore proportional reasoning in high school students with idealistic personality types, offering insights valuable to both teachers and students. Furthermore, the findings may inform future research on proportional reasoning profiles across diverse personality types in solving mathematical problems.

Literature Review

Proportional Reasoning

Proportional reasoning is essential in learning, especially mathematics. In mathematics learning, proportional reasoning, also known as logical reasoning in proportional settings, is a mental activity that comprehends the relationship between two quantities (Aktas, 2022; Sari, et al., 2023). Logical thinking, which includes reasoning, is an important component of mathematical reasoning, particularly the ability to engage in proportional reasoning (Hjelte et al., 2020). Proportional reasoning relates to the relevant skill level, for example, fraction learning (Schadl & Ufer, 2023). The concept of proportional reasoning has extensive applications in mathematics education (Acikgul, 2021). Proportional reasoning is one of the most significant ideas in mathematics and should be well understood in various real-life situations. It should also serve as the basis for further mathematics in dealing with more complex and challenging concepts.

Proportional reasoning is a thought process to infer information in situations involving multiplication relationships or the ability to compare entities in ratio situations and proportions in multiplication (Izzatin, 2021). Concepts that need to be well understood so that unmistakable thoughts or arguments are formed are ratio, proportion, and proportional reasoning, which are interrelated. Arican (2019) states that these three concepts are essential in school mathematics. A *ratio* is a number that relates two quantities or measures in a given situation in a multiplication relationship (as opposed to an additive or difference relationship). Ratio and proportion are related in that they involve multiplication rather than addition because the same ratio results from multiplication or division rather than addition or subtraction. Proportion is a statement about the similarity of two ratios, which builds an understanding of using proportions and connects to students' understanding of equivalent ratios (Walle et al., 2020). This research involves ratios and proportions. A ratio is a number that relates two quantities or measures in a particular situation between distance and angle. While proportion is the similarity of two ratios when determining the type of comparison of more than one ratio.

Proportional reasoning in this study involves proportions, encompassing concepts such as similarity between two ratios, multiplication, and covariation between two variables. Indicators adapted from Lamon (2020) are that students can demonstrate activities according to components, including 1) understanding covariation, 2) understanding ratio, 3) understanding proportion, and 4) developing a variety of strategies or specific strategies. Where students are sometimes wrong in choosing appropriate strategies due to differences in receiving, remembering, processing, organizing, and storing information when solving problems. Therefore, personality types exhibit individual differences in their problem-solving abilities.

Personality Type

Following the development of personality theories by Keirsey (1998), another theory of personality types was created, which became the basis for the book Please Understand Me II. Keirsey argues that individuals differ from one another, and there is no reason to expect them to conform to a certain standard. Differences are not bad but good, and people need to be accepted as they are or invited more inclusively. The four temperaments identified by Keirsey & Bates (1984) are as follows: 1) Spontaneous and realistic artisans are passionate, active, risk-taking people, and they need to be encouraged by others; 2) Responsible and normative guardians; they are responsible, realistic, determined, normative, protective, loyal and helpful people; 3) Rational pragmatist and logical, they are calm, grumpy, independent, curious and tend to be scientists as autonomous and skeptical people. 4) Idealists and benevolent diplomats often prefer not to be criticized, but they can understand emotions as emotional individuals. They are also successful individuals in terms of academic life.

Some common traits or characteristics are evident in the behavior of each personality type, according to Keirsey & Bates (1984). One of these is the idealistic personality type used in this study, which is future-oriented, focusing on what is happening. As a learner: a) Likes lessons about ideas and values, as well as fundamental problems so that they can solve their problems; b) Likes to write essays because they can express their ideas and thoughts; c) Likes learning with the theme of what will happen; d) Dislikes competition, because idealistic personality types prefer to compete with themselves rather than with others; e) More suitable in small classes where students and students with teachers know each other well. Based on research by Ananti et al. (2019), idealist students tend to find the most exciting and meaningful ways to solve problems and can think abstractly. In addition, idealistic students solve problems using symbols, formulas, and representations. Research by Islamiah et al. (2024) demonstrated that idealistic students can perform all stages of the thinking process in solving mathematical problems, including receiving information, processing information, and forming conclusions. Meanwhile, according to (Ratnaningsih, 2021), the idealist students' preparation stage tends to be quick in understanding the problem. The idealist personality type in solving problems, especially in mathematics, can describe certain tendencies that positively or negatively impact learning.

Methods

Research Design

The research design employed is an intrinsic case study with a descriptive qualitative approach, in which idealistic subjects complete proportional reasoning tasks to generate valuable insights within the academic field, in line with what is stated Hadi et al. (2021) if an in-depth case study contains interesting things to learn from the case itself. Additionally, case studies are well-suited for research that demands in-depth explanations through comprehensive interviews, enabling participants to provide meaningful insights based on their experiences with proportional reasoning (Creswell, 2014). The results of the qualitative research concerning student activities, responses, and abilities yielded meaningful information that can contribute to enhancing knowledge and understanding. The proportional reasoning ability test was administered to an idealistic subject studying comparative trigonometry with moderate mathematical proficiency.

