



Science Problem-Solving Dynamics: Gender and Personality Type Analysis in Students

Rizky Agassy Sihombing*

Science Education Master Program, Universitas Pendidikan Indonesia, West Java, Indonesia

Naufal Rabah Wahidin

Science Education Master Program, Universitas Pendidikan Indonesia, West Java, Indonesia

Adi Rahmat

Department of Biology Education, Universitas Pendidikan Indonesia, West Java, Indonesia

Nanang Winarno

Department of Science Education, Universitas Pendidikan Indonesia, West Java, Indonesia

Yanti Hamdiyati

Department of Biology Education, Universitas Pendidikan Indonesia, West Java, Indonesia

Amir Karimi

Research Lecturer at Farhangian, University of Alborz, Alborz, Iran

*Correspondence author: rizkyagassy@upi.edu

DOI: <http://dx.doi.org/10.18592/tarbiyah.v13i2.13513>

Key Words:

gender
personality types
science problem solving

Abstract:

This study examines how problem-solving patterns in science among 9th-grade students correlate with different personality types based on Keirsey's classification: Idealist, Artisan, Guardian, and Rational. It employs the Investigation of Lived Experience methodology in Cognitive Psychology to delve into the internal experiences of 36 students from SMP Negeri 5 Bandung. The research explores gender distribution, school representation, and the prevalence of each personality type among the participants. Data collection methods include adapted questionnaires, written tests on earth and space science concepts, and follow-up interviews. These instruments are analyzed using the fixed comparison method to identify and understand distinct problem-solving tendencies associated with each personality type. Specifically, Idealists are found to prioritize understanding, Artisans employ intuitive-analogical approaches, Guardians rely on intuitive hypotheses, and rationalists utilize analogical reasoning. Overall, this study provides detailed insights into how personality types influence problem-solving strategies in

Received : 30 June 2024

Revised : 1 October 2024

Accepted : 27 November 2024

Published : 23 December 2024

science education. It suggests implications for personalized educational approaches tailored to individual student preferences and tendencies, aiming to enhance learning outcomes in 9th-grade science classrooms.

To cite this article: Sihombing, R.A., Wahidin, N.R., Rahmat, A., Winarno, N., Hamdiyati, Y., Karimi, A. (2024). Science Problem-Solving Dynamics: Gender and Personality Type Analysis in Students. *Tarbiyah: Jurnal Ilmiah Kependidikan*. Vol 13 (2), 137-153.

This is an open access article under the CC-BY License
(<https://creativecommons.org/licenses/by/4.0/>)



Introduction

The predominant assessment methods of science education focus on evaluating students' abilities to interpret, analyze, discuss, and solve scientific problems (Mateus et al., 2021). These assessments typically result in grades or constructive feedback to determine whether students have acquired the necessary skills, influencing their academic performance (Dewiyani & Sagirani, 2014). Effective teacher-student interaction is crucial in science education, emphasizing comprehension over memorization (Sulthon, 2017; Sihombing et al., 2024). This approach involves applying knowledge from observation and research to explain various phenomena (Panggabean et al., 2023). Teacher professionalism is vital, requiring deep subject knowledge and expertise in designing tailored learning experiences (Hoesny & Darmayanti, 2021; Sihombing et al., 2021; Sihombing et al., 2022; Sihombing et al., 2023). Educational methods continually adapt to prepare individuals for increasingly complex challenges in life (Octavia et al., 2022; Sihombing & Hasruddin, 2024).

Problem-solving is important in scientific fields such as science, addressing phenomena or real-life issues (Octor et al., 2015; Fitroh et al., 2020; Kiraga, 2023). It plays a crucial role in learning by enhancing students' flexibility in handling challenges. The centrality of problem-solving in student life underscores its fundamental role in science education at all levels. This is because problem-solving activities entail analysis, interpretation, reasoning, prediction, evaluation, and reflection. This passage underscores the significance of problem-solving, particularly within scientific disciplines, highlighting its crucial role in the learning process and its ability to cultivate students' adaptability when confronted with challenges (Darling-Hammond et al., 2019; Alfathy & Linuwih, 2019). According to Gagne, as cited by Mulyasa (2008), encountering problems not only leads to their resolution but also facilitates the acquisition of new knowledge. Problem-solving activities involve multiple stages, such as analysis, interpretation, reasoning, prediction, evaluation, and reflection, as articulated by Anderson (2009). Mourtos et al. (as cited in Kusumah et al., 2021) elaborate on these stages, which include defining the problem, exploring possible solutions, planning solutions, implementing the chosen plan, verifying the solution, and evaluating the outcome. Furthermore, the passage stresses the relevance of problem-solving skills in the 21st century, aligning with perspectives shared at the Partnership for 21st Century Skills Event in 2020 (CBSE, 2020).

The passage also discusses documented differences in problem-solving approaches based on gender, as noted by previous researchers (Echavarri et al., 2007; Ginevra et al., 2015; Zhu et al., 2023). Research indicates that men rely more on spatial and abstract reasoning, whereas women favor verbal strategies. Recognizing these variations could inform the development of more targeted approaches for knowledge transfer and learning, tailoring educational content to leverage each gender's strengths. Additionally, understanding gender differences in assessment may provide insights into students' problem-solving challenges during their educational journey. Female students may have more incredible difficulty grasping conceptual aspects, while male students may experience average difficulty. However, both genders face lower difficulty when dealing with computational challenges (Sebastian, 2017).

