Mathematics thinking ability in metaphorical based on personality type

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Abstract. This study aims to describe students’ metaphorical mathematical thinking skills based on sanguinis and melancholy personality types in one-variable linear equation system (OLES). The data source of this research is the seventh-grade students of SMP Negeri 2 Kalibagor. Respondents in this study were taken using the purposive sampling method, there are two types of personality taken as respondents, namely the sanguinis personality type and the melancholy personality type. The methods used to collect data in this study were personality type tests, metaphorical thinking tests, and interviews. Based on the results of the research that has been done, it can be concluded that students with the sanguinis type of personality are able to fulfill four of the six stages of metaphorical thinking abilities. The stages that are fulfilled are Connect, Relate, Explore, and Transform, while the stages that are not fulfilled are the Analyze and Experiment stages. Students with melancholy personality types are able to fulfill all stages of metaphorical thinking skills, namely Connect, Relate, Explore, Analyze, Transform, and Experiment.

1. Introduction
Mathematics has an important role in various aspects of human life, for example in the development of science, technology, and everyday life [1]. However, mathematics is often seen as a science that studies calculation only by some people, even though, having a good calculating ability does not guarantee that a student can solve math problems correctly. Problem-solving requires a variety of thinking skills such as reporting, describing, analyzing, classifying, interpreting, criticizing, predicting, drawing conclusions, and making generalizations based on the information obtained [2]. So it can be said that mathematics is not only about counting, but it needs other abilities to solve mathematical problems.

One of the abilities that can be applied in solving mathematical problems is the ability to think metaphorically [3]. Metaphorical thinking is the ability to solve complex mathematical problems because there are six stages of thinking in the problem-solving process [4]. The metaphorical thinking process referred to is to connect, relate, explore, analyze, transform, and experience. Metaphorical is a thought process to understand and communicate abstract concepts in mathematics to be more concrete by comparing two things with different meanings [5, 6].

Models and metaphors have a very close relationship. Metaphors are formed in every mathematical model in a problem. It can be interpreted that metaphors have an important role in making models, therefore metaphors become the basic elements in making the desired model [7, 8]. The benefits of the ability to think metaphorically are: students can connect the problem given into a statement that can be
used to dig deeper information; students can find new concepts that are expected to form the basis of their statements; students are able to create creative ideas that come from the problems at hand; students can apply the results of their thoughts in the form of a statement of the problem given [9]. This shows that the ability to think metaphorically is an ability that students need to have in solving mathematical problems.

The stage of metaphorical thinking is called the creation process. Connect is a student connecting two or more different things, then expressing their ideas by replacing a statement using notations, symbols, or symbols to solve problems mathematically. Relate, namely, students associate different ideas at the connect stage with previously known or possessed the knowledge. Explore is students make mathematical models of existing problems based on ideas that have been found previously. Analyze is a student re-examining the mathematical model that has been poured, to see the suitability of the model with the problems at hand. Transform, namely, students conclude the results obtained in the previous stage and find something based on the ideas and models that have been outlined. Then, Experience, namely students apply a model that has been found at the stages that have been passed to solve the problems faced [10]. So it can be concluded that metaphorical thinking is a thought process in understanding and communicating abstract ideas that are meaningfully mapped into different concepts using the Create stage.

Each individual has a different level of ability. Personality type is a factor in the ability of each individual to varying. Personality type was first introduced by Hippocrates (460-370SM) which was later refined by Galenus. He divided them into four types based on the types of fluids that have the most influence on the human body, namely chole, sanguinis, phlegm, and melancholy [11-13]. This personality type was further developed by Littauer in his book, Personality Plus. Littauer revealed that there are 4 types of personalities possessed by humans, namely the strong choleric personality type, the popular sanguinis personality, the perfect melancholy personality, and the peaceful phlegmatic personality [14]. All types each have advantages and disadvantages [15].

The researcher took two types of personality, namely sanguinis and melancholy. These two types have a striking similarity in that they always give their best to achieve maximum results, but the underlying motives are very different. Sanguinis are people who are open, active, and easy to get along with other people [16]. When obtaining satisfying results, sanguinis make the attention and praise of others as motivation to continue to give the best effort in doing everything [17]. Meanwhile, melancholy is a person who tends to be closed and quiet, he does not like a failure and wants a perfect result for self-satisfaction [16].