Subject and Data Collection

The subject of this study was a female student from class X IA at a high school in SMA Negeri 1 Wundulako. The selection criteria included gender (female) and moderate mathematical ability. Because most of the students at the school are female, their overall mathematical ability is average moderate. A total of 89 female students completed a mathematics ability test and a personality type assessment based on David Keirsey's instrument. The results of the students' mathematics ability tests showed that 45 had a moderate ability, 5 had a high ability, and 39 had a low ability. One student consistently demonstrated an idealistic personality type across the first, second, and third assessments, aligning with the criteria for an idealistic personality and moderate mathematical ability. For mathematics proficiency, scores between 60 and less than 80 were considered moderate and served as the benchmark, namely 77. The following is a categorization of mathematics proficiency tests (Henra, et al., 2024)

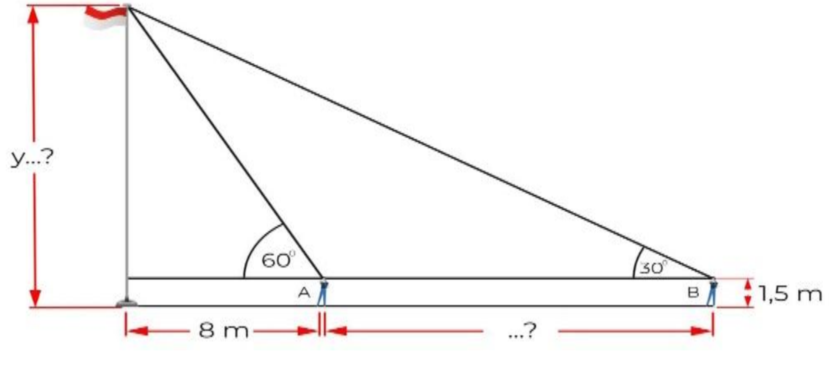
Mathematical Ability Level	**Scoring**
High	$x \geq 80$
Moderate	$60 \leq x < 80$
Low	$x < 60$

Table 1. Scoring Scheme for Mathematical Ability Level

Research Instruments

The research instruments included a personality-type grouping questionnaire, a mathematics ability test, and a proportional reasoning task. The personality-type questionnaire was employed to identify participants with an idealistic personality type and was adapted from David Keirsey's instrument. The original personality type classification text was provided in English; to prevent misunderstandings and classification errors among the subjects, the researcher adapted and translated it into Bahasa Indonesia. The translated version was then reviewed and validated by linguists to ensure the accuracy and clarity of each question's meaning. Validation was conducted by two language expert and one psychology, followed by revisions based on their feedback. The consensus among all validators was that the personality type instrument (TPPM) is appropriate for use. To assess students' abilities, the Mathematics Proficiency Test Instrument was developed by converting 40 national exam questions into descriptive format. After identifying an idealistic subject, a proportional reasoning test consisting of trigonometry questions was administered. This test was validated by two experts—one lecturer from a university in Surabaya and another from Kendari. The validation confirmed the instrument's validity for use, pending minor revisions.

A Mathematical Proportional Reasoning (TPPM) task consisting of five questions was administered to obtain an overview of proportional reasoning activities, as outlined below:



A flagpole stands upright on a flat field if Andi stands at position A, which is 8 m from the flagpole, observing the top of the flagpole with an elevation angle of 60°. It is known that the height of Andi's eye position from the ground is 1.5 m. Next, Andi moves back a few meters to position B, and Andi again observes the top of the flagpole with an elevation angle of 30°.

a. How does Andi's distance from the flagpole change concerning the change in the magnitude of the elevation?

b. Determine the height of the flagpole! Explain the steps!

c. If Andi's distance from the flagpole is 8 m, the elevation angle is 60°. How far is Andi from the flagpole so the elevation angle is 30°?

d. Is the comparison direct proportion or inverse proportion, or neither?

e. If Andi's distance from the flagpole is a1m, then the elevation angle to the top of the flagpole is α1°. If Andi's distance from the flagpole is a2m, then the elevation angle to the top of the flagpole is α2°. Compare Andi's distance from the flagpole and the elevation angle. Determine whether the comparisons are direct proportion, inverse proportion, or neither?

Figure 1. Mathematics Proportional Reasoning Task (Ramlan et al., 2025).

The task was designed to gather data on proportional reasoning, complemented by in-depth interviews. The investigation focused on aspects such as understanding covariation, ratios, and proportions, as well as the application of specific strategies to solve mathematical problems.

The proportional reasoning indicators used to evaluate students' performance in solving trigonometry problems are summarized in Table 2.