Polya's problem-solving framework, as described by [Vilianti et al. \(2018\)](#), [Sepriyanti et al \(2020\)](#) and [Mardhiyatirrahmah & Abdussakir \(2021\)](#), emphasizes several key stages: understanding the problem, devising a plan, implementing the plan, and reviewing the solution. Carin's suggested strategies for fostering problem-solving skills, as cited by [Alfathy et al. \(2018\)](#), include initiating topics from personal experiences or media, employing qualitative, quantitative, and correlational research methods, utilizing visual aids such as images or graphs for information collection and processing, and communicating findings through oral or written reports. Additionally, Dewey's problem-solving model, discussed by [Brown \(2012\)](#) and [Stompff et al. \(2022\)](#), mirrors the scientific inquiry process, involving understanding the problem, formulating hypotheses, executing plans, reviewing outcomes, and drawing conclusions. This approach closely aligns with the scientific learning methodology embedded in the Merdeka Curriculum, making Dewey's framework particularly relevant for this study. Research by [Molnár & Csapó \(2018\)](#), [Güner & Erbay \(2021\)](#), and [Manuaba & Wu \(2022\)](#) underscores variations in student problem-solving influenced by their developmental cognitive levels, suggesting that insights from broader theoretical frameworks can elucidate individual differences in problem-solving strategies.

Each student has a unique personality that influences information reception, decision-making processes, and task performance ([Embarak et al., 2021](#); [Suryadi et al., 2022](#)). Personality encompasses traits shaping expectations, self-perceptions, values, and attitudes, impacting responses to others, subjects, and events. [Keirse & Bates \(1984\)](#) and [Keirse \(1998\)](#) categorize personalities into guardian, artisan, rational, and idealist types based on observable behavioral differences ([Widiyatmoko, 2018](#)). [Keirse \(1998\)](#) developed this classification drawing from "The Myers-Briggs Types Indicator" (MBTI), a well-known personality assessment by Myers and Briggs, highlighting how each type's distinct traits influence verbal and written communication. This study investigates how various temperament categories relate to problem-solving methods, uncovering specific cognitive and expressive tendencies associated with each personality type.

Each personality type demonstrates unique characteristics in educational settings. Guardian-type students typically prefer conventional, well-organized classrooms with detailed explanations, showing less enthusiasm for group discussions. Artisan-type students are consistently active, enjoy being the center of attention, thrive in dynamic interactions, and may become bored with repetitive learning methods. Rational-type students prioritize logical explanations, possess a firm intellectual grasp of subjects, and excel in learning through experiments, discoveries, and solving complex problems. Idealist-type students are drawn to abstract ideas, prefer working alone over group activities, find fulfilment in reading and writing, and value classroom interactions as essential for mutual understanding ([Keirse & Bates, 1984](#); [Keirse, 1998](#)). These traits underscore how diverse personality types approach and engage with learning environments uniquely.

The link between personality and problem-solving methods can be seen as a cognitive process involving rational mental abilities, as [Ginerva et al. \(2015\)](#) and [Grimm & Richter \(2024\)](#) discussed. This process initiates with the reception of information, whether from external sources or internal thoughts, followed by the

processing and storage of this information in the student's memory, as emphasized by [Fourie and Schlebusch \(2023\)](#). [Keirsey \(1998\)](#), in his book "Please Understand Me," synthesized earlier theories and categorized personalities into four types: Guardian, Artisan, Rational, and Idealist, collectively known as The Four Temperament Theory. Each personality type demonstrates unique characteristics in how individuals express their thoughts verbally and in written form.

Research evaluating students' problem-solving abilities about personality traits, like those by [Alfathy et al. \(2018\)](#) and [Agustin \(2018\)](#), has primarily focused on Physics and Mathematics education using qualitative methods. This study, however, seeks to investigate problem-solving skills in science education through the lens of [Keirsey's \(1998\)](#) personality types. Although numerous studies have explored problem-solving with a focus on personality types ([Jackson, 2011](#); [Pertiwi et al., 2014](#); [Panjaitan, 2015](#); [Ginevra et al., 2015](#); [Zanberg et al., 2016](#); [Alfathy & Linuwih, 2019](#); [Mawaddah et al., 2021](#)), there remains a significant gap as none have identified specific problem-solving strategies or techniques linked to individual personality types. Examining these strategies is crucial, aligning with [Olson & Hergenhahn's \(2013\)](#) view that each person has a unique mix of thoughts, traits, and behaviours shaped by genetic factors and personal experiences, collectively called personality.

The study's main objective is to investigate how problem-solving strategies in science education vary across different student personality types, particularly about gender. This research aims to uncover meaningful connections between personality traits and problem-solving skills, potentially identifying correlations or distinctions among various temperament categories. By analyzing problem-solving behaviours, the study aims to enhance our understanding of how individual personality differences can shape students' methods of tackling scientific challenges.

Research Method

Research Design

This study employed a survey-based research model based on the framework proposed by [Creswell & Clark \(2018\)](#). Survey research aims to quantitatively describe trends, attitudes, or opinions within a population by analyzing a sample. It utilized the Investigation of the Lived Experience methodology [Gall et al. \(2003\)](#) outlined. This methodology, commonly applied in Cognitive Psychology, investigates individuals' internal experiences, focusing on aspects such as perception, memory, attention, cognitive abilities, and problem-solving.

Research Subjects

The research utilized random sampling to select participants from 36 ninth-grade science students at SMP Negeri 5 Bandung. Participants were categorized into [Keirsey's \(1998\)](#) four personality types: Guardian, Artisan, Rational, and Idealist. Nine students from each personality type were purposefully selected, guided by recommendations from teachers and researchers. Factors considered included personality type, participation in science learning activities, and overall readiness. Table 1 provides a comprehensive breakdown of the research subjects.

Table 1. Characteristics of Samples

No	Gender	<i>f</i>	%
1.	Female	26	72.2
2.	Male	10	27.8

Data Collection

This study exclusively relied on primary data collected directly from participants. The research instruments included a questionnaire adapted from Keirsey's (1998) model, translated into Indonesian, consisting of 70 questions corresponding to Keirsey's Personality Types. In addition to the questionnaire, written tests on earth and space science concepts were administered, featuring reasoning-based multiple-choice questions. Follow-up interviews were conducted to validate and further explore participants' problem-solving strategies and the reasoning underlying their responses. The reliability of the constructs was evaluated using Cronbach's alpha values and analyzed with SPSS 26. A Cronbach's alpha exceeding 0.60 indicates good reliability. Detailed results of the reliability tests for the questionnaire used in this study are presented in Table 2.

