

The Use of TAPPS in Mathematics Learning: Is It Good or Not?

Ahmad Wafa Nizami^{1,a)}, and Ali Mahmudi^{2,b)}

¹⁾*Graduate Program Mathematics Education, Yogyakarta State University,
Jl. Colombo No.1, Caturtunggal, Depok, Sleman, Special Region of Yogyakarta 55281, INDONESIA*

²⁾*Mathematics Education Departement, Yogyakarta State University
Jl. Colombo No.1, Caturtunggal, Depok, Sleman, Special Region of Yogyakarta 55281, INDONESIA*

^{a)}ahmad.wafa2016@student.uny.ac.id

^{b)}ali_uny73@yahoo.com

Abstract. The skill of critical thinking and problem solving is very useful in learning Mathematics. It is one of the skills needed in the 21st century. To meet the need, a learning model is needed; that is Thinking Aloud Pair Problem Solving (TAPPS) model. This article is to know whether the TAPPS model is good or not to implement in mathematics learning. TAPPS is a collaborative learning model where students work in pairs and each of them has their respective roles as problem solver and listener to solve a problem. This research is a theoretical study about the application of TAPPS model in which the students were divided into small groups consisting of 2 members. Then the teacher gave a problem in the form of problem solving that the students had to do in turn. After the first problem had been solved, they exchanged the couple. Then they finished the second problem. At the end of the learning activities, the teacher explained if there was still difficulty in understanding the material given. One of the advantages of this model is each member of the TAPPS pair can learn from each other's problem-solving strategies, so that they are aware of the thinking process of each. The weakness of this model is thinking while explaining is not easy for the students, especially those who are less familiar with such things. In addition, TAPPS model is very well used in improving students' cognitive abilities

Keywords: TAPPS Model, Mathematics, Learning

INTRODUCTION

Achieving learning objectives require the existence of literacy in the learning process. The literacy of learning process is an integration of listening, speaking, writing, reading, and critical thinking skills [1]. One of the skills of Mathematical literacy is critical thinking. Critical thinking is a thinking process that occurs in a person who aims to make rational decisions about something that can be believed to be true [2,3]. Critical thinking and problem-solving skills are the necessary skills in the 21st century today. This is supported by [4] saying in his book that the skills needed in this 21st century include critical thinking and problem solving. Learning that requires the skill, one of which is learning Mathematics.

Mathematics is a universal science underlying the development of modern technology. It has an important role in various disciplines and develops human mind power. To that end, Mathematics becomes one of the most important subjects to be taught to the students. One of the goals of learning Mathematics in schools is that the students have the ability to solve daily problems. Mathematics standards should include content and process standards [5]. Process standard includes problem solving, reasoning and verification, interconnection, communication, and representation. The aforementioned standard is a part of the learning process.

Learning process is the core of educational activities in schools and a process of building knowledge that involves the interaction between teachers and students as well as mutually beneficial materials. Teachers also play a role in managing the teaching and learning process by applying intellectual skills, explaining problems and solving them. Thus, the success of student learning is determined by the ability to think critically and to solve problems in the learning activities. Besides, the success is also influenced by the learning model applied by

teachers in the learning process. One of the learning models that can improve critical thinking and problem-solving skills of the students is TAPPS or Thinking Aloud Pair Problem Solving.

Thinking Aloud Pair Problem Solving (TAPPS) is a thinking technique verbalized in pairs in solving the problem. In this model, students work on problems they encounter in pairs, with one partner member functioning as a problem solver and the other as a listener. Problem solvers put forward all their thoughts while looking for a solution. Listeners encourage their peers to keep talking and offer general assumptions or hints if troubleshooting sections are depressed. TAPPS is one of learning models for students to learn and think by themselves that can create active learning conditions. Therefore, TAPPS model challenges students to learn and think for themselves. The results of the study conducted [6] suggest that the students who use TAPPS technique in solving engineering problems have better problem-solving skills than those who do not. In addition, the research conducted by [7] on Cooperative Learning Model, especially Scientific TAPPS provides better learning achievement of Mathematics than TAI cooperative learning model and scientific classical learning model.

This article is to explain how TAPPS model implemented in mathematics learning. In this part also explain whether is good or not used, and the advantages and disadvantages of the model. The purpose of this study is to find out the application of TAPPS model and its advantages and disadvantages. The benefits of this research are as a literature for those who want to examine TAPPS model and as an alternative model of learning for teachers or future teachers.

PROBLEM SOLVING

Kruklik and Rudnick mentioned that *“a problem is situation, quantitative or otherwise, that confronts an individual or group of individuals, that requires regulation, and for which the individual sees no apparent or obvious means or path to obtaining a solution”* by using the idea of a problem, there will arise a solution to the problem. J. A *“it [problem solving] is the means by which individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation”* [8]

According to [9] problem solving is a human activity that combines the concepts and rules that have been obtained before, and not as a generic skill. The point is that someone who has been able to solve a problem is the one has the ability and new skills in problem solving. Hence, with many problems he faced, he is also able to deal with problems in everyday life

In addition [10] also argued that problem solving is a process to overcome difficulties encountered to achieve a desired goal. Problem-solving skill requires a specific skill and ability of each student, which may differ among them in solving a problem. According to [11], problem-solving skill is the ability of students to use existing information to determine what to do in a particular situation. The main feature of problem-solving process is related to non-routine issues. Similarly, according to [12], problem solving refers to the effort required by students in determining the solution to his or her problems.