Indicators of Proportional Reasoning	**Proportional Reasoning Activity**
Understanding of covariation	1. Detecting the covariation relationship in the given problem. (K1) 2. Provide the reason why the quantity relationship is a covariation relationship. (K2) 3. Using covariation in solving the given problem. (K3) 4. Provide reasons for using covariation in solving the given problem. (K4)
Understanding of ratio	1. Using ratio in solving the given problem. (R1) 2. Giving reasons for using ratios in solving the given problem. (R2)
Understanding of proportion	1. Plan the use of quantity as a proportion relationship of quantity. (P1) 2. Give reasons for using quantity as a proportion relation. (P2) 3. Extends the same relationship to other pairs of quantities. (P3) 4. Provides reasons for extending the same relationship to other quantity pairs. (P4)
Use of specific Strategies	1. Using a particular strategy or method to solve a given problem. (L1) 2. Provides reasons for using the strategy in solving the given problem. (L2)

	3. Revisiting the initial conjecture about the solution obtained by using other strategies in solving the given problem. (L3) 4. Checking the suitability of the solution obtained with the given problem. (L4)

Table 2. Indicators of Proportional Reasoning in Solving Trigonometric Problems

Notes: Adapted from the characteristics of proportional reasoning (Lamon, 2006: Walle et al., 2020)

Data Analysis Technique

The data analysis employed qualitative methods, involving stages of data classification or grouping, data reduction, data presentation, and data interpretation (Miles et al., 2014). Data were grouped according to proportional reasoning indicators, collected from proportional reasoning tasks, and triangulated to ensure validity before processing. Data reduction focused on key and relevant points, followed by concise presentation describing the proportional reasoning abilities of idealistic students. Interpretation involved analyzing student work, interview responses, and confirmation from the idealistic students themselves. In the final stage, the researcher drew conclusions by interpreting the research findings.

The data analysis flow can be diagrammed as follows:

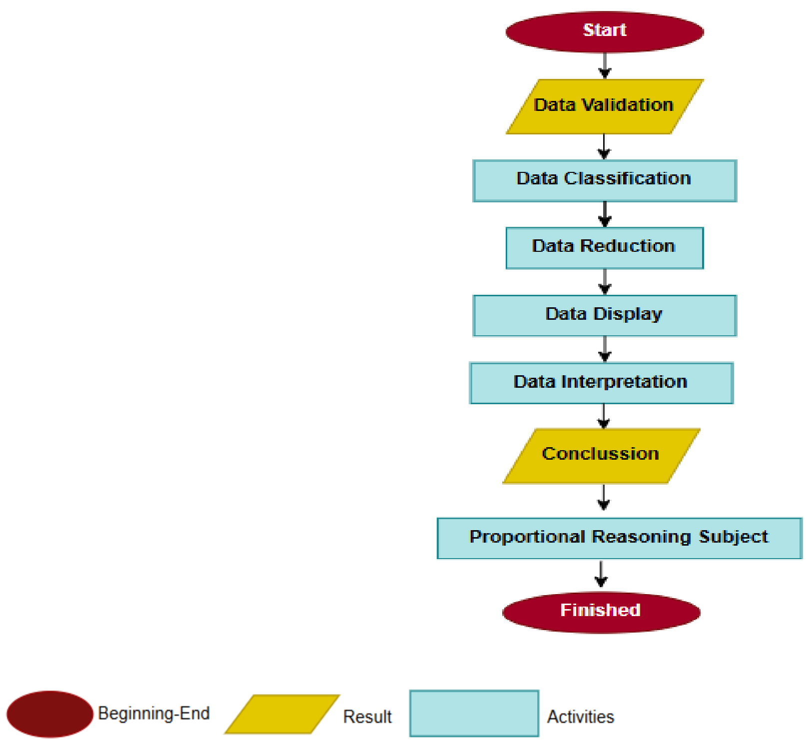


Figure 2. Data Analysis Flowchart

Results

Descriptive analysis was conducted to assess the proportional reasoning ability of students with idealistic personality types, based on the following proportional reasoning indicators:

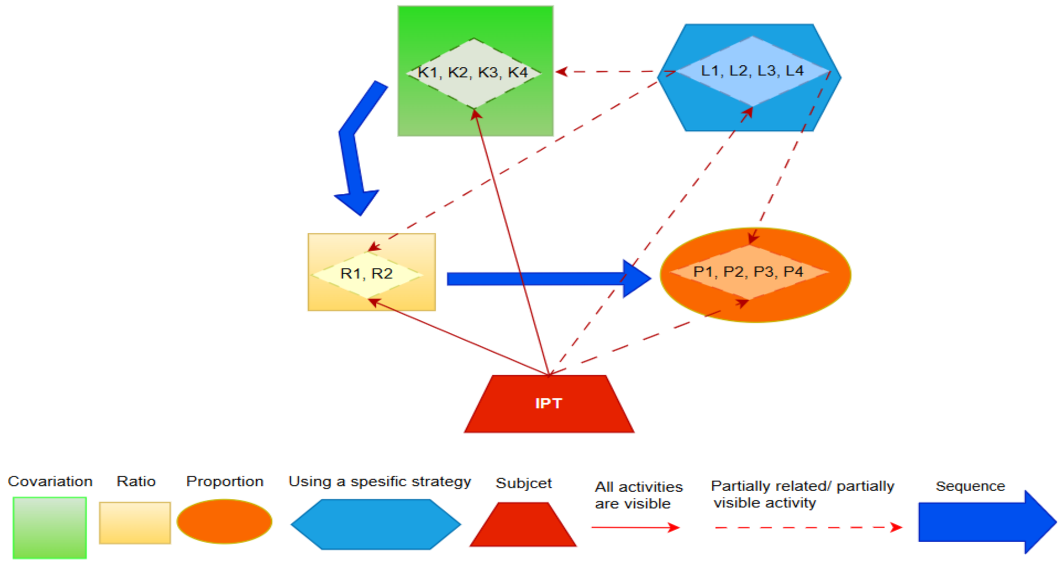
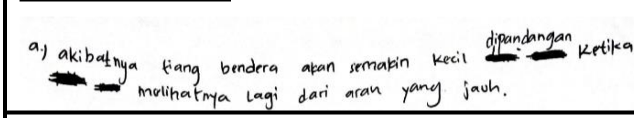