Table 2. The Results of Questionnaire's Reliability Test

Reliability Statistics	
Cronbach's alpha	N of Items
.680	70

Data Analysis

In this study, data analysis employed SPSS 26 to conduct descriptive statistics primarily. Cronbach's alpha coefficients were calculated for each dimension using the raw data collected from both the initial and subsequent administrations of the questionnaire. These coefficients were utilized to evaluate the internal consistency of questionnaire dimensions within the dataset, particularly emphasizing reliability assessment.

Results and Discussion

This study explores group problem-solving methods within Dewey's framework that apply to group and individual contexts. It assesses problem-solving indicators and identifies patterns among Guardian, Artisan, Rational, and Idealist personality types in science. The research adheres to standard procedures where results and discussions are presented separately, with results detailing the obtained and analyzed data, often presented through tables, figures, or graphs. The abbreviations used for the personality types analyzed in this study can be seen in Table 3.

Table 3. Abbreviations for the Types of Personality Traits (Keirsey, 1998)

Name	Skilled Intelligent Roles			
Artisan (AR)	Promoter ESTP	Performer ESFP	Composer ISFP	Crafter ISTP
Guardian (GU)	Supervisor ESTJ	Provider ESFJ	Inspector ISTJ	Protector ISFJ
Idealist (ID)	Teacher ENFJ	Champion ENFP	Counselor INFJ	Healer INFP
Rational (RA)	Inventor ENTP	Fieldmarshal ENTJ	Architect INTJ	Mastermind INTJ

Description: S: Sensing; T: Thinking; F: Feeling; P: Perceiving; N: Intuiting; J: Judging; I: Introvert; E: Extrovert.

Profile Personality Types of Students According to Gender

This study investigates problem-solving approaches in science according to student personality types aligned with the Four Temperament Theory. Out of 36 surveyed students, Guardians comprise the largest group at 50%, predominantly among females (14 females, four males). Artisans follow at 38.9%, with an even distribution between genders (9 females, five males). Rational follow at 8.3% with

distribution between genders (2 females, one male). Idealists account for 2%, predominantly female (2 females). The distribution of student personality types by gender is detailed in Table 4.

Table 4. Student Personality Types Based on Gender

		AR	GU	ID	RA
Gender	Female	9	14	2	2
	Male	5	4	-	1
Total		14 (38.9%)	18 (50%)	2 (5.6%)	3 (8.3%)

38.9% of artisans exhibit diversity with types like ESFP and ESTP, emphasizing expressive traits. Guardian dominates at 50%, showcasing judging and sensing characteristics. Rationals, constituting 8.3% of the population, exhibit a balanced gender distribution and are characterized by being extroverted, intuitive, thinking, and judging. Idealist, a smaller cohort (5.6%), features an INFP Healer, highlighting unique intuitive and feeling traits. The continuation of student personality types based on gender can be seen in Table 5.

Table 5. Continuation of Student Personality Types Based on Gender

Personality Types	Intelligent Roles	<i>f</i>	%
Artisan	Performer (ESFP)	8	22.2
	Promoter (ESTP)	2	5.6
	Crafter (ISTP)	3	8.3
	Composer (ISFP)	1	2.8
Subtotal		14	38.9
Guardian	Supervisor (ESTJ)	5	13.9
	Inspector (ISTJ)	7	19.4
	Provider (ESFJ)	5	13.9
	Protector (ISFJ)	1	2.8
Subtotal		18	50
Idealist	Teacher (ENFJ)	-	-
	Counselor (INFJ)	-	-
	Champion (ENFP)	-	-
	Healer (INFP)	2	5.6
Subtotal		2	5.6
Rational	Fieldmarshal (ENTJ)	1	2.8
	Mastermind (INTJ)	1	2.8
	Inventor (ENTP)	1	2.8
	Architect (INTP)	-	-
Subtotal		3	8.3
Total		36	100

Additionally, the study draws insights from Keirsey's personality characteristics. Guardians prefer traditional, structured classrooms that require detailed and concrete explanations. Artisans thrive in active, attention-grabbing learning environments, favouring discussions and presentations. Rationals seek logical explanations, excel in grasping complex material, and prefer experimental learning. Idealists enjoy ideas-related tasks, preferring independent work and demonstrating a fondness for reading and writing. These findings contribute to understanding the nuanced relationship between personality types and problem-solving approaches, offering valuable insights

for personalized educational strategies. The personality characteristics of Keirsey in learning can be seen in Table 6.

Table 6. Personality Characteristics of Keirsey in Learning (Agustin, 2018)

No	Type of Personality	Characteristics
1.	Guardian	<ul style="list-style-type: none"> a) Prefers traditional classrooms with structured procedures. b) Requires detailed, precise, and concrete explanations of materials. c) Typically shows less enthusiasm for participating in discussions.
2.	Artisan	<ul style="list-style-type: none"> a) These students are consistently active and seek attention in all situations. b) They enjoy engaging in discussions, making presentations, and participating actively. c) They prefer to demonstrate their skills and abilities. d) They tend to complete tasks quickly, have little patience, and get easily bored with monotonous learning processes.
3.	Rational	<ul style="list-style-type: none"> a) These students favor explanations that are logical. b) They can comprehend the material with a high degree of intelligence. c) They not only explain the material but also its origins. d) They prefer learning models that involve experiments, discovery, exploration, and solving complex problems.
4.	Idealist	<ul style="list-style-type: none"> a) These students are interested in materials that involve ideas. b) They prefer to solve tasks independently rather than in groups. c) There is a strong inclination towards reading and writing within this group. d) They enjoy class activities because it helps members get to know each other better.

In general, the personality types as defined by Keirsey (1998) vary and are detailed in Table 7.

Table 7. Characteristics Personality Types in General (Keirsey, 1998)

No	Type of Personality	Characteristics
1.	Guardian	Prioritize security and stability, showing a practical and well-organized approach to life. They seek belonging within institutions and demonstrate responsibility, loyalty, and diligence. They are meticulous in upholding and adhering to these institutions' established rules, structures, and traditions.
2.	Artisan	Embrace the present and find joy in life, often excelling in sports, artistic endeavors, or tasks that demand special skills. They prefer hands-on, practical jobs that offer freedom and flexibility. Adventurous and adaptable, they excel at solving problems during crises but occasionally bend the rules.
3.	Rational	They prioritize knowledge and skill above everything else, aiming to understand the world and contribute to its improvement. However, they typically avoid dealing with details. They excel at grasping the larger context, connecting ideas, and identifying patterns. Often preferring to do things independently, they can sometimes come across as serious or absent-minded.

