UJME 9 (3) 2020: 236-242
UNNES JOURNAL OF MATHEMATICS EDUCATION
https://journal.unnes.ac.id/sju/index.php/ujme/
ISSN: 2252-6927 (print); 2460-5840 (online)

Analysis of students' mathematical literacy skills in TAPPS model learning with metaphorical thinking approach assisted by Class Dojo

Muhammad Dwi Yanto*, Wardono

Universitas Negeri Semarang, Sekaran Gunungpati, Semarang 50229, Indonesia

** E-mail address: dwi.yanto1101@gmail.com*

ARTICLEINFO

Article history:
Received 23 October 2020
Received in revised form 31 October 2020
Accepted 22 November 2020

Keywords:
Mathematical Literacy;
TAPPS;
Metaphorical Thinking;
Class Dojo

Abstract

This research aims to describe students' mathematical literacy skills in the Think Aloud Pair Problem Solving learning model with a metaphorical thinking approach assisted by Class Dojo. The research method used in this study is qualitative. The research subjects were selected by purposive sampling technique based on students' level of mathematical literacy skills. In this study, data were obtained using triangulation of techniques including test methods, interview methods, and observation methods, as well as using triangulation of sources with 6 research subjects consisting of 2 upper-class students, 3 moderate class students, and 1 lower-class student. Qualitative data analysis includes data validity, data reduction, data presentation, and concluding. The results showed that upper-class students were able to master the six components, there are communication, mathematizing, representation, reasoning and argument, devising strategies for solving problems, and using mathematical tools. Moderate class students are quite capable of mastering the five components, there are communication, mathematizing, representation, devising strategies for solving problems, and using mathematical tools. Lower-grade students were able to master the three components well, there are communication, mathematizing, and using symbolic, formal, and technical language, and operations.

1. Introduction

Education is one of the basic needs of every human being to support their life. Meanwhile, mathematics is one of the subjects that play an important role in education because mathematics is considered a basic science that is taught at every level of education. The function of mathematics is to organize and improve students' reasoning acuity so that it can clarify problem-solving in daily life, train the ability to communicate using numbers and symbols, train students to be truth-oriented by developing logical, critical, creative, objective, rational attitudes, careful, disciplined and able to work together effectively, and train students to always think regularly, systematically and structurally in a clear conception (Jufri, 2015).

There are five competencies in learning mathematics (NCTM, 2000): mathematical problem-solving, mathematical communication, mathematical reasoning, mathematical connection, and mathematical representation. The combination of these five competencies is called mathematical literacy skills that can help students solve problems in everyday life. The Organization for Economic Cooperation and Development (OECD) is an organization that conducts research related to the Programme International of Student Assessment (PISA) which includes mathematical literacy, reading literacy, and scientific literacy. Mathematical literacy can be defined as an individual's ability to formulate, use, and interpret mathematics in various contexts, including mathematical reasoning and using mathematical concepts, procedures, facts, and mathematical tools to describe, explain and predict phenomena (OECD, 2016).

To cite this article:
Yanto, M. D. & Wardono. (2020). Analysis of students' mathematical literacy skills in TAPPS model learning with metaphorical thinking approach assisted by Class Dojo. *Unnes Journal of Mathematics Education*, *9*(3), 236-242. doi: 10.15294/ujme.v9i3.44540

In fact, Indonesian students' mathematical literacy skills are still low. Judging from the academic quality between nations through the Program for International Student Assessment (PISA) in mathematics in 2018, Indonesian students are ranked 72 out of 78 participating countries with a score of 379 from the OECD average score of 500 (OECD, 2019). The results of the PISA study (Wahyuni, 2009: 180) also show that 25% - 34% of Indonesian students enter the literacy level-1. Whereas for the literacy level-5, less than 1% of Indonesian students are at this level. This means that only a few students have the ability to find complex information, demonstrate detailed understanding, draw conclusions, evaluate critically, build hypotheses, and put forward concepts. This shows that the ability of Indonesian students to solve problems in the form of study questions, give reasons, communicate, and solve and interpret various problems is still very low.