Figure 3. IPT Proportional Reasoning Process in Solving Mathematics Problems

Understanding Covariation

Based figure 3, The IPT subject addressed the questions by comprehending the problem and providing both the answer and an explanation for the relationship between changes in Andi's distance from the flagpole and the elevation angle. The subject's response is shown in Figure 4, specifically for question point a.

Original Version


a) akibatnya tiang bendera akan semakin kecil dipandangan ketika melihatnya lagi dari arah yang jauh.

Translate Version

a) As a result, the flagpole will appear smaller when viewed from a distance.

Figure 4. IPT Written Answer on The Indicator of Understanding Covariation

Based on the subject's response in Figure 4, the IPT subject demonstrates proportional reasoning, specifically an understanding of covariation. This is evident in the problem-solving process, where the subject identifies the relationship between changes in Andi's distance from the flagpole and the elevation angle by analyzing the illustration and comprehending the question's information. This is supported by the following excerpt from the IPT subject's interview transcript:

Label	Interview Excerpts	Indicator
R	Explain your answer!	
IPT	The answer is that there is an increase so that the flagpole will be	K1

	smaller from the elevation angle.	
R	So, when Andi's distance from the flagpole gets smaller, then?	
IPT	The elevation angle will be larger.	K3
R	What is the reason why you say the elevation angle is larger?	
IPT	When looking from a distance.	K2, K4
R	What is Andi's elevation angle? You said it is getting larger, right?	
IPT	The farther, the smaller. The closer, the larger.	K3
R	Conclude your answer.	
IPT	The farther the distance from the flagpole, the smaller the elevation angle. So, the closer the distance from the flagpole, the larger the elevation angle.	K3

Table 3. Interview Excerpt the Understanding Covariation for Question A.

The IPT subject responded that there is an increase; as Andi's distance from the flagpole decreases, the elevation angle becomes larger. This observation also applies when Andi views the flagpole from a greater distance. In other words, the larger the elevation angle, the closer the distance to the flagpole. Conversely, as the elevation angle decreases, the distance increases. The subject demonstrates an understanding of the covariation between changes in distance and elevation. In other words, the subject recognized the covariation relationship within the trigonometry problem, provided explanations for the quantitative relationship, and effectively applied this understanding to solve the problem.

Using a Specific Strategy

The IPT subject addressed the questions by comprehending the problem and providing a solution for the height of the flagpole, including the detailed steps taken to arrive at the answer. The subject's response is presented in Figure 5.

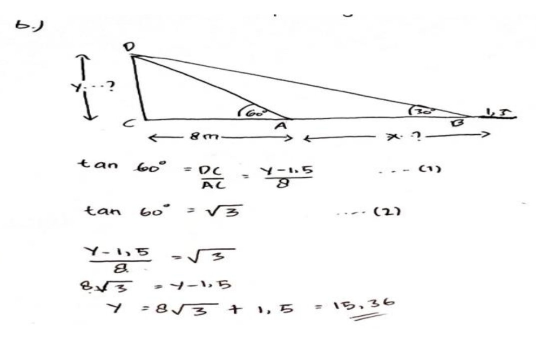


Figure 5. Using a Specific Strategy (question b)

Based on the subject's response in Figure 5, the IPT subject employed a specific approach involving the cross-multiplication strategy. This is evident in the process of determining the flagpole's height, which includes a series of methodical steps. The subject began by sketching the problem as presented in the question. The subject identified the side opposite the angle and the side adjacent to the 60° angle, then calculated tan 60° and applied cross-multiplication to determine the height of the flagpole as 15.36. The subject justified that this method was appropriate. This is supported by the following excerpt from the IPT subject's interview regarding the use of a specific strategy (question b):

Label	Interview Excerpts	Indicator
R	Can you explain to me the strategy you used to get this answer?	
IPT	Find the front angle and side angle of the 60° angle.	L1
R	Then?	
IPT	Next, find tan 60°, and add them up.	L1
R	So how much is obtained?	
IPT	15.36. The height of the pole. The height of the flagpole.	L1
R	According to you, is the information known enough not to answer the question and why?	
IPT	Enough. The work steps are correct. So it's enough.	L2
R	Did you think of any other strategies to solve this problem?	
IPT	Not.	
R	Did you check your answer?	
IPT	Yes, when I finished answering, I rechecked it. Is there a mistake	L4

Table 4. Interview Excerpt the Using a Specific Strategy for Question b.