No	Type of Personality	Characteristics
4.	Idealist	Typically embrace the present and find joy in life; skilled in sports, artistic pursuits, or tasks demanding special abilities; prefer engaging in practical, hands-on work that provides freedom and flexibility; enjoy adventure and easily adjust to new situations; adept at solving problems during crises but occasionally inclined to disregard rules.

The Idealist Pattern of Science Problem Solving

Students classified as Idealists demonstrate proficiency in identifying interconnected concepts to address problems, termed conceptual problem-solving patterns. An example, I-1, effectively solves problem five related to the application of the water cycle in daily scenarios, explaining the phenomenon causing a reduction in water levels in a container over time. I-1 supports their response with an illustrative image, aligning it with existing theories and processes. Further insights into I-1's problem-solving approach to this question were gleaned through an interview. The interview's excerpt shed light on I-1's perspective regarding phenomena that seemingly reduce container water levels.

I: Applying this to everyday scenarios, how might placing an open water container in direct sunlight cause the water level to drop?

R: Certainly, the reduction in water levels in an open container placed in direct sunlight is due to evaporation. This process is driven by the heat energy from the sun, which causes water molecules to escape into the air, by the principles of the water cycle.

I: How does this process of evaporation align with the water cycle?

R: The water cycle involves various processes, including evaporation, condensation, and precipitation. In the context of the open container, the heat energy from the sun increases the kinetic energy of water molecules, causing them to transition from liquid to gas. This aligns with the evaporation stage of the water cycle, which eventually leads to condensation and precipitation in the natural environment.

Based on the interview excerpt, Idealist problem-solving follows a structured approach. It begins with a thorough understanding of the problem, followed by selecting relevant concepts to address it. While some students use sketches to assist them, not all do. The next step involves proposing a hypothesis as a tentative solution. Many students evaluate their chosen answer by comparing it with other possible hypotheses. The final stage of the Idealist problem-solving process entails concluding to reach a definitive solution. The structured approach of Idealist problem-solving can be observed in Figure 1.

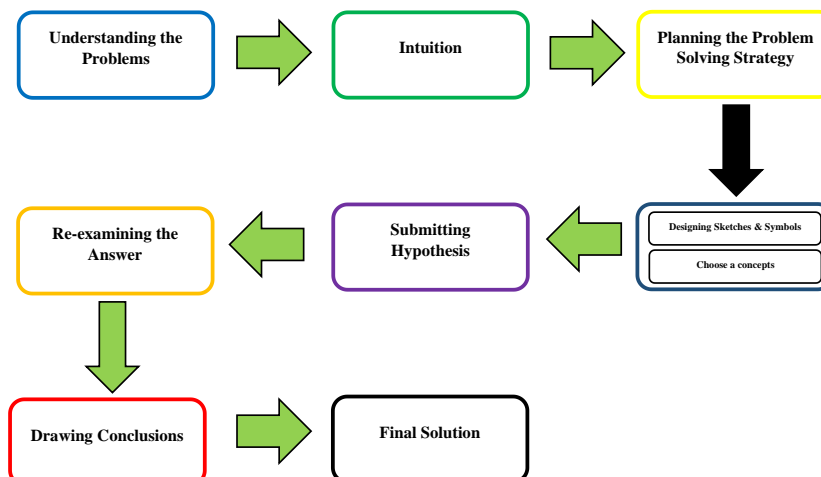


Figure 1. Idealist Problem Solving patterns of Science (Alfathy et al., 2018)

The study's findings on Idealist types are consistent with Keirsey's (1998) theory, suggesting that Idealists prioritize materials concerning ideas and values. Additionally, Idealist types show proficiency in exploring issues from multiple viewpoints (Agustin, 2018). This observation is further supported by the adept problem-solving abilities demonstrated by Idealists, which align closely with Dewey's five criteria for effective problem-solving.

The Artisan Pattern of Science Problem Solving

Artisan students approach problem-solving differently compared to Idealist students. They typically utilize an intuitive-analogic problem-solving method, blending intuition and analogy. Intuitive problem-solving indicates that students rely on instinct rather than formal planning when tackling a problem. According to Shelton (2018), Artisan types tend to favour quick actions and often hurry, making intuitive problem-solving their preferred approach. This approach was evident in the outcomes of written test A-2, precisely problem 2, which examined the application of the water cycle principles in everyday situations, such as understanding how water levels change in a container exposed to sunlight. The subsequent interview with A-2 offers insights into their intuitive thought process and analogical reasoning in addressing scientific problems.

I: When considering feeling lighter, you mentioned being on a boat in the middle of the ocean. Please elaborate on why you think this scenario results in feeling lighter.

R: Well, when you are on a boat in the middle of the ocean, there is a sensation of lightness because of the gentle rocking and movement of the water. It is like floating, and during that moment, the feeling of weight is significantly reduced due to the buoyancy of the water.

I: How does this relate to the principles of buoyancy and gravity?

R: Buoyancy is the upward force exerted by the water, counteracting the force of gravity. In this scenario, the person feels lighter because the buoyant force partially offsets their weight, similar to how astronauts feel lighter in water during training for microgravity conditions.

This interview excerpt shows that Artisan problem-solving adheres to an intuitive-analogic pattern. They rely on their instincts initially to grasp the problem and draw parallels from everyday experiences to devise a solution. While they may not engage in extensive planning, their approach proves effective for swift and pragmatic problem-solving. This intuitive-analogic method is notably apparent in their ability to connect real-world experiences with scientific principles. The structured framework of the Artisan problem-solving process can be seen in Figure 2.