Therefore, melancholy always makes failure a lesson to be better at the next opportunity. Based on this, research on the ability to think metaphorically in terms of sanguinis and melancholy personality types needs to be done. People with the popular sanguinis personality type love compliments and the center of attention. A person with a sanguinis personality type in terms of work has characteristics of volunteering for assignments, thinks of new activities, looks great on the surface, is creative and innovative, has energy and enthusiasm, starts out brilliantly, inspires others to join in, and enchants others to work [18]. Sanguinis a figure who looks always happy, cheerful, and always happy. He likes to avoid work but always finds friends who are willing to help because they are very likable individuals. Everything they said sounded pleasant. They did well in school in everything except manners and handwriting. They're the type who doesn't like to train hard because their main purpose in life is to have fun. A person who is articulate, optimistic, passionate, and full of passion, but undisciplined, forgetful, and motivated by praise [19].

Sanguinis is motivated by a need for pleasure and praise. This motivation makes him able to generate many creative ideas, become someone who plays an important role in many people, is able to learn quickly, provides convincing arguments to get back the support of others and has a strong desire to be able to fit in with anyone [15].

Melancholy types are known for being perfectionists, they are obsessed with perfect results and not disappointing them. A person with a melancholy personality in terms of work has characteristics of schedule-oriented, perfectionist, high standards, conscious of details, persistent and careful, well-organized, organized and tidy, economical, oriented to a problem, has creative solutions, requires himself to quickly solve what he has started, likes charts, graphs, charts, and lists. Melancholy is
sensitive to its environment and tends to be touched easily. They finished the job on time and corrected it [20]. They try hard to make sure everything is perfect, but they do not like to show the results of their work to anyone for fear of failure and rejection [18].

They have great compassion and love to defend the oppressed. They get discouraged when things don't go according to plan and no one else cares. They dream of something that seems impossible from a perfect world. A thinker, deep, directed, sensitive, talented, creative, analytical, organized, moody, negative thinking, too introspective, socially closed, and prone to depression. They appear independent, but actually, they want someone who is sympathetic, understands them and recognizes them. Their needs without being told. They are like that because they are figures who are too perfectionist so that they are often ignored by others [19].

Researchers will conduct research at SMP Negeri 2 Kalibagor, Banyumas Regency. SMP Negeri 2 Kalibagor is an educational institution in Banyumas Regency that uses the 2013 curriculum. In this type of question, students can use metaphorical thinking skills. In addition, based on the results of interviews with mathematics subject teachers, students' metaphorical thinking skills were not clearly seen. Thus the researchers conducted this research at SMP Negeri 2 Kalibagor.

2. Methods

This research will be conducted at SMP Negeri 2 Kalibagor which is located Banyumas Regency, Central Java, Indonesia. The implementation time is in the even semester of the 2019/2020 school year. This type of research is descriptive-qualitative, in which the researcher will explain and provide an overview of the seventh-grade students' metaphorical thinking skills in SMP Negeri 2 Kalibagor in terms of sanguinis and melancholy personality types in solving math problems on the material of the one-variable linear equation system (OLES). This study used a qualitative approach design, with the hope of being able to reveal in detail and specifically the students' metaphorical thinking skills. Qualitative research is a research procedure that will produce descriptive data in the form of written or oral sentences from the observed subject. The subjects in this study were seventh-grade students of SMP Negeri 2 Kalibagor who had studied OLES material at the beginning of the even semester.

Students of this class are taken as research subjects on the advice and direction of the mathematics subject teacher because this class has heterogeneous or diverse students. The sampling technique was purposive sampling, in which the researcher took the sample as a data source by considering several things. The thing that is considered in this study is the results of the personality type test, these results will divide the subject into 4 groups, namely subjects with sanguinis, melancholic, cortical, and phlegmatic personalities. Researchers took 6 samples with 3 samples with a sanguinis personality and 3 samples with a melancholy personality. Researchers used a personality profile test developed by Florence Littauer which is ready to use and valid for classifying student personality types in his book, Personality Plus, which has been translated into Indonesian. This test will classify students into 4 groups, namely the sanguinis, cortical, melancholic, and pragmatic personality groups. The instrument of this test consists of 40 questions divided into 2 categories, 20 questions regarding strengths and 20 weaknesses where each question has 4 points in the form of answer choices and each point represents each personality type.