The IPT subject employed a specific strategy to solve the proportional reasoning task but provided unclear or illogical justifications for the chosen answers. Although no alternative strategies were used, the subject double-checked the responses and ultimately arrived at correct answers.

The next question, shown in Figure 1, point c, was solved by the IPT subject through comprehension, sketching, and providing an answer. Given that Andi's initial distance from the flagpole is 8 meters, the elevation angle is 60°, and Andi's total distance from the flagpole is 30 meters, the subject's response is illustrated in Figure 6 below:

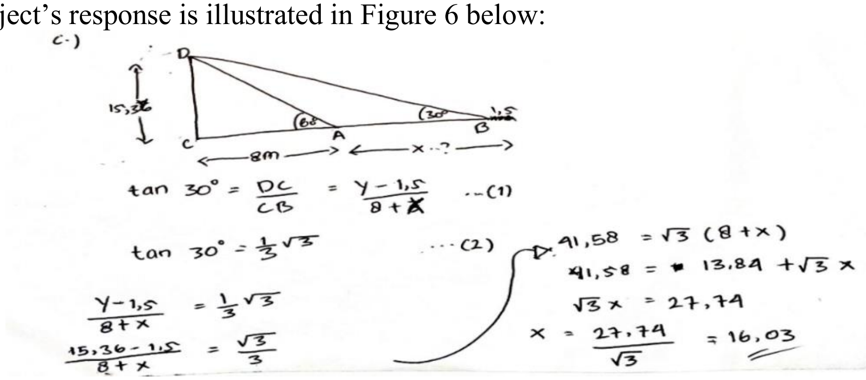


Figure 6. Using a Specific Strategy (question c)

Based on the subject's response in Figure 5, it is evident that the IPT subject approaches proportional reasoning questions by employing a specific strategy. This is demonstrated through the solution steps, which begin with determining the side opposite the 30° angle (DC) and the adjacent side (CB). Next, y - 1.5 with 1/8+x. Then, find tan 30°, namely 1/3√3, and replace the y value previously obtained in the work step, using the cross-product strategy and so on the work steps in Figure 4 so that the x value is 16.03 as the value from A to B. However, the IPT subject overlooked the 8-meter distance required to complete the answer. This approach was considered simpler than other methods, resulting in a less precise response. Specifically, the value of AB obtained was not added to the known 8 meters stated in the question. This is supported by the following excerpt from the IPT subject's interview transcript regarding the use of a specific strategy (question c):

Label	Interview Excerpts	Indicator
R	Can you explain the steps to get the answer, please?	
IPT	First, we find the front angle to be 30 degrees, DC, and the side angle to be CB. Then we equate y - 1.5 with 1/8 + x.	L1
R	Then?	
IPT	Then, we find a 30°, which is 1/3√3, then y-1.5/8+x and = 1/3√3, then the sum of y is 15.36, and subtracted by 1.5 and 1/8 3, 8+x which =√3 1/3, √3/3 then 15.36 we first subtract by 1.5. Then multiply by 3 with the result 41.8 and 8+x with √3 changed by the first √3. Then (8+x) it is in brackets, 41.58 = 13.84, where 13.84 is obtained from √3 x 8. Then we add it with √3x. Then, √3x = 27.74 is the result of 41.58 minus 13.84.	L3
R	What is the next step and your reasons?	
IPT	The next step is to find the actual value of x, which is x = 27.74/√3, where the result is 16.03 Distance from A to B. The answer is precise and clear	L1, L2
R	Have you thought about other ways or strategies?	
IPT	Yes, but longer. It is simpler.	L3
R	Can you explain what other strategies are, just in general?	
IPT	The method for finding tan 30° is very long, so I simplified it.	L3
R	So, your method is simply to determine how much tan 30 is?	
IPT	Yes.	L3
R	So, is the strategy you use cross-multiplying?	
IPT	Yes.	L3
R	So you get it?	
IPT	16.03 as the answer of the question.	L4

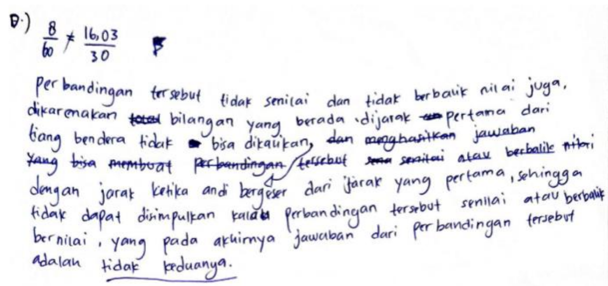
Table 5. Interview Excerpt the Using a Specific Strategy for Question c.

