Student’s Analogical Reasoning Based on Clement’s Stage

by Dewi Asmarani 4

International Conference on Islam, Law, and Society (INCOILS) 2022
Confrerence Proceedings

Article

Student's Analogical Reasoning Based on Clement's Stage in Solving Mathematical Problems in Terms of The Mathematical Abilities of Class VII A Students of MTsN 2 Kota Blitar

Nabila Triasari[1], Dewi Asmarani[2]

Tadris Matematika, Universitas Islam Negeri Sayyid Ali Rahmatullah Tulungagung
[1]Email: nabila.sari553@gmail.com [2]Email: dewiasmarani.iain@gmail.com

ABSTRACT:

Learning mathematics requires reasoning. However, in practice, kids still have poor problem-solving skills when it comes to mathematics. Analogical reasoning is one of the crucial reasoning abilities that must be cultivated. Students need to use analogous thinking to tackle more challenging or uncommon topics. Based on Clement's stages in solving mathematical problems, this study sought to describe the analogical sense of class VII pupils with high, medium, and low mathematical talents. The research methodology employed is a qualitative case study research methodology. Three pupils from MTsN 2 Blitar City's class VII A served as the research subjects. Interviews and analogies reasoning exams are used as data collection methods. The findings of this research are: 1) Mathematically gifted students can progress through Clement's four stages. 2) Students with average math skills can only complete the first three steps: creating the analogy, comprehending the analogy case, and communicating results. 3) Students with weak mathematical skills can only complete the generation of the analogy stage.

Keywords: Mathematical Ability, Clement Stages, and Analogous Reasoning.

INTRODUCTION

Education 4.0 is a program to support the realization of intelligent education by raising and equating the quality of education, increasing access, and emphasizing the relevance of utilizing technology in achieving world-class education that fosters teamwork, communication, and critical and creative thinking abilities. The "Freedom to Learn" education initiative, which serves as a roadmap for future learning, was launched by the Minister of Education and Culture to increase the caliber of human resources.[1] This is consistent with the objectives for learning mathematics set forth in the Regulation of the Minister of National Education (Permendiknas) Number 22 of 2006 regarding Mathematics Subject Content Standards for All Levels of Primary and Secondary Education so that students can:

1. Comprehend mathematical ideas.

[1] Wayan Numertayasa dkk, *Implementasi Kurikulum Merdeka di SMP Negeri 3 Selemadeg Timur*, dalam Jurnal Madaniya Vol. 3 No. 3, 2022.

2. Making use of pattern recognition.
3. Figuring out mathematical issues.
4. Using symbols, tables, graphs, or other visual aids to convey concepts in order to make situations or difficulties more clear.
5. Having a mindset that values the application of mathematics in daily life.

These aims include the inclusion of reasoning as one of the goals of learning mathematics.[2]

In mathematics, reasoning is crucial, particularly for grasping ideas and resolving issues. The cause is a process or activity of thinking that involves coming to conclusions or forming a new, accurate assertion based on a number of previously held or validated assumptions. Analogical reasoning is one sort of reasoning used in mathematics.

The capacity to connect two problems, especially source problems and target problems, by analogous reasoning (problems that are rarely encountered). Since the source issue is one that is frequently seen, it is simpler to resolve. Although the levels of the source problem and the target problem are different, these two difficulties have parallels, and the target problem is a problem that is uncommonly encountered, making it fairly challenging to address.[3] The capacity of pupils to identify parallels and apply them in various circumstances has an impact on their capacity to solve difficulties. By drawing parallels between the difficulties they frequently confront and more challenging ones, they rarely encounter, students can use analogical reasoning to tackle more challenging problems and learn about concepts, patterns, and solving techniques. Analyzing analogies can assist in the resolution of issues with analogous structures.[4]

Analogical thinking is crucial for kids learning mathematics. This is consistent with a number of professional viewpoints and research findings, including Katagiri's assertion that the ability to reason analogically is essential for establishing perspectives and solving problems. Additionally, Sasanti's study of junior high school pupils revealed that using analogies could help kids become better at solving mathematical issues. According to English, resolving analogy issues can improve pupils' conceptual and mathematical understanding. This was further supported by Mofidi, who claimed that by using analogical reasoning, pupils might learn mathematics more thoroughly and retain mathematical ideas longer. He claims that using analogical reasoning problems to convey mathematical concepts to students is one of the most effective teaching strategies available.[5] As a result, using analogies to solve difficult arithmetic problems is crucial to mastering the subject of mathematics.