The metaphorical thinking test is used to find out how students' metaphorical thinking skills in OLES material. In this study, the researcher gave a subjective test in the form of an essay test totaling 3 questions with each question having 6 question points which aimed to measure the extent to which students' metaphorical thinking skills could be seen from students' answers based on each indicator. The ability to think metaphorically of students in doing math problems is not only seen from the right or wrong results of students' calculations in solving problems but also seen from the process of students answering and presenting their answer ideas because metaphorical thinking can be seen from the metaphorical thinking process, namely connect, relate, explore, analyze, transform, experience. Each point on the question will measure each indicator, this is done so that it makes it easier to analyze the answers and the results of the analysis will be more detailed. Based on these questions, it is hoped that students will use their ideas and ideas in solving OLES questions.
Interviews were conducted to obtain qualitative data that was more valid and reliable. The interview is used as a data collection technique if the researcher wants to conduct a preliminary study to find problems that must be researched, and also if the researcher wants to know more in-depth things from the respondent. The interview used in this interview is a structured interview. Interviews were conducted with 6 students consisting of 3 students with sanguinis personality and 3 students with melancholic personalities, interviews were used as further action to obtain in-depth information about the students' metaphorical thinking processes. Interviews were conducted after students' metaphorical thinking tests and personality type tests. Students will be asked about how the metaphorical test was carried out, the steps taken to solve the problems given to each point, and what difficulties students experienced during the work.

3. Result and Discussions

Based on the data on the answers to the metaphorical thinking test and interviews with 6 respondents that had been conducted, the researcher described the students' metaphorical thinking skills in solving math problems with one variable linear equation in terms of sanguinis personality type and melancholic personality. Based on the results of research from personality type tests, metaphorical thinking tests, and interviews, it can be concluded that respondents with sanguinis personality types have fulfilled four stages, namely connect, relate, explore, and transform. However, there are two unfulfilled stages, namely the analysis and experience stages. Thus it can be concluded that respondents with sanguinis personality type have a fairly good metaphorical thinking ability, although not yet perfect. Analyze is a stage where the respondent analyzes whether the answer is in accordance with the instructions in the question and checks the mathematical model made according to the problems presented. This is related to the respondent's accuracy when working on metaphorical thinking test questions. The problem with the Analyze stage is on question number one point f, where the respondent is asked to double-check the results of their work. Whereas in question number two this stage is located at point d, where the respondent must complete a sketch of the soil to ensure that the size found matches the drawing. Similar to question number one, the Analyze stage for question number 3 lies in the last point where the respondent is asked to recheck his work. In questions number one and three, it was said that respondents did not meet the Analyze stage if they made errors in answering other points. This indicates that the respondent is not careful so that he is not aware of any mistakes in his work. At the Analyze stage, an error that is often made by respondents with the sanguinis personality type is not checking the results of their work. In addition, respondents with sanguinis personality types also did not check the suitability of the mathematical models they made to solve problems. This stage is very important so that the answer obtained is correct.