The IPT subject employed a specific strategy to solve proportional reasoning tasks but did not provide explanations for the chosen answers. Instead, the subject revisited the initial solution by applying alternative strategies, re-examined the responses, yet left the solution incomplete by overlooking a step. Specifically, the subject failed to add Andi's initial distance from the flagpole (8 meters) to the calculated result. For example, in Figure 1, Part c, the subject answered 16.03, but the correct final answer should have been 24.03, obtained by adding 8 to 16.03.

Understanding Ratios and Proportions

The IPT subject solved the problem by comprehending the question, comparing Andi's distance from the flagpole to the elevation angle, and identifying the type of comparison involved. The subject's response is illustrated in Figure 7.

Original Version


D.) $\frac{8}{60} \neq \frac{16.03}{30}$

Perbandingan tersebut tidak senilai dan tidak berbalik nilai juga, dikarenakan ~~total~~ bilangan yang berada di jarak pertama dari tiang bendera tidak bisa dikalikan, ~~dan menghasilkan jawaban yang bisa membuat perbandingan tersebut senilai atau berbalik nilai~~ dengan jarak ketika andi bergeser dari jarak yang pertama, sehingga tidak dapat disimpulkan kalau perbandingan tersebut senilai atau berbalik bernilai, yang pada akhirnya jawaban dari perbandingan tersebut adalah tidak keduanya.

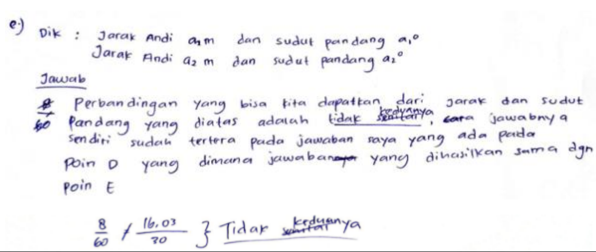
Translate Version

D) The comparison does not represent either direct or inverse proportion because the initial distance from the flagpole cannot be multiplied by the change in distance when Andi moves from the starting point. Therefore, it cannot be concluded that the relationship is a direct or inverse proportion.

Figure 7. IPT Written Answer on Understanding Ratios and Proportions (question d)

Based on Figure 7, the subject's understanding of ratios and proportions is demonstrated through the use of specific numbers to make comparisons and identify the type of comparison. However, as shown in Figure 6, the subject employs symbols to perform comparisons and classify the types of comparisons, while ultimately reverting to numerical values to provide the final answer.

Original Version


e.) Dik : Jarak Andi a_1 m dan sudut pandang a_1°

Jarak Andi a_2 m dan sudut pandang a_2°

Jawab

$\frac{8}{60}$ Perbandingan yang bisa kita dapatkan dari jarak dan sudut pandang yang diatas adalah tidak keduanya, cara jawabnya sendiri sudah tertera pada jawaban saya yang ada pada Poin D yang dimana jawabannya yang dihasilkan sama dgn poin E

$\frac{8}{60} \neq \frac{16.03}{70}$ } Tidak keduanya

Translate Version

e) Known: Distance Andi m and elevation angle a_1°,

Distance Andi m and elevation angle a_2°,

Answer:

The comparison of the distance and elevation angle above is neither. The answer is stated in the answer in point d, where the resulting answer is the same as point e.

$\frac{8}{60} \neq \frac{16.03}{30}$ } Neither.

Figure 8. IPT Written Answer on Understanding Ratios and Proportions (question e)

Based on inaccurate information, the IPT subject made a comparison that did not correspond to direct proportion, inverse proportion, or a combination of both. Although the comparisons were not fully documented, the subject correctly performed the comparison despite an incorrect initial step in the calculation for question three (the previous question). The correct answer may have resulted because the IPT subject did not incorporate all previously obtained information and relied solely on specific numbers, making it easier to derive or sum the answer. This is supported by the following excerpt from the IPT interview regarding understanding of ratio and proportion (question d):

Label	**Interview Excerpts**	**Indicator**
R	Can you state your answer?	
IPT	The comparison is not direct or inverse proportion because the number at the first distance from the flagpole cannot be multiplied by the distance when Andi moves from the first distance. So, it cannot be concluded that the comparison is a direct or inverse proportion.	P1, P2
R	What is the value of not direct proportion or inverse proportion?	
IPT	Andi's distance is 8/60=16.03/30. When 38 is multiplied by the comparison of the second distance, it cannot be multiplied, and the answer is not direct proportion or inverse proportion.	R1, P1
R	What if the condition is reversed? Is the comparison still not equivalent or reverse value?	
IPT	Still.	P3
R	So, the conclusion?	
IPT	The comparison is not direct proportion or inverse proportion.	P3
R	How do you know that the step is correct by multiplying?	
IPT	It can be multiplied, but the answer cannot answer the comparison in direct proportion or inverse proportion. So, the answer is neither.	R2, P4
R	What is the value?	
IPT	Andi's distance is 8/60=16.03/30. When 38 is multiplied by the ratio of the second distance, it cannot be multiplied, and the answer is not direct proportion or inverse proportion.	R2, P4

Table 5. Interview Excerpt the Understanding Ratios and Proportions d.