According to the Global Institute's study on Indonesian students' reasoning skills, just 5% of Indonesian students are able to respond to questions in the higher categories that call for reasoning. As many as 78% of Indonesian pupils can work on memorization-based questions in the meantime.[6] Another study's findings revealed that junior high school pupils still lacked the mathematical reasoning (analogy) skills necessary for success because their

---

[2] Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 22 Tahun 2006 tentang Standar Isi Untuk Satuan Pendidikan Dasar dan Menengah, BNSP, hal.8.

[3] Sarjoko dkk, *Penguasaan Penalaran Analogi dalam Pemecahan Masalah Unsur-unsur dan Luas Kubus* dalam Jurnal Pendidikan Matematika Vol 8 No.1.

[4] Munaroh Novisa, Subanji dan Purwanto, "*Penalaran Analogi Siswa SMP Tipe Climber dalam Menyelesaikan Masalah Matematika*", Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, Vol. 5,No. 2, Februari 2020.

[5] Siti Nurul Azimi, Purwanto dan Abadyo, "*Penalaran Analogi Siswa Dalam Menyelesaikan Masalah Keliling dan Luas Segi Empat*", Jurnal Kajian Pembelajaran Matematika, Vol. 1, No. 2, Oktober 2017.

[6] Rahayu Purwanti, Agung Hartoyo, dan Dede Suratman, "*Kemampuan Penalaran Analogi Matematis Siswa SMP dalam Materi Bangun Ruang*", *Jurnal UNTAN,* Vol. 5, No. 10 (2016), hal.2

scores were only 49% of the desired level.[7] It has been demonstrated by the findings of the aforementioned description that pupils' ability to reason in order to solve mathematical issues is lacking.

In this study, researchers used Clement's stages to analyze how students used similar reasoning. Based on Clement's locations, pupils' analogy thinking has the following locations:[8] (1) Generating the analogy, which is the process of illustrating the requirements and potentials for compatibility between the source problem and the target problem. At this level, it is determined whether the items listed as initial conditions are appropriate for the source problem and target problem. (2) Evaluating the Analogy Relationship, which involves carefully re-examining if the analogy relationship between the source problem and the target problem is appropriate and figuring out the right analogy relationship between the two. This stage involves a more thorough study of the applicability discovered in the analogy-generation stage to pinpoint the relevant issue in both the source problem and the target issue. (3) Understanding the Analogy Case, which is the act of putting each element of the source problem through testing or analysis in order to fully comprehend the target problem. In this stage, the source problem is solved, and the best way to tackle the target problem is determined by analyzing how well the source problem and target problem fit together. (4) Transferring Findings, often known as the process of moving solutions or conclusions from the source problem to the target problem. In this stage, the target problem is solved using the target problem-solving technique that was discovered during the comprehension of the analogy case stage.

METHOD

A case study research method with a qualitative approach was used in this study. Assessments of mathematical aptitude, tests of problem-solving skills using source and target problems, and interview protocols were all used in this study. Students took mathematical aptitude tests to choose the research topics. Students were divided into three groups according to their level of mathematical proficiency by researchers: high, medium, and low. One kid from each category was chosen based on the results of the mathematics ability exam to serve as the study subject.

The chosen subject was also tested on problem-solving skills by the researcher. The ability of each subject to use analogous reasoning is tested through problem-solving exercises. The researcher interviewed the subject after the problem-solving test was completed to learn more about the analogical reasoning process based on Clement's stages that had not been revealed on the subject's problem-solving test sheet.

RESULT AND DISCUSSION

High Math Ability

Based on the collected data, it has been determined that students who are highly proficient in mathematics perform tasks that demonstrate all stages of analogy reasoning according to Clement's stages, namely creating the analogy, assessing the analogy relation, comprehending the analogy case, and communicating findings.