However, respondents with this sanguinis personality type tend not to check their work again after finishing. This happens because the respondent feels that the answer is definitely correct. While the experience stage is the stage where the respondent applies the mathematical model that has been made previously. In question number one, all respondents with the sanguinis personality type did not meet this stage because they misunderstood the concept, the respondent should have used the amount of Akbar candy after it was distributed to Fahri, but the respondent used the number of Akbar candies before distribution. In question number two, there were two respondents with a sanguinis personality type who did not fulfill this stage, respondent sanguinis 1 did not fulfill it because they did not work on the points with the experience stage, and respondent sanguinis 3 did not fulfill it because they miscalculated. Then in question number 3, all respondents with sanguinis personality types were able to fulfill this stage. This means that out of the 3 questions given, only 1 question meets the experience stage. The Analyze and Experience stages are related to each other, most of the mistakes made by respondents with the sanguinis personality type at the experience stage occur because respondents do not analyze or double-check their work results. Errors in counting can be corrected if the respondent checks his / her job to make sure there are no mistakes. However, respondents with sanguinis personality type tend to work in a hurry so that they are not careful, and after finishing they don't want to double-check. This is in line with the opinion of Littaure (2011) which states that someone with a sanguinis personality type is impatient. In addition, a person with a sanguinis personality type also has high self-confidence so that when he is doing something he believes that the result of his work is correct and does not need to be
checked again. Based on the description above, respondents with sanguinis personality types have fulfilled four of the six stages of metaphorical thinking abilities. So it can be said that respondents with sanguinis personality type have sufficient metaphorical thinking skills.

Based on the results of research from personality type tests, metaphorical thinking tests, and interviews, it can be concluded that all respondents with melancholy personality types have fulfilled all stages of metaphorical thinking, namely connect, relate, explore, analyze, transform, and experience. This means that the respondent's melancholy personality type has fulfilled all the indicators of metaphorical thinking ability. Thus it can be said that respondents with the melancholy personality type have excellent metaphorical thinking skills. In the first stage, namely, connect where students connect two or more different ideas, all respondents with melancholy personality types are able to completely write down all the information contained in the narrative and relate to one another. At the related stage with the linking stage of ideas with existing knowledge, all respondents with melancholy personality types are able to link the material used in the metaphorical thinking test, namely the linear equation material of one variable with other material, for example in question number 2 the respondent relates this material to flat wake material.

Not only linking the two materials, but respondents with melancholy personality types also wrote them in more detail. In the third stage, namely explore where students make mathematical models, on each question all respondents with melancholy personality types are able to make mathematical models of the problems given. In fact, all respondents with melancholy personality types have brought up a mathematical model in the first point problem where the respondent is asked to write down things that are known from the narrative, all respondents with melancholy personality types have brought up a mathematical model in the first point problem where the respondent is asked to write down things that are known from the narrative, all respondents with melancholy personality types change the sentence into a mathematical model. Respondents with melancholy personality types understand the concept of calculating to make mathematical models well. Then in the next stage, namely analyze, where students check the suitability of the mathematical model with the problem. This stage is a stage that is not fulfilled by respondents with sanguinis personality types. However, respondents with melancholy personality types are able to fulfill this stage. This is in line with Littauer's opinion which states that one of the strengths of a person with a melancholy personality type is analytical. In the metaphorical thinking test of 3 questions done by 3 respondents with a melancholic personality type, only one respondent made a mistake in question number 1.

The error occurred because the respondent was hesitant in working on the question. In this question, there are 6 question points, and only 1 question is not answered perfectly. Furthermore, in the transform stage with the stage of interpreting the results obtained, all respondents with melancholy personality types can fulfill this stage. Then in the last stage, namely the experience stage, with the stage of applying a mathematical model to solve the problem. This stage is the final stage where the respondent is asked to apply the ideas he has obtained and apply the mathematical model he has created in the previous stages. Another advantage that can be seen from the results of the respondent's work with the melancholy personality type is the writing that is easy to read and understand, detailed writing accompanied by descriptions of what is written, and at the end of the respondent's answer with the melancholic personality type, write down the conclusions of the answers they get. This is consistent with Littauer's statement, apart from being analytic, a person with a melancholy personality type also has another positive trait, namely details. This illustrates the characteristic traits of the melancholy personality type, namely the perfectionist. Based on the description above, it can be concluded that the respondent with the melancholy personality type has met all the stages of metaphorical thinking ability.