There are four contents of knowledge in mathematical literacy according to PISA 2015 (OECD, 2017) including (1) change and relationship, (2) space and shape, (3) quantity, (4) Uncertainty and data. Mathematical literacy refers to three processes called mathematical processes, these three processes include (1) formulating situations mathematically (identifying, translating, and formulating real problems into mathematical forms), (2) employing mathematical concepts, facts, procedures, and reasoning (applying concepts, facts, procedures and mathematical reasoning to solve problems), (3) Interpreting, applying, and evaluating mathematical outcomes (reflecting on solutions, results, or conclusions and interpreting them in context). According to PISA 2015, there are seven basic math skills (OECD, 2017), including communicating, mathematizing, representation, reasoning and argument, devising strategies for solving problems, using symbolic, formal and technical language and operations, and using mathematical tools. While the context used in the assessment is (1) personal, (2) occupational, (3) societal, (4) scientific.

The ability of students to apply mathematical concepts to daily problems better and effectively is related to mathematical literacy skills (Sari, 2018). Therefore, solving real problems becomes an important component in mathematical literacy where students formulate and implement strategies to solve problems that include components of mathematical literacy, namely devising strategies for solving problems. To improve mathematical literacy skills, a teacher must be able to select and apply an appropriate learning model. Research shows that the TAPPS learning model can improve problem-solving skills (Mashuri et al, 2018). Besides, students' communication skills are an important component of mathematical literacy (Wardono et al, 2020). Improved communication skills and mathematical reasoning skills with TAPPS learning are better than ordinary learning (Rosyana & Sari, 2015).

The TAPPS learning model requires two students who act as problem solvers and listeners to work together in solving problems by following certain rules. The TAPPS learning model is effective for optimizing problem-solving skills because when the problem solver reads the problem to listeners, students can optimize their problem-solving abilities directly to understand the problem. Furthermore, when the problem solver begins to explain problem-solving steps, students can optimize their problem-solving abilities at the stage of designing and implementing a plan. The previous phase will be optimal when the listener does their job, which is to correct the actions taken by the problem solver on its completion so that students can optimize their problem-solving abilities (Winarti et al, 2019).

To optimize the TAPPS learning model, a metaphorical thinking approach can be used. The metaphorical thinking approach is relevant to the objectives of learning mathematics. Metaphorical thinking is a thinking concept that emphasizes the relationship between mathematics and real phenomena. In mathematics learning, metaphors are used to connect mathematical concepts with concepts that are familiar to students in everyday life (Roesdiana, 2016). The concept of metaphoric thinking based on the structure and ways of reasoning according to the sensory-motory system is called conceptual metaphors (Hendriana 2012) which includes (1) grounding metaphors is understanding mathematical ideas and relating them to everyday experiences, (2) linking metaphors are building the relationship between the two topics, (3) redefinitional metaphors are redefining metaphors according to the topic being studied. According to Watson (Wijayanti, 2016), one of the creative teaching strategies is to use technology media that is following the development of the students' era. In this study, the Class Dojo media was used to help students' learning process.

Based on the background of the problems described above, the purpose of this study was to determine the description of students 'mathematical literacy skills after being taught using the TAPPS learning

model with metaphorical thinking approach assisted by the Class Dojo based on the class category of students' mathematical literacy skills.

2. Methods

The research was conducted at seventh-grade Junior High School 9 Salatiga. Class VII B as experimental class was taught using the TAPPS learning model with a metaphorical thinking approach assisted by Class Dojo. This type of research is a qualitative. Qualitative research methods aim to analyze and describe phenomena or research objects through social activities, attitudes, and perceptions of people individually or in groups. Subjects in this study were selected using the purposive sampling technique, which means that the subject was selected based on certain considerations in accordance with the research objectives and was able to communicate opinions orally or in writing. Prior to the selection of research subjects, students were grouped based on the class category of students' mathematical literacy skills based on the initial test results of mathematical literacy skills.