---

[7] Harry Dwi Putra, "*Pembelajaran Geometri dengan Pendekatan Savi Berbantuan Wingeom untuk Meningkatkan Kemampuan Nalogi Matematis Siswa SMP*", *Prosiding Seminar Nasional Pendidikan Matematika STKIP Siliwangi Bandung*, Vol. 1 (2012), hal. 3

[8] *Ibid.*,

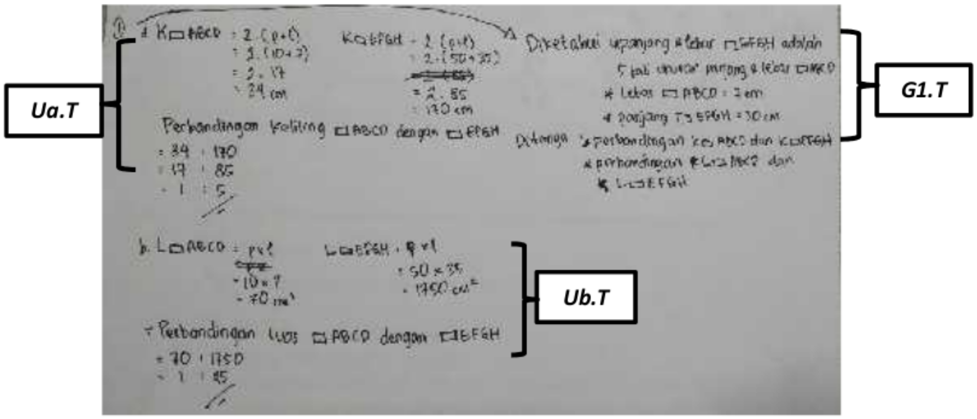


Figure 1. Answer to sources questions of subject with high mathematical ability

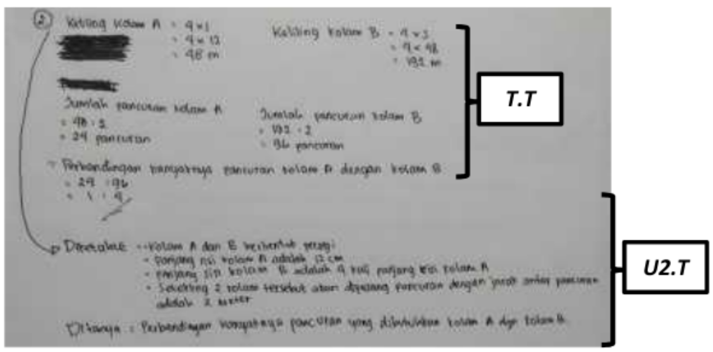


Figure 2. Answer to target questions of subject with high mathematical ability

Students with strong mathematical aptitudes can complete the step of producing the analogy, according to the results of the analogy reasoning test and the interview. This is consistent with the findings of Siti Nurul Azimi, Purwanto, and Abadyo's study, which showed that students with strong mathematical skills could identify all known and requested facts from source problems and target problems by expressing them as symbols and sentences during the encoding process.[9] High-level math students can present what is being asked in the two questions by mentioning what is known from the source problem and the target problem.

According to the findings of the interviews, children with strong mathematics skills can complete the step of analyzing the analogous relation. Rahayu Purwanti, Agung Hartoyo, and Dede Suratman's research findings, which claim that students at the upper ability level can draw conclusions from the similarity of the relationship between the source problem and the target problem so that they can present and determine the proper relationship between the two, support this claim.[10] Students are required to describe the connection between the source

---

[9] Siti Nurul Azmi, Purwanto & Abadyo, "*Penalaran Analogi Siswa dalam Menyelesaikan Masalah Keliling dan Luas Segiempat*", Jurnal Kajian Pembelajaran Matematika, Vol. 1, No. 2, Oktober 2017, hal. 152

[10] Rahayu Purwanti, Agung Hartoyo & Dede Suratman, "*Kemampuan Penalaran Analogi Matematis Siswa SMP dalam Materi Bangun Ruang*", Jurnal Pendidikan dan Pembelajaran Khatulistiwa, Vol. 5, No. 10, 2016, hal. 8

problem and the goal problem at this point. High-achieving math students can determine how the source problem (problem 1) and the goal problem should be related (problem 2).