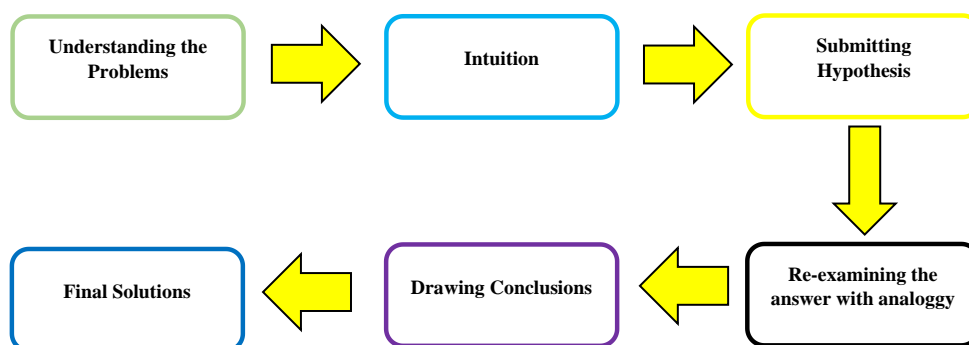


Figure 2. Artisan Problem Solving patterns of Science (Alfathy et al., 2018)

The study's findings on Artisan types align with Keirse's (1998) characterization of Artisans as individuals who make quick decisions and often rely on intuition. The research suggests that Artisan students typically adopt an intuitive-analogic problem-solving approach, characterized by rapid decision-making without extensive planning. This pattern involves grasping the problem, formulating a hypothesis, comparing potential solutions, and drawing conclusions to arrive at a resolution (Nupus et al., 2024). These findings support that Artisan types generally favour swift, action-oriented decision-making strategies. Artisan students with an intuitive-analogic problem-solving pattern have a problematic tendency to express the exact concept in every science problem-solving. Artisan students intuit how to draw hypotheses and use analogy strategies to reinforce the hypothesis.

The Guardian Pattern of Science Problem Solving

Much like Artisan students, Guardian students utilise intuition in their problem-solving approach. This is exemplified by G-4 while addressing problem 7, which focuses on explaining the variations in shadow length during the day. The interview with G-4 underscores their reliance on intuitive thinking patterns when tackling problems in earth and space science, known as the intuitive problem-solving pattern. Here is an adapted excerpt from the interview with G-4 regarding Problem 7:
I: How did you approach solving the problem of explaining the changes in shadow length throughout the day?

R: Well, I thought about it, and it seemed like if we go with what feels right, we can understand how shadows change. It is like going with your instincts to figure out the solution.

I: Can you explain why you chose this approach?

R: Sometimes, you do not need a big plan; you do what makes sense now. So, I went with what felt right, and it worked.

I: How confident are you in this intuitive approach to problem-solving in general?

R: It works well, especially when the problem concerns common sense. Trusting your gut can lead to practical solutions without overthinking things.

Based on this interview excerpt, Guardian's problem-solving follows an intuitive pattern. They begin by relying on their instincts to understand the problem and apply common sense to find a solution. While they may not engage in detailed planning, their approach is effective for practical, everyday problem-solving. This intuitive method is particularly evident in how they relate real-world observations to scientific principles in earth and space science.

Based on the analysis of the interview excerpt, Guardian students generally follow a problem-solving pattern that starts with a thorough understanding of the problem. Once they grasp the problem, Guardian students quickly propose hypotheses based on intuition (Alfathy et al., 2018). Then, some students evaluate their chosen answer by intuitively comparing it with alternative hypotheses. The final step in the Guardian pattern involves synthesizing all gathered information to draw well-founded conclusions that lead to a final solution. This step is crucial as it consolidates insights from earlier stages and guides the decision-making process towards resolution. The structure of the Guardian problem-solving pattern, as illustrated in The sequential actions involved in each step of the problem-solving process, is outlined in Figure 3.

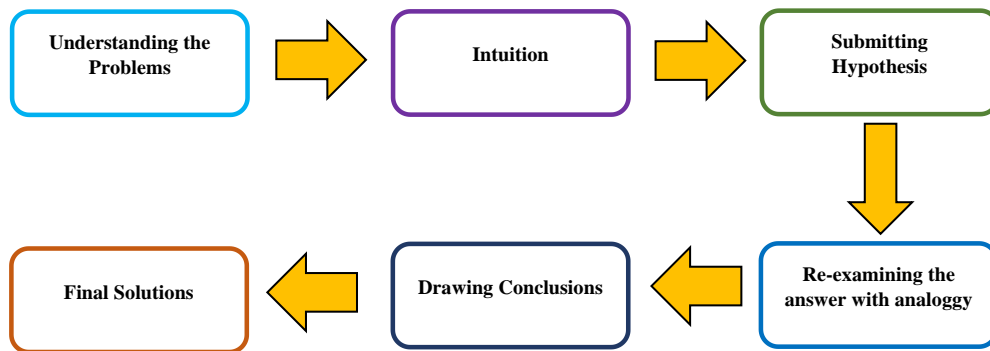


Figure 3. Guardian Problem Solving patterns of Science (Alfathy et al., 2018)

Guardian students share intuitive problem-solving patterns with Artisan students, differing primarily in their treatment of hypotheses. Unlike Artisan students, who may reassess initial answers using analogy, Guardian students consider the intuition-derived hypothesis the final solution. Some Guardians re-evaluate within the boundaries of true and false while relying on intuition. This nuanced distinction highlights the unique problem-solving approaches of Guardian and Artisan students. Although both prefer intuitive hypothesis generation, Artisan students distinguish themselves by favouring analogical re-examination (Keirsey & Bates, 1984; Keirsey, 1998).

The Rational Pattern of Science Problem Solving

Rational students employ analogies, relating problems to real-life phenomena, for enhanced problem-solving. Despite occasional instances where the analogies lack scientific concepts, Rational students exhibit proficiency in problem-solving. This is evident in the interview excerpt with R-5 discussing problem 4.

I: Can you elaborate on why the length of shadows changes throughout the day?