The experimental class was taught using the TAPPS learning model with a metaphorical thinking approach assisted by Class Dojo, which was held four times. The material taught during the research is social arithmetic. The variable used in this study was the students' mathematical literacy skills. In this study, data were obtained using triangulation of techniques and triangulation of sources. Triangulation of technique means that data collection is carried out using different techniques to obtain data from the same source including (1) observations made during learning and interviews, (2) tests of mathematical literacy skills carried out after treatment, (3) structured interviews with related respondents. Triangulation of source means getting data from different sources with the same technique. Triangulation of sources in this study, data were taken from 2 upper-class students, 3 moderate class students, and 1 lower-class student.

Qualitative data analysis was used to describe students' mathematical literacy skills after participating in the TAPPS learning model with metaphorical thinking approach assisted by Class Dojo. Data analysis consists of four steps including (1) data validity testing which includes credibility, transferability, dependability, confirmability tests using triangulation of techniques and triangulation of sources (2) data reduction or summarizing data to obtain a clearer picture, (3) presentation of data reduction results in the form of a brief description that compiles a description of students' mathematical literacy skills, (4) concluding based on the results of data analysis that has been carried out.

3. Results & Discussions

The classification of mathematical literacy abilities of class VII B students obtained the results of 20% from class VII B or 6 students in the upper-class, 66.7% from class VII B students or 20 students in the moderate class, and 13.3% from class VII B or 4 students are in the lower-class. The proportion of students in the moderate class is greater than the upper and lower-classes. In this study, there are seven components of mathematical literacy which are described based on the results of observations, tests, and interviews. The indicator of the communication component is that students can understand statements or questions to facilitate problem-solving, present the results of solutions to others by summarizing and conveying the steps used. The mathematizing component has the criteria of being able to transform real-world problems into mathematical forms (including making structures, concepts, assumptions, and formulating models), interpreting, and evaluating mathematical results or modeling real problems. The indicator of the representation component is that students can present mathematical objects including interpreting, translating, using graphs, tables, diagrams, pictures, equations, formulas, and materials. The reasoning and argument components have indicators that can connect elements in the problem so that they can make reasonable arguments to support the conclusion of the solution. The indicator of the strategic components of solving problems is identifying, compiling, and implementing a plan or strategy to make it easier to solve problems mathematically. The indicators of using symbolic, formal, and technical language and operations components are that students can understand, interpret, and determine the appropriate use of language, symbols, and operations based on mathematical definitions and rules. The component of using mathematical tools has an indicator that students can use mathematical tools that can help in learning and find or confirm solutions to problems.

3.1. Mathematical Literacy Skills of Upper-class Students

Research subjects with mathematical literacy skills from the upper-classes are EA-1 and EA-2. The EA-1 and EA-2 subjects were more active in asking questions and giving responses during learning or discussions and conveying them aloud and fluently. During learning and interviews, students are able to focus on the interlocutor and answer questions posed calmly.

In the communication component, EA-1 and EA-2 are able to understand problems well. From the results of the EA-1 test, it is able to write down known information and complete, coherent, and correct complete steps and present conclusions. During the interview, EA-1 was able to communicate answers fluently and in a loud voice. While EA-2 is able to present complete information from the questions given, write down the problems and communicate the steps for solving them coherently even though the final answers and conclusions that are written are still not correct. During learning EA-2 is active in asking questions and giving responses. It can be concluded that upper-class students are able to communicate information and steps to solve it well.

In the mathematizing component, EA-1 is able to write real problems into mathematical form and use concepts correctly. The EA-2 subject when interviewed was able to explain the mathematical model of the real problem and present it. Overall students are able to model problems from everyday life into mathematical forms appropriately. Students are also able to understand the concepts used in the problems presented and determine the formulas that must be used to solve the problems correctly.

In the representation component, EA-1 has no difficulties and is able to understand and convey the meaning of the table appropriately to help students clarify problems. EA-2 is able to represent and read the meaning of the table presented and write equations appropriately. It can be concluded that students do not have difficulty interpreting the problem so that they are able to understand the problem well. Students are able to write mathematical equations based on the information obtained from the questions. From the table presented, students are able to understand and convey the meaning of the table appropriately to help students clarify the problem.