High-achieving arithmetic students can comprehend the analogy case stage. This is consistent with the findings of Hesti Nurhalimah and Haerudin's study, which showed that students with strong inferring skills were adept at handling resource problems. The ideas in the original problem can be inferred by students.[11] High-level math students can accurately handle source problems, such as determining the ratio between the diameter and area of two rectangular objects. and be able to determine the rectangle's unknown side's length. High-achieving math students may describe each step they took to solve the source problem.

Students with strong mathematical skills can complete the stage of transferring findings. According to Tatag Yuli Eko Siswono's research, high mathematics students can solve target problems, choose the correct solutions, and explain the analogies employed.[12] At this point, students are expected to use calculations and concepts from solving source issues to solve target questions.[13] High-achieving math students can successfully solve the target problem using the solution method's conclusion from the source problem. High-achieving math students can outline each step taken to solve the goal problem.

Moderate Math Ability

Students with modest mathematical proficiency can complete the generating the analogy stage, according to the findings of the analogy reasoning test and interview. According to Siti Nurul Azimi, Purwanto, and Abadyo's research, students with strong mathematics skills can recognize all known and requested facts from source issues and target problems at the encoding stage by expressing them as symbols and sentences.[14] Students who have a basic understanding of mathematics can present the information from the source problem and the target problem and state what is known from both problems.

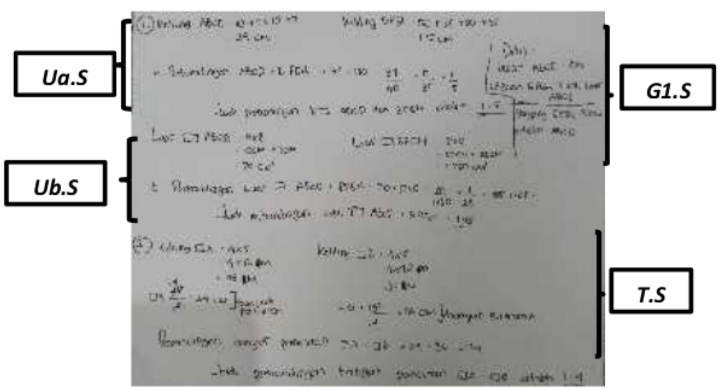


Figure 3. Answer to sources questions and target questions of subject with moderat mathematical ability

[11] Hesti Nurhalimah dan Haerudin, "*Analisis Kemampuan Berfikir Analogi Matematis Siswa SMP dalam Menyelesaikan Soal Limas*", Jurnal Imiah Pendidikan Matematika, Vol. 8, No. 1, 2021, hal. 463.

[12] Tatag Yuli Eko Siswono, "*Proses Berfikir Analogi Siswa dalam Memecahkan Masalah Matematika*, Seminar Nasional Matematika, Jember 2009.

[13] Purwanti, Hartoyo, & Suratman, "*Kemampuan Penalaran Analogi Matematis Siswa SMP dalam Materi Bangun Ruang*", hal.5

[14] Siti Nurul Azmi, Purwanto & Abadyo, "*Penalaran Analogi Siswa dalam Menyelesaikan...* , hal. 153

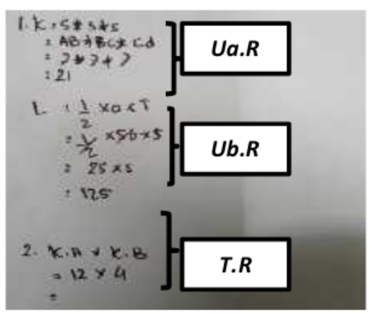
According to the results of the interviews, students with moderate mathematical proficiency were unable to complete the stage of evaluating the analogous relation. The findings of Tatag Yuli Eko Siswono's study, which found that students in the moderate mathematics group frequently struggle with discovering connections or resolving the objective problem and are unable to describe the analogies employed, provide support for this.[15] Students with average mathematics skills have had trouble figuring out how the source problem (problem 1) and the target problem are related in detail (question 2).