The IPT subject approaches the questions by comprehending the problem, comparing Andi's distance from the flagpole with the elevation angle, and identifying the type of comparison based on the conditions given—particularly when certain symbols substitute for distance and angle. The subject's response, illustrated in Figure 8, demonstrates the use of proportional reasoning. This is evident from the process carried out by the IPT subject, which involves recognizing and establishing patterns of relationships between quantities based on images or other manipulatives previously created in the form of sketches. Additionally, multiplicative relationships were utilized to solve problems involving proportional scenarios, resulting in solutions that corresponded with the trigonometry questions. However, the IPT subject made comparisons based on incorrect information, which did not align with direct proportion, inverse proportion, or a combination of both. The subject correctly made comparisons despite starting from an incorrect initial step in the calculation for question three and chose to use numbers instead of symbols for ease of computation. However, the subject demonstrated an understanding of the distinction between questions d and e in terms of using numbers versus symbols. Correct answers may arise because the IPT subject does not incorporate all the information gathered from previous work, instead relying on specific numerical values. This is supported by the interview transcript with the IPT subject regarding their understanding of ratio and proportion (question e), which states:

Label	Interview Excerpts	Indicator
R	Is question e related to the previous question?	
IPT	Yes, it is related to part d. The answer and the way to do it are also the same. However, question d uses symbols while e uses numbers.	P3
R	Can you state the answer?	
IPT	It is known that Andi's distance is a_1m, the elevation angle is $a_1°$, and Andi's second distance is a_2m, and the elevation angle is $a_2°$. So, the comparison is neither equivalent nor inverse in value. The working steps are stated in the answer in point b, where the answer produced is the same as point e, namely 8/60 = 16.03/30. However, when multiplied, the comparison of equal or not equivalent cannot be obtained, so the answer is neither.	R1, R2, P1, P2
R	However, initially, you said the same as equal or not equivalent?	
IPT	Yes, but the multiplication result cannot answer whether it is equal or inverse in value. So, neither.	P4
R	What does neither mean?	
IPT	Neither equal nor inverse in value.	P1
R	Why did you finally choose this method?	
IPT	There is another way to change this symbol into a number. However, the results obtained are the same as point d. so, in the end, the answer is also applied using numbers.	R1
R	Why don't you use symbols? Prefer numbers?	
IPT	It's easier to produce the answer or add up.	R2
R	That's the reason, even though there was another way to do it.	
IPT	Yes, but the other plan is the same, so let's get straight to the point.	P3, P4

Table 6. Interview Excerpt the Understanding Ratios and Proportions e.

The student with an idealistic personality type successfully completed proportional reasoning tasks and responded to the researcher's questions, demonstrating an understanding of covariation, ratios, and proportions, as well as the ability to differentiate, develop, and apply specific strategies in solving mathematical problems. Although some answers remain incomplete, the student provides valuable insights. The idealistic student demonstrates an understanding of covariation, even if not explicitly stated. This is evident in the responses showing that as Andi's distance from the flagpole decreases, the elevation angle increases, and conversely, as the elevation angle decreases, the distance increases. In this scenario, Andi's elevation angle decreases as his displacement at point A increases, demonstrating a negative covariation between these two variables. The idealistic student comprehends the covariation between distance and elevation changes, recognizing the relationship between the quantities presented in the problem and offering a rationale to explain this connection.

Discussion

Based on the work results and interview, the idealistic student applied the cross-multiplication strategy to determine the height of the flagpole and successfully produced the correct answer. Despite providing incomplete and incorrect responses to the third question, the student was able to solve proportional reasoning problems effectively. However, a lack of accuracy led to the omission of the final step, even though the correct strategy was employed. Additionally, the student correctly performed comparisons despite an erroneous initial calculation step in the third question. As stated Ratnaningsih & Hidayat (2021), the factors contributing to errors include hesitation, lack of carefulness, failure to perform calculations, misinterpretation of the problem information, and rushing to draw conclusions without proper analysis. Similar issues were observed in this study. The IPT subject employed a specific strategy involving cross-multiplication. While the answer to question two was appropriate, the response to question three was incomplete. This occurred because the subject favored the chosen method for its simplicity over other approaches, resulting in a less precise answer. The subject's understanding of ratios and proportions includes using specific numbers to make comparisons and identifying the type of comparison involved. When numbers are replaced with symbols, the student tends to continue using numbers to simplify the problem-solving process. Consequently, the student may provide correct answers even when based on inaccurate information derived from previous responses. Burgos et al. (2019) state that teachers only focus on procedural teaching to their students, namely techniques for dealing with problems that involve the concepts of ratio and proportion when working. Teachers should avoid focusing solely on procedural skills; equal attention must be given to students' comprehension of underlying theories, deeper exploration of the material, and conceptual development. These aspects, alongside the influence of an idealistic personality type, can contribute to difficulties in understanding ratios and proportions. As stated by Aziez et al. (2025), one way to create optimal learning is through good classroom management. Supported by Purwanti & Vania (2021), teachers' skills are crucial for effective classroom management. These skills include the ability to handle various situations that may arise in the classroom and be responsive to the individual needs of each student. With the right skills, a teacher can lead the class efficiently and effectively, thereby creating an environment that supports meaningful learning for all students. This can be achieved if information about specific personality types is known.