The next component of mathematical literacy skills is reasoning and argument. EA-1 is able to connect related problems, write down steps to solve them in a coherent manner and provide reasonable and logical conclusions. EA-1 provides reasons for a given solution in a convincing tone of voice. EA-2 is confident when delivering solutions by providing logical reasons for the complete steps and written conclusions. This shows that upper-class students are able to connect two interrelated problems and carry out the calculation process according to mathematical procedures to find solutions. Students can also write down the complete steps and conclusions from the solutions given. In addition to writing conclusions, students are able to convey logical reasons and support the conclusions or complete steps given.

In the devising strategies component for solving problems, EA-1 is able to determine strategies to solve problems. During the interview, EA-1 was able to mention the steps to be carried out coherently and correctly. EA-2 Able to convey how to get a solution correctly even though it is not complete. During short quizzes, EA-2 is able to answer quizzes quickly. It can be concluded that students are able to plan strategies based on known information to solve the problems presented. In addition to planning, students can apply the strategies that have been made and write it into the steps to resolve with a coherent and complete in order to obtain a true solution

In the components using symbolic, formal, and technical languages, and operations, EA-1 is quite capable of using mathematical operations and symbols even though there is still no exact solution obtained. EA-2 is less careful in using mathematical operations, looks a little hesitant, and thinks for a moment before answering. This means that students are still lacking in understanding the use of symbols and language in mathematics to make it easier and save processing time. However, students sometimes make the wrong use of mathematical operations and calculations because they tend to work on problems quickly which makes students less careful and mistakes occur.

In the component using mathematical tools, EA-1 is able to perform calculations with a calculator and can use communication tools to open learning media properly during online classes. EA-2 is capable of using mathematical tools to obtain solutions. It can be concluded that students are able to use a calculator to speed up and make calculations easier. With the mathematical literacy skills of students in the upper-class, it will help students solve problems in daily life more easily.

3.2. Mathematical Literacy Skills of Moderate Class Students

The research subjects with moderate grade mathematical literacy abilities were ES-1, ES-2, and ES-3. Subjects ES-1, ES-2, and ES-3 were quite active during group discussions only. When asked by the researcher and asked to express their opinion, students answered with a lack of confidence and doubt. During learning and interviews, students do not focus on the interlocutor.

In the communication component, the ES-1 can write down known information but the steps to solve it are still incomplete and wrong. The complete steps are written and delivered by ES-2 are still incomplete and wrong, and do not present a conclusion to the settlement. ES-3 lists known information and steps for completion even though it is incomplete and does not present a conclusion. This means that students are capable of understanding the problem well. Students can find information that can help solve problems. Students are quite capable of writing and conveying the information obtained, the problems asked and the solution steps are taken to obtain solutions. However, students in presenting it were not detailed and there were still errors. When conveying to others, students appear less confident with a loud tone of voice but a slow intonation.

In the mathematizing component, ES-1 is capable of understanding the problem, but there are deficiencies in writing and errors in stating the answer. The ES-2 made an error during the calculation process and incorrectly stated the formula. ES-3 is capable of presenting problems in mathematical form, but the solution steps presented are incomplete. It can be concluded that students are capable of understanding the problems shown by students being able to connect real problems with their mathematical knowledge. Students are able to determine the formula that must be used to find solutions even though there are still errors in writing and mistakes in doing calculations.

In the representation component, the ES-1 is able to translate tables but there are still errors in writing the equations. ES-2 understands the meaning of the table but is still wrong in writing the equation. ES-3 is able to interpret the table presented. It can be concluded that students can understand and interpret problems well as shown by students being able to translate and convey the meaning of the table presented. Students are also able to choose the formula correctly even though in writing the mathematical equations there are still mistakes and there are errors in doing calculations because they are not careful when doing it.

The next component of mathematical literacy skills is reasoning and argument. ES-1 Is not able to reason about a given problem so that he cannot provide a reasoned solution. ES-2 is able to provide reasons for written conclusions even though it is not complete. ES-3 is able to provide arguments based on the conclusions made even though they are hesitant when conveying. This shows that students are quite capable of thinking logically which is shown by the written complete steps which are quite good even though they are still incomplete. In addition, students are also able to provide conclusions from the solutions obtained and their reasons, but they are still incomplete.