R: The length of shadows changes throughout the day because of the sun's position. When the sun is lower in the sky, shadows are longer in the morning and late afternoon. When the sun is directly overhead at noon, shadows are shorter. This happens because of the angle at which sunlight hits objects on the ground.

I: When choosing a specific time of day to measure the shortest shadow, what considerations influenced your decision?

R: Opting for noon is ideal because the sun is at its highest point in the sky, casting the shortest shadows. Any other time would result in longer shadows due to the lower angle of the sun, which increases the length of the shadows.

Based on this interview excerpt, Rational students use real-life analogies to understand and solve problems in earth and space science. They relate the sun's changing position to the varying lengths of shadows, illustrating their ability to draw connections between observed phenomena and scientific concepts. This approach allows them to effectively address problems by leveraging intuitive comparisons and logical reasoning.

The problem-solving approach of Rational students begins with understanding the problem, followed by employing analogies and estimation techniques to find a solution. Rational students use analogies to simplify problem-solving by comparing real-life situations (Agustina & Galatea, 2024). Next, they propose a hypothesis as a tentative answer. Some students review their chosen answers by comparing the

hypothesis with alternative solutions. The final step involves concluding to determine the optimal solution to the problem.

Figure 4 depicts the structure of the Rational problem-solving pattern. As Keirsey (1998) noted, rational students use analogies to support their preference for logical explanations. The results of problem-solving tests indicate that Rational students demonstrate strong proficiency across all assessment criteria.

A similar trend can be noted between Rational and Artisan students, although they differ primarily in their problem-solving approaches. Rational students favour hypotheses and employ problem-solving strategies rooted in analogical reasoning. This distinction is highlighted in the interview with R-5 discussing problem 4, where the focus is on the analogical thinking pattern characteristic of Rational students. This method involves drawing parallels between established concepts.

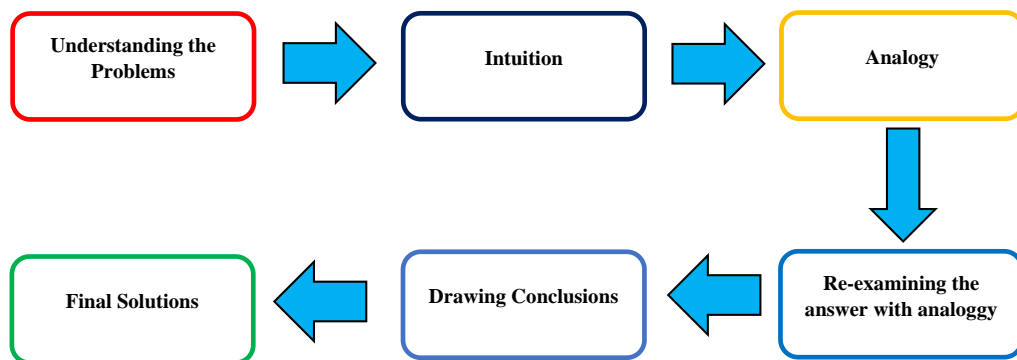


Figure 4. Rational Problem Solving patterns of Science (Alfathy et al., 2018)

The Personality Type Tendency in Problem Solving Technique

The investigation into personality types and their problem-solving inclinations provides valuable insights into how individuals approach challenges based on their inherent traits (Kipman et al., 2022; Kokinos et al., 2024). Idealists, for instance, exhibit a methodical approach rooted in their penchant for abstract thinking and pattern recognition. They excel in interpreting data through sketches and symbols, which helps them formulate hypotheses and apply conceptual frameworks effectively. Idealists also prioritize self-assessment, continuously seeking to refine their understanding of problems by identifying shared patterns and abstract concepts (Keirsey & Bates, 1984; Keirsey, 1998).

In contrast, Artisans emphasize efficiency and adaptability in their problem-solving methods. They quickly generate intuitive hypotheses, often relying on immediate insights and practical applications to address challenges. This intuitive approach allows Artisans to navigate dynamic situations flexibly, making rapid decisions based on their ability to grasp the essence of a problem swiftly. This adaptability is a hallmark of Artisan problem-solving, reflecting their preference for hands-on, action-oriented approaches that yield tangible results in diverse contexts (Keirsey & Bates, 1984; Keirsey, 1998).

Conclusion

This research employs the Investigation of Lived Experience methodology in Cognitive Psychology to explore how 9th-grade science students approach problem-

solving, categorized by Keirsey personality types: Idealist, Artisan, Guardian, and Rational. Personality traits significantly influence how students tackle problems. Idealists focus on goals, emphasizing data interpretation and using sketches in problem-solving. Artisans prioritize efficiency, employing an intuitive-analogical method. Guardians also rely on intuition, treating hypotheses derived from intuition as conclusive solutions. Rational utilizes analogy and logical reasoning, stressing practical comparisons. Understanding these patterns provides valuable insights for tailoring educational approaches to individual preferences. Future research could further explore additional factors impacting problem-solving methods, thereby enhancing the development of more adaptive educational strategies.