Based on the findings obtained, in line with research by Supply et al. (2023), the findings indicate that students do not find proportional questions challenging when solving trigonometry problems, likely because these questions are connected to everyday contexts familiar to them. Meanwhile, Akrom et al. (2020) found that students with idealist personalities could not make logical conclusions. The student with an idealistic personality type did not meet the indicators for logical reasoning due to a lack of mastery of the cosine rule concept. Although the student followed certain calculation procedures and was able to estimate answers and anticipate the problem-solving process, they applied an incorrect formula during problem-solving, reflecting an incomplete understanding of both the sine and cosine rules.

Students with idealistic personality types demonstrate the ability to anticipate both answers and problem-solving processes. In this study, errors primarily occurred due to carelessness near the completion of tasks. During interviews and problem-solving, the idealistic student, as described by Keirsey's theory, showed a future-oriented mindset, focusing on current events and favoring subjects related to ideas, values, and real-world problems. These students tend to avoid competition with others, preferring instead to challenge themselves. Additionally, they thrive in smaller class settings where closer relationships between students and teachers can be fostered (Keirsey & Bates, 1984). Based on research by Gea et al (2023) regarding the relationship of equality between ratios. The student compares multiplication operations and determines that the ratios are equivalent. This method yields correct answers when the ratios belong to the class of equivalent fractions. However, in this study, the student's comparisons of direct or inverse proportions sometimes led to correct answers despite relying on inaccurate information.

Students with specific tendencies linked to their personality types can enhance their self-awareness in solving mathematical problems by recognizing their strengths and weaknesses. This awareness enables them to minimize errors, deepen their understanding, and approach problem-solving more carefully. Insights drawn from personality descriptions and student responses provide valuable lessons that can improve the effectiveness and efficiency of knowledge transfer in the learning process. Hence, it is important to acknowledge students' potential, personality types, tendencies, and areas of weakness that warrant further intervention. This study is limited to the topic of trigonometry; future research could extend to other mathematical topics.

Conclusion

Idealistic students can solve proportional problems even if there are incorrect steps or a lack of thoroughness. There are still proportional reasoning activities that are not yet apparent in their understanding of proportions and the use of specific strategies, as well as their connection to ratios and covariances, which are indirectly present in idealistic students. Proportional reasoning and personality types play a crucial role in mathematics education, as they are fundamental to understanding science and mathematics across all school levels. Gaining an initial understanding of students' personality types offers valuable insights that can inform tailored instructional approaches based on individual characteristics. This research provides valuable insights that can inform future studies in designing effective learning approaches. For example, it can guide the selection of innovative learning models and educational media tailored to the characteristics of idealistic students, specific mathematics topics, and the development of diverse personality types.

Suggestion

Ideally students who are idealistic in solving mathematical problems, especially those involving proportional reasoning, need to develop their potential and be more careful so that they can provide accurate answers and logical reasons. This enables them to understand covariation, ratios, and proportions and use appropriate strategies. Educators can recognize differences in personality types, such as the characteristics of idealistic students when constructing knowledge. This enables educators to design questions and mathematical learning models, particularly those related to proportional reasoning. Additionally, future researchers can integrate proportional reasoning with other personality types, particularly Keirsey's theory, as well as the idealistic personality type.

Funding Statement

Funding is Support by Lembaga Pengelola Dana Pendidikan (LPDP) / Beasiswa Pendidikan Indonesia (BPI) / Pusat Pelayanan Pembiayaan dan Assesmen Pendidikan Tinggi (PPAPT) Ministry of Higher Education, Science, and Technology of Republic Indonesia.

Declarations

Author Contributions. Andi Mariani Ramlan contribute to the conceptualization, writing-original draft, visualization, methodology, and investigation. I Ketut Budayasa contribute to the supervision and validation. Endah Budi Rahaju contribute to supervision and validation.

Conflicts of Interest. The authors declare no conflict of interest.

Funding. This research is funded by the Indonesia Endowment Funds for Education (LPDP) Ministry of Higher Education, Science, and Technology of Republic Indonesia.

Ethical Approval. (This study was approved by the Deanship of Graduate state University of Surabaya -Reference number: B/21964/UN38.3/LT.02.02/2023.

Data Availability Statement. The data that supports the findings of this study are available from the first and corresponding author upon reasonable request.

Acknowledgments.

The authors would like to acknowledge the Indonesian Education Scholarship (BPI), the Center for Higher Education Funding and Assessment (PPAPT), and the Indonesian Endowment Funds for Education (LPDP) Ministry of Higher Education, Science, and Technology of the Republic Indonesia.

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