In the devising strategies for solving problems component, the ES-1 is quite capable of writing down and mentioning steps to find a solution even though the writing is still not quite right. ES-2 wrote and stated incomplete steps to solve. ES-3 covers complete steps but is still incomplete. From the three subjects, it is known that students are able to write down known information and use it to develop strategies. Students can also apply the strategies shown by students being able to write and mention processes or steps to write solutions even though they are still less detailed. In developing strategies, moderate class students take longer than upper-class students.

In the components using symbolic, formal, and technical languages, and operations, the solution provided by ES-1 is still not correct. The ES-2 is able to use mathematical symbols and operations with precision. ES-3 is able to write and mention the symbols and language used in mathematics even though the result is still wrong. This shows that students are quite capable of using symbols and mathematical language but sometimes they are still incomplete in writing.

On the components of using mathematical tools, the ES-1 is able to use a calculator without difficulty. The ES-2 is able to use problem-solving tools such as a calculator. ES-3 has problems using a calculator to solve difficult problems. It can be concluded that students are able to use calculators in the calculation process to find solutions. However, sometimes students have problems using it when the questions gave have a high level of difficulty. During the online class, students do not experience difficulties in using the computer-based media used, namely Class Dojo. With the mathematical literacy skills of students in moderate classes, it will be quite helpful for students to solve problems in everyday life.

3.3. Mathematical Literacy Skills of Lower-class Students

Research subjects with mathematical literacy skills from the lower-classes are EB-1. The subject of EB-1 was quite inactive during group discussions and during lessons. When asked by the researcher and asked to express their opinions, students answered with a lack of confidence and hesitation, sometimes students answered they did not know or were just silent. During learning, students do not focus on the interlocutor.

In the communication component, EB-1 is quite capable of presenting known information and questions to ask either orally or in writing, although sometimes it is still incomplete. When conveying the information and the steps used, students need a long time to think.

In the mathematizing component, the subject of EB-1 is quite capable of turning real problems into mathematical models. EB-1 is also quite capable of determining the formula that will be used to solve the problem. However, students do not understand how to apply it and often experience errors in writing and calculations.

In the representation component, EB-1 did not understand how to translate the meaning of the table presented so that it made students have difficulty interpreting the problem. In addition, the EB-1 students also could not write down the math equations correctly to find a solution.

The next component of mathematical literacy skills is reasoning and argument. EB-1 is still not able to do problem reasoning which is shown by EB-1 not writing logical steps for solving it. In addition, EB-1 is also unable to provide conclusions from the settlement obtained and the reasons that support it. During the study and interview, EB-1 was unable to convey the steps for completion and the reasons for it, and EB-1 stuttered and often kept silent to think.

In the devising strategies for solving problems component, EB-1 had difficulty creating and implementing strategies to solve problems so that he could not find the correct solution. EB-1 is only able to state known information. Based on the results of the final test, many questions were not given known information and steps to solve them.

In the components using symbolic, formal, and technical languages, and operations, the EB-1 is quite capable of determining symbols and mathematical operations, but sometimes it is still incomplete in writing and makes mistakes in its calculations.

In the component of using mathematical tools, EB-1 is not familiar with using a calculator to help solve problems correctly and quickly. During the online class EB-1 sometimes experienced problems using the computer-based media used. With the mathematical literacy skills of students in the lower-classes, it makes students difficult to solve problems in everyday life.

According to research by (Wardono, 2018) states that in improving students' mathematical literacy skills, an active learning process is needed so that it provides opportunities for students to be able to develop their own ideas. Therefore in this study using the TAPPS learning model with a metaphorical thinking approach assisted by Class Dojo. During learning, students become more active and enthusiastic in asking questions, solving problems, and expressing opinions during learning. Students can develop their ideas during the pair and problem-solving process. The activeness of students makes their communication skills better, this is indicated by students from the three categories being able to master the communication component.

In addition, learning with a metaphorical thinking approach can improve mathematical literacy skills (Setiani et al., 2018). Students understand the material easier because they use a metaphorical thinking approach. Students can connect learning material with various problems in everyday life so that students will easily change real problems into mathematics or otherwise. This is shown by the students being able to master the mathematizing component.