4. Conclusion

Based on research conducted at SMP Negeri 2 Kalibagor on Students' Metaphorical Thinking Ability in Mathematics in terms of Sanguinis and Melancholy Personality Types on one-variable linear equation material, it is concluded that students with sanguinis personality type have worked on the problem well even though they have not fulfilled all the stages of thinking. Metaphorical. The stages that are fulfilled are connected, relate, explore, and transform, while in the Analyze and Experience stages students tend to be less careful when applying the results of the mathematical models he made in the previous stage and do not double-check the results of their work so that they do not realize there are errors in it. The process. Students with the melancholy personality type have worked on the questions presented very
well and have met all stages of metaphorical thinking skills, namely connect, relate, explore, analyze, transform, and experience. Students with melancholy personality types write down detailed and complete answers, as well as write information about what they have written and write conclusions at the end of their answers. Students with this type tend to work on the questions given coherently.

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6. References

[1] Chapman O 1997 Metaphors in the Teaching of Mathematical Problem Solving Educ. Stud. Math. 32 p 201–28
[2] Nasution M A 2010 Kurikulum dan pengajaran (Bumi Aksara)
[3] Hendriana H, Eti Rohaeti E and Hidayat W 2017 Metaphorical thinking learning and junior high school teachers’ mathematical questioning ability J. Math. Educ. 8 p 55–64
[4] Hendriana H, Hidayat W and Ristiana M G 2018 Student teachers’ mathematical questioning and courage in metaphorical thinking learning J. Phys. Conf. Ser. 948 p 1–5
[5] Gorobets K and Trunk I O 2019 The Unity of Interna tional Law: An Exercise in Metaphorical Thinking p 80–109
[6] Huang S, Carulli M, Hekkert P, Schifferstein R N J and Bordegoni M 2020 Designing Product Metaphor to Promote Sustainable Behaviour : A Proposed Method p 1921–30
[7] Carreira S 2001 Where There’s a Model, There’s a Metaphor: Metaphorical Thinking in Students’ Understanding of a Mathematical Model Math. Think. Learn. 3 p 261–87
[8] Lai M Y 2013 Constructing meanings of mathematical registers using metaphorical reasoning and models Math. Teach. Educ. Dev. 15 p 29–47
[9] Palešová K 2009 The Opportunity in Ambiguity : Developing a Method of Qualitative Inquiry Through Visual Cues in The Domain Of Second-Hand Shopping p 1–10
[10] Anwar B 2019 Model Pembelajaran Metaphorming Shaut al Arab. 7 78
[11] Vollrath M and Torgersen S 2000 Personality types and coping Pers. Individ. Dif. 29 p 367–78
[12] Sahirirahman N 2012 Kepribadian Tokoh “ Yoshihide” Dalam Cerita Pendek Jigoku Hen Karya Ryuunosuke Akutagawa (Pendekatan Psikoanalisis)
[13] Rasyada A 2018 Pola pembinaan kepribadian islamisiswa di pesantren modern al barokah kec. dolok batu nanggar kab. simalungun
[14] Littauer F L S 2011 Personality Plus (Kepribadian Plus). Bagaimana Memahami Orang lain dengan Memahami Diri Anda Sendiri
[15] Iskandar S, Sholeh M and Iswahyudi C 2015 Sistem Pakar Untuk Menentukan Kepribadian Seseorang Berdasarkan Tes Personalitas Florence Littauer Berbasis Web J. Scr. 2 p 47–54
[16] Robins R W, John O P, Caspi A, Moffitt T E and Stouthamer-Loeber M 1996 Resilient, overcontrolled, and undercontrolled boys: three replicable personality types J. Pers. Soc. Psychol. 70 p 157–71
[17] Emanuel R 2013 Do Certain Personality Types Have a Particular Communication Style
[18] Made N, Lestari A, Gede I K, Putra D, Ketut A A and Cahyawan A 2013 Personality Types Classification for Indonesian Text in Partners Searching Website Using Naïve Bayes Methods IJCSI Int. J. Comput. Sci. 10 2013
[19] Thadea O S A, Putra S T and Putra I G N G S 2018 The Relationship Between Galen’s Personality Type Theory and Emotional Intelligence Level Biomol. Heal. Sci. J. 1
[20] Vorkapić S T and Tatalović Vorkapić S 2011 Electrophysiological Differences in Sanguine, Choleric, Phlegmatic and Melancholic Rom. J. Psychol. 1 p 67–96