References

- Agustin, M. D. A. (2018). Proses Berfikir Matematis Siswa Dalam Memecahkan Masalah Matematika Ditinjau Dari Tipe Kepribadian Keirsey. *Madrosatuna: Journal of Islamic Elementary School*, 2(2), 29-38. <https://doi.org/10.21070/madrosatuna.v2i2.1967>
- Agustina, L., & Galatea, C. (2024). Logical Thinking in Idealist and Rational Students. *Journal of Education and Learning Mathematics Research (JELMaR)*, 5(1), 42-54. <https://doi.org/10.37303/jelmar.v5i1.141>
- Alfathy, R., Astuti, B., Linuwih, S. (2018). Identification of Problem-Solving Pattern of Physics Based on Students Personality. *Variable*, 1(2), 42-50. <http://dx.doi.org/10.26737/var.v1i2.690>
- Alfathy, R., Astuti, B., Linuwih, S. (2019). The Profile of Physical Problem-Solving Based on Student's Personality Types. *Physics Communication*, 3(1), 21-28. <https://doi.org/10.15294/physcomm.v3i1.15258>
- Anderson, J. (2009). *Mathematics Curriculum Development and the Role of Problem Solving*. Discussion Paper, ACSA National Conference on October 2009..
- Brown, M. J. (2012). John Dewey's Logic of Science. *HOPOS: The Journal of the International Society for the History of Philosophy of Science*, 2(2), 258-306.
- Central Board of Secondary Education (CBSE). (2020). *21st Century Skills (A Handbook)*. Delhi: India.
- Creswell, J. W., & Clark, V. L. P. (2018). *Designing and conducting mixed methods research* (3rd ed.). Thousand Oaks, CA: SAGE.
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications For Educational Practice of The Science of Learning and Development. *Applied Developmental Science*, 24(2), 97-140.
- Dewiyani, M. J. S., & Sagirani, T. (2014). Inculcation Method of Character Education Based on Personality Types Classification in Realizing Indonesia Golden Generation. *International Journal of Evaluation and Research in Education (IJERE)*, 3(2), 91-98. <http://dx.doi.org/10.11591/ijere.v3i2.4199>
- Echavarri, M., Godoy, J.C., Olaz, F. (2007). Gender Differences in Cognitive Skills and Academic Performance in College Students. *Univ. Psychol*, 6(2), 319-329.
- Embarak, O., Khan, Z., & Gurung, B. (2019). Understanding Students Personality to Detect Their Learning Differences. *Lecture Notes on Data Engineering and Communications Technologies*, 29(February), 383-390. https://doi.org/10.1007/978-3-030-12839-5_35

- Fitroh, U. N., Rusilowati, A., Darsono, T., Marwoto, P., & Mindyarto, B. N. (2020). Analysis of Student Problem Solving Skills in Harmonic Motion Materials. *Physics Communication*, 4(2), 25–31. <https://journal.unnes.ac.id/nju/index.php/pc/article/view/31174>
- Fourie, M., & Schlebusch, G. (2023). A Cognitive Stance to Enhance Learner Information Processing Ability in the Classroom: Structural Equation Modelling Approach. *Journal of Advocacy, Research and Education*, 10(1), 18–31. <https://doi.org/10.13187/jare.2023.1.18>
- Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational Research: An Introduction (7th ed.)*. Boston: Allyn & Bacon.
- Ginevra, M. C., Nota, L., Heppner, P. P., Heppner, M., & Soresi, S. (2015). The Relationship of Personality Type, Problem-Solving Appraisal, and Learning Strategies. *Journal of Career Assessment*, 23(4), 545–558. <https://doi.org/10.1177/1069072714553075>
- Grimm, J., & Richter, T. (2024). Rational thinking as a general cognitive ability: Factorial structure, underlying cognitive processes, and relevance for university academic success. *Learning and Individual Differences*, 111(March). <https://doi.org/10.1016/j.lindif.2024.102428>
- Güner, P. & Erbay, H. N. (2021). Metacognitive Skills and Problem-Solving. *International Journal of Research in Education and Science (IJRES)*, 7(3), 715-734.
- Hoesny, M. U., & Darmayanti, R. (2021). Permasalahan dan Solusi untuk Meningkatkan Kompetensi dan Kualitas Guru: Sebuah Kajian Pustaka. *Scholaria: Jurnal Pendidikan dan Kebudayaan*, 11(2), 123-132.
- Jackson, J. J. (2011). The Effects of Educational Experiences on Personality Trait Development. *Disertation*. Urbana, United State: Univerity of Illinois.
- Keirsey, D. (1998). *Please Understand Me II: Temperament, Character, Intelligence*. United States: Prometheus Nemesis Books.
- Keirsey, D., & Bates. (1984). *Please Understand Me*. California: Prometheus Nemesis Book Company.
- Kipman, U., Bartholdy, S., Weiss, M., Aichhorn, W., & Schiepek, G. (2022). Personality traits and complex problem solving: Personality disorders and their effects on complex problem-solving ability. *Frontiers in psychology*, 13, 788402. <https://doi.org/10.3389/fpsyg.2022.788402>
- Kiraga, F. (2023). a Study of Problem Solving in Physics Learning: a Systematic Review. *EduFisika: Jurnal Pendidikan Fisika*, 8(3), 303–315. <https://doi.org/10.59052/edufisika.v8i3.29446>
- Kokkinos, C. M., Antoniadou, N., & Voulgaridou, I. (2024). Majors unleashed: Unravelling students' personality profiles across academic disciplines. *Current Psychology*, 43, 17635–17645. <https://doi.org/10.1007/s12144-024-05721-2>
- Kusumah, R. G. T., Sasongko, R. N., Kristiawan, M., Walid, A., & Andaria, M. (2021). Assessment to Measure Problem Solving Ability in the Lesson of the Interaction of Living Things with the Environment. *Jurnal Studi Guru dan Pembelajaran*, 4(1), 147-155.
- Manuaba, I. B. A. P., No, Y., & Wu, C. C. (2022) The Effectiveness of Problem Based Learning in Improving Critical Thinking, Problem-Solving and Self-Directed