4. Conclusion

Based on the description above, it can be concluded that students' mathematical literacy skills after participating in learning with the TAPPS learning model with the Class Dojo-assisted metaphorical thinking approach from each class are

a. Upper-class students are generally able to master six components of mathematical literacy skills well including communication, mathematizing, representation, reasoning and argument, devising strategies for solving problems, and using mathematical tools. Even though they have mastered it well, sometimes students experience errors in calculations because they are not careful.

b. Moderate class students are sufficiently able to master the five components of mathematical literacy skills including communication, mathematizing, representation, devising strategies for solving problems, and using mathematical tools. Students still have difficulty with the reasoning and argument components and using symbolic, formal, and technical language, and operations.
c. Lower-class students master the three components of mathematical literacy skills well, including communication, mathematizing and using symbolic, formal, and technical language, and operations.

References

Hendriana, H. (2012). Pembelajaran Matematika Humanis dengan Metaphorical Thinking untuk Meningkatkan Kepercayaan Diri Siswa. *Infinity, 1*(1): 90 – 103.

Jufri, L. H. (2015). Penerapan Double Loop Problem-solving untuk Meningkatkn Kemampuan Literasi Matematis Level 3 pada Siswa Kelas VIII SMSPN 27 Bandung. *Lemma, 2*(1), 52 – 62.

National Council of Teacher Mathematics. (2000). *Principles and Standards for Schools Mathematics*. Res-ton. VA: NCTM.

OECD. (2016). *PISA 2015 Results (Volume I): Excellence and Equity in Education. PISA. Paris: OECD publishing.*

OECD. (2017). *PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem-solving, revised edition. PISA. Paris: OECD Publishing.*

OECD. (2019). *PISA 2018 Result (Volume I): What Students Know and Can Do. PISA. Paris: OECD Publishing.*

Mashuri, M., Nitoviani, N. D., & Hendikawati, P. (2018). The mathematical problem-solving ability of student on learning with Thinking Aloud Pair Problem-solving (TAPPS) model in term of student learning style. *Unnes Journal of Mathematics Education, 7*(1): 1 – 7.

Roesdiana, L. (20160. Pembelajaran dengan pendekatan metaphorical thinking untuk mengembangkan kemampuan komunikasi dan penalaran matematis siswa. *Judika (Jurnal Pendidikan Unsika)*, *4*(2): 169 – 183.

Rosyana, T., & Sari, I. P. (2015). Penerapan Aktivitas Quick On The Draw Melalui Pendekatan Thinking Aloud Pair Problem-solving Untuk Meningkatkan Kemampuan Komunikasi Dan Penalaran Matematis Siswa MA. *P2M STKIP Siliwangi*, *2*(2): 192-202.

Sari, R. H. N. (2015). Literasi Matematika: Apa, Mengapa dan Bagaimana?, In *SEMINAR NASIONAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA UNY 2015*. Yogyakarta.

Setiani, C., Waluya, S. B., & Wardono. (2018). Analysis of Mathematical Literacy Ability Based on Self-Efficacy in Model Elicting Activities Using Metaphorical Thinking Approach. *Journal of Physics: Conference Series.* doi :10.1088/1742-6596/983/1/012139.

Wahyuni, S. (2009). Menumbuh kembangkan Minat Baca Menuju Masyarakat Literat. *Diksi, 16*(2): 179 – 189.

Wardono, & Mariani, S. (2018). "The analysis of mathematical literacy on PMRI learning with media schoology of junior high school students". *Journal of Physics: Conference Series*. doi:10.1088/1742-6596/983/1/012107.

Wardono, Rochmad, Uswatun, K., & Mariani, S. (2020). Comparison between Generative Learning and Discovery Learning in Improving Written Mathematical Communication Ability. *International Jornal of Instruction, 13*(3), 729 – 744.

Winarti, E. R., Haryanti, M. D., & Asih, T. S. N. (2019). Student's problem-solving ability in thinking aloud pair prolem solving learning assisted by schoology viewed from mathematical disposition. *Unnes Journal of Mathematics Education, 8*(1): 14 – 18.