The understanding the analogy case step can be completed by students with average math skills. This is consistent with the findings of research by Hesti Nurhalimah and Haerudin, who found that students with moderate talents were able to perform accurate calculations, use formulas, and employ the right settlement procedures while solving source problems at the inferring stage.[16] Students who are proficient in mathematics may accurately solve source problems, such as determining the ratio between the areas and circumferences of two rectangular objects. and be able to determine the rectangle's unknown side's length. Mathematically competent students can describe each stage of solving the source problem.

Students with average math skills can complete the stage of transferring findings. According to Tatag Yuli Eko Siswono's research, pupils with ordinary ability levels can use the same source problem-solving techniques or ideas to address target issues.[17] Students with average arithmetic skills can successfully solve the target problem using the findings from the source problem's solution approach. Students who are proficient in applied mathematics can explain each step used to solve the goal problem.

Low Math Ability

Figure 4. Answer to sources questions and target questions



of subject with lowmathematical ability

According to the findings of the analogy reasoning test and the interview, students with weak mathematics skills can complete the analogy generation stage. This is consistent with the findings of research by Rahayu Purwanti, Agung Hartoyo, and Dede Suratman, who found that students with lower ability levels can only recognize what is understood from the source problem, and even then, it is incomplete and unable to recognize the target problem.[18] Low math proficiency students can present what is being asked from the two questions by

---

[15]Tatag Yuli Eko Siswono, "*Proses Berfikir Analogi Siswa dalam Memecahkan Masalah Matematika*", hal. 14

[16] Kartika Purwaningtyas, *Penalaran Analogi Siswa SMP terhadap Soal Geometri Tipe HOTS dari Kemampuan Matematika*, dalam Jurnal Program Studi Pendidikan Matematika Vol. 5 No.2.

[17] Rahayu Purwanti, Agung Hartoyo & Dede Suratman, "*Kemampuan Penalaran Analogi Matematis* ... hal. 11

[18] Rahayu Purwanti, Agung Hartoyo & Dede Suratman, "*Kemampuan Penalaran Analogi Matematis* ... , hal. 6

mentioning what is known from both the source problem (problem 1) and the target problem (question 2). Giving the information gleaned from the two inquiries nonetheless needs to be finished.

According to the results of the interviews, pupils with weak mathematics skills were unable to complete the step of evaluating analogy relationships. The findings of Siti Nurul Azimi, Purwanto, and Abadyo's study, which claimed that low-category students were unable to establish the relationship between source problems and target problems during the mapping process (mapping), confirm this. The precise connection between the source problem and the target problem cannot be mentioned by the students.[19] Low-ability math students have not yet discovered the precise connection between the source problem (problem 1) and the target problem (question 2).

The understanding the analogy case level has not yet been completed by students with poor math skills. This is consistent with the findings of a study by Rahayu Purwanti, Agung Hartoyo, and Dede Suratman, which showed that pupils with low ability levels had a limited capacity for mathematical computation. Additionally, low-ability kids are still unable to use their knowledge and comprehension to solve resource challenges.[20] Low-level math students were unable to accurately solve the source problem, and the formula used to determine a rectangle's perimeter was also incorrect. This is a result of forgetting how to calculate a rectangle's area and frame. Therefore, it is challenging to address the root issue (problem 1).

Students who struggle with math haven't yet been able to complete the transferring findings step. According to Tatag Yuli Eko Siswono's research, students in the low mathematics group are unable to correctly choose the solution to the target problem at the applying stage and are unable to explain the analogy (similarity) that was used to connect the source problem to the target problem.[21] Low-level arithmetic students are unable to establish a connection between the source problem and the goal problem. It is challenging to answer the target problem for students with limited mathematical proficiency since they were unable to solve the source problem, which was at the level of grasping the analogy situation. Therefore, it is unable to address the intended issue.