- Learning in First-Year Medical Students: A Meta-analysis. *PLoS ONE*, 17(11): e0277339, 1-12.
- Mardhiyatirrahmah, L., & Abdussakir. (2021). Restructuring of students' thinking in junior high school through defragmentation for solving mathematical problems. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 10(2), 95-102. <http://dx.doi.org/10.18592/tarbiyah.v10i2.4810>
- Mateus, C., Campis, R., Aguaded, I., Parody, A., & Ruiz, F. (2021). Analysis of Personality Traits and Academic Performance in Higher Education at A Colombian University. *Heliyon*, 7, 1-7.
- Mawaddah, A., Anwar., Yusrizal., & Zubainur, C. M. (2021). The Impact of Students' Personality Types On The Application of Problem-Solving Strategies In Solving PISA Questions. *Journal of Physics: Conference Series*, 1882(012062), 1-9.
- Moleong, L. (2002). *Metode Penelitian Kualitatif*. Bandung: CV. Remaja.
- Molnár, G., & Csapó, B. (2018) The Efficacy and Development of Students' Problem-Solving Strategies During Compulsory Schooling: Logfile Analyses. *Front. Psychol.* 9(302), 1-17.
- Mulyasa. (2008). *Menjadi Guru Profesional Menciptakan Pembelajaran Kreatif dan Menyenangkan*. Bandung: PT. Remaja Rosdakarya.
- Nupus, Y., Heryani, Y., & Rustina, R. (2024). Kemampuan Spasial Ditinjau dari Tipe Kepribadian David Keirsey. *Indiktika: Jurnal Inovasi Pendidikan Matematika*, 6(2), 136-150. <https://doi.org/10.31851/indiktika.v6i2.15166>
- Octavia, S. C., Sihombing, R. A., Destine, K. T., & Hutagalung, J. F. (2022). Analysis of Obstacles on Limited Face-To-Face Learning During the Covid-19 Pandemic Junior High School in Medan. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 11(1), 18-28.
- Octor, J. L., Strand, N. E., Mestre, J. P. & Ross, B. H. (2015). Conceptual Problem Solving in High School Physics. *Physical Review Special Topics-Physics Education Research*, 11(2), 1-13.
- Olson, M. H., & Hergenhahn, B. R. (2013). *An Introduction to Theories of Personality*, Ed: 8. Terjemahan: Yudi Santoro. Yogyakarta: Pustaka Pelajar
- Panggabean, F. T. M., Simanjuntak, L. A., Sihombing, R. A., Octavia, S. C., & Tambunan, J. (2023). Analysis of 7th-grade Students' Misconceptions of Acid-Base. *J-PEK (Jurnal Pembelajaran Kimia)*, 8(1), 1-7.
- Panjaitan, B. (2015). Karakteristik Metakognisi Siswa dalam Memecahkan Masalah matematika Berdasarkan Tipe Kepribadian. *Jurnal Ilmu Pendidikan*, 21(1), 19-28.
- Pertiwi, A. D., Masrukan & Susilo. (2014). Analisis Kemampuan Komunikasi Matematis Melalui Pembelajaran Model 4K Berdasarkan Tipe Kepribadian Peserta Didik Kelas VII. *Jurnal Kreano*, 5(2), 195-204.
- Sebastian, M. A. (2017). Students' Gender, Learning Style, and Difficulties in Solving Problems in College Algebra. *International Journal of Multidisciplinary Research and Modern Education*, 3(2), 87-95.
- Sepriyanti, N., Trinova, Z., Susanto, A., & Mahmuda, R. (2020). The application of the Polya's steps reviewed from problem-solving ability in two-variable linear equation system (SPLDV). *Tarbiyah: Jurnal Ilmiah Kependidikan*, 9(1), 51-65. <http://dx.doi.org/10.18592/tarbiyah.v9i1.3543>

- Shelton, T. C. (2018). Student Temperament Assessment and Its Relationship with The Selection of Accounting as A Major. *Disertation*. Blacksburg: Virginia Polytechnic Institute and State University.
- Sihombing, R. A., & Hasruddin. (2024). Development of Science, Technology, Engineering, and Mathematics (STEM)-Based E-Book on Human Digestive System Material Based on Scientific Literacy. *Jurnal Pendidikan Matematika dan IPA*, 15(2), 182-197.
- Sihombing, R. A., Manurung, G. A., & Simanjuntak, L. A. (2021). Analysis of Implementation of TPACK by Teachers Through Distance Learning at Junior High School in Medan. *Indonesian Science Education Research (ISER)*, 3(2), 1-11.
- Sihombing, R. A., Manurung, G. A., & Simanjuntak, L. A. (2022). Analysis Implementation of Technological Pedagogical Content Knowledge by Science Teachers Through Distance Learning at Junior High School in Medan. *Jurnal Pendidikan Matematika dan IPA*, 13(2), 214-230.
- Sihombing, R. A., Muslim., & Rahman, T. (2023). The Development of Interactive Audio-Visual-Based Media Using VideoScribe to Reduce Misconceptions Electrical Potential and ECG Material. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 12(2), 69-80.
- Sihombing, R. A., Muslim., Rahman, T., & Karimi, A. (2024). Literature study of the Ebook based on Education for Sustainable Development (ESD) as the main solution to improving sustainability awareness. *INSECTA: Integrative Science Education and Teaching Activity Journal*, 5(1), 108-120.
- Stompff, G., Bruinessen, T. V., & Smulders, F. (2022). The Generative Dance of Design Inquiry: Exploring Dewey's Pragmatism for Design Research. *Design Studies*, 83(101136), 1-24.
- Sulthon, S. (2017). Pembelajaran IPA yang Efektif dan Menyenangkan bagi Siswa MI. *Elementary Islamic Teacher Journal*, 4(1), 38-54.
- Suryadi, D. F., Muis, M., Taba, I., & Hakim, W. (2022). Personality And Knowledge-Sharing Behavior Among Students at Stie YPUP Makassar. *Journal of International Conference Proceedings*, 5(2), 184-190. <https://doi.org/10.32535/jicp.v5i2.1683>
- Vilianti, Y. C., Pratama, F. W., Mampouw, H. L. (2018). Description of The Ability of Social Arithedical Stories by Study Problems by Students VIII SMP Reviewed from The Polya Stage. *International Journal of Active Learning*, 3(1), 23-32.
- Widiyatmoko, S. (2018). Deskripsi penalaran analogi ditinjau dari tipe kepribadian David Keirse siswa SMP Negeri 1 Ajibarang. *AlphaMath: Journal of Mathematics Education*, 4(2), 9-14.
- Zanberg, L., John L. Q., Marc N., & Kees V. O. (2016). Personality-dependent Differences in Problem-solving Performance in a Social Context Reflect Foraging Strategies. *Behavioural Processes J*, 134(1), 95-102.
- Zhu, C., Leung, C. O., Lagoudaki, E., Velho, M., Segura-Caballero, N., Jolles, D., Duffy, G., Maresch, G., Pagkratidou, M., & Klapwijk, R. (2023). Fostering Spatial Ability Development in and for Authentic STEM Learning. *Front. Educ*, 8, 1-17.