CONCLUSION

It was concluded that students' analogy reasoning was based on Clement's stages in solving mathematical problems in four stages, namely generating the analogy, evaluating the analogy relation, understanding the analogy case, and transferring findings. This was based on the results of data analysis, research findings, and discussion of the research described. The following are the study's findings:

1. Students with strong mathematical aptitude can go through four phases of analogy reasoning based on Clement's stages: creating the comparison, assessing the analogy relation, comprehending the analogous case, and transferring discoveries.
2. Students with moderate mathematics skills who use Clement's stages for their analogy reasoning can only complete the first three steps: creating the analogy, comprehending the analogous case, and applying results.
3. Students with weak mathematics skills who use Clement's stages for analogy reasoning can only complete the first stage, which is creating the analogy.

---

[19] Siti Nurul Azmi, Purwanto & Abadyo, "*Penalaran Analogi Siswa dalam Menyelesaikan* ... , hal. 153

[20] Rahayu Purwanti, Agung Hartoyo & Dede Suratman, "*Kemampuan Penalaran Analogi Matematis* ... , hal. 8

[21] Tatag Yuli Eko Siswono, "*Proses Berfikir Analogi Siswa dalam Memecahkan Masalah Matematika*…, hal. 9

BIBLIOGRAPHY

Azimi, Siti Nurul dkk. 2017. *Penalaran Analogi Siswa Dalam Menyelesaikan Masalah Keliling dan Luas Segi Empat*. Jurnal Kajian Pembelajaran Matematika. *1(2).*

Novisa, Munaroh dkk. 2020. *Penalaran Analogi Siswa SMP Tipe Climber dalam Menyelesaikan Masalah Matematika*. Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan. *5(2).*

Peraturan Menteri Pendidikan Nasional Republik Indonesia. Nomor 22. 2006. Tentang Standar Isi Untuk Satuan Pendidikan Dasar dan Menengah. BNSP.

Purwaningtyas, Kartika. 2019. *Penalaran Siswa SMP Terhadap Soal Geometri Tipe HOTS dari Kemampuan Matematika*. APOTEMA: Jurnal Program Stusi Pendidikan Matematika. *5(2).*

Purwanti, Rahayu dkk. 2016. *Kemampuan Penalaran Analogi Matematis Siswa SMP dalam Materi Bangun Ruang*. Jurnal UNTAN. *5(10).*

Putra, Harry Dwi. 2012. *Pembelajaran Geometri dengan Pendekatan Savi Berbantuan Wingeom untuk Meningkatkan Kemampuan Nalogi Matematis Siswa SMP. Prosiding Seminar Nasional Pendidikan Matematika STKIP Siliwangi Bandung*. Vol.1

Sarjoko dkk. *Penguasaan Penalaran Analogi Dalam Pemecahan Masalah Unsur-Unsur dan Luas Kubus*. Jurnal Pendidikan Matematika. 8(1).

Siswono, Tatag Yuli Eko. 2009. *Proses Berfikir Analogi Siswa dalam Memecahkan Masalah Matematika*". Seminar Nasional Matematika Jember.

Wayan dkk. 2022. *Implementasi Kurikulum Merdeka di SMP Negeri 3 Selemadeg Timur*. Jurnal Madaniya 3(3).

Student’s Analogical Reasoning Based on Clement’s Stage

ORIGINALITY REPORT

18%	16%	7%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repo.uinsatu.ac.id Internet Source	10%
2	Siti Lailiyah, Kusaeri Kusaeri, Endah Retnowati, Erman Erman. "A Ruppert’s framework: How do prospective teachers develop analogical reasoning in solving algebraic problems?", JRAMathEdu (Journal of Research and Advances in Mathematics Education), 2022 Publication	3%
3	incoils.or.id Internet Source	2%
4	lppm.ibrahimy.ac.id Internet Source	1%
5	repository.unisda.ac.id Internet Source	1%
6	Submitted to IAIN Tulungagung Student Paper	<1%
7	doaj.org Internet Source	<1%

8	garuda.kemdikbud.go.id Internet Source	<1%
9	snhrp.unipasby.ac.id Internet Source	<1%