According to John Dewey in [13], the steps to be taken in solving the problem are (1) knowing that there is a problem, (2) recognizing the problem, (3) using past experience, (4) writing possible resolutions, (5) evaluating the resolution and drawing conclusions based on the available evidence. In solving a problem, the first step that must be done is to know the existence of a problem. By knowing the problem, students can think hard how to solve the problem. Then, they are expected to recognize the problem faced. By recognizing the problem, they can solve it. Using past experience means that based on their past experience or perhaps the similar problem the students have encountered, they can solve the problem they already knew. Writing down the possible answers to the problem, we know that in solving the problem does not necessarily have one correct answer, there may be some answers of the problem. The last is drawing conclusions based on the available evidence.

In this study, problem solving is viewed as an activity through which the students will have a significant basic skill, more than just thinking skill, because in the process of problem solving, they are required to be skilled in selecting relevant information, analyzing it, and finally examining the result. The problem used is non-routine problem.

Thinking Aloud Pair Problem Solving (TAPPS) Model

Collaborative learning is a combination of two or more students working together by sharing the workload to achieve the desired learning outcomes [14]. [15] said collaborative teaching has 6 steps: (1) delivering goals and motivating students; (2) presenting information in the form of demonstrations or through reading material; (3) organizing students into study groups; (4) guiding group work and study; (5) assessing what has been learned so that each group presents its work; (6) rewarding either group or individual.

One of the collaborative learning techniques in problem solving is TAPPS. TAPPS model was first introduced by Claparede, which was later used by Bloom and Border to examine the student problem-solving process. Art Whimbey and Jack Lochhead had developed this method on the teaching of Mathematics and Physics. [16] reinforced that *“The thinking aloud pair problem solving (TAPPS) technique is a strategy for improving problem solving performance through probing and elaboration”*. TAPPS model is a strategy for improving problem solving skills through verbal investigation and elaboration.

In Indonesian, Thinking Aloud means to think hard. Pair means pairing, and Problem-Solving means overcoming a problem. Hence, it can be said that TAPPS model is a technique of thinking hard in pairs in solving problems. It is one of learning models that can create active learning conditions to students.

In addition, Louchhead in [17] stated that *“TAPPS strategy involves one student solving a problem while a listener asks the question to prompted the student to verbalize their thoughts and clarify their thinking”* which means TAPPS strategy involves one student as a problem solver while others become listeners. Then listeners ask questions to encourage the student to process their thoughts and explain their thinking.

Thus, the learning process with TAPPS learning model is a collaborative learning model in which students work in pairs, and each student has their respective roles as *problem solver* and *listener* to solve a problem. According to Lochhead & Whimbey, TAPPS learning model requires two students, who serve as a problem solver and a listener to work together in solving problems, following a set of rules, as quoted by [16] *“TAPPS requires two students, the problem solver and the listener to work cooperatively in solving a problem, following strict role protocols”*.

The purpose of Gourgey's TAPPS learning model presented by [17] is to develop problem solver ability to monitor their cognitive and meta-cognitive abilities. In TAPPS learning model, students are divided into some groups, each of which consists of two sides. One side becomes a problem solver and the other becomes a listener. Each member of the group has their respective duties. TAPPS learning model requires a student to solve the problem, while the other as a listener in charge of luring him to explain his thoughts and clarify his thoughts.

The tasks of a Problem Solver and a listener

In the learning process by using TAPPS model we know that in this process student role is important as problem solver and listener. The Problem solver and listener have the role as stated by Beverly C. Pestel in his book *Teaching Problem Solving Without Modeling though “Thinking Aloud Pair Problem Solving”* stated that every learner in the TAPPS learning model is given a problem to be solved [18]. Each learner has a different task. The followings are the details of the problem solver and listener tasks:

The tasks of a Problem Solver are as follows:

- a) Reading the questions aloud so the listener can know the issues to be solved.
- b) Setting up the problem solving in his own way. Problem solver puts all his opinions and ideas to the listener. In unlucky recognition, problem solver must analyze according to the facts and concepts that have been understood. In addition, he also conveys the resolutions steps that he would undertake and includes what, why, and how the resolution is taken. In this way, it is expected that listener can understand the solution implemented by the problem solver.
- c) Problem solver should be more daring to reveal all th results of his thoughts. Let's say that the listener is not evaluating.
- d) Trying to solve the problem even if the problem solver considers that the problem is easy.

The tasks of a Listener are as follows:

- a) Listening and analyzing the opinions given by the problem solver
- b) Understanding every step, answer, and analysis provided by problem solver in details.
- c) Asking problem solver to keep up until the problem is resolved.
- d) Asking when the problem solver says something obvious. Preventing the problem solver to continue his explanation if the listener does not understand or if the listener feels that the explanation is going wrong, or if the listener feels that the error has occurred by asking the problem solver to check the resolution steps.
- e) Not solving the problem of problem solver. Pointing out the error, but not helping give an answer or explanation if the problem solver continues to make mistakes in thinking or counting.

Teachers role in implementing this model is monitoring the student and guiding problem solver and listener to active in conducting the problem has been given or in giving question. This is necessary because the success of this model will be achieved when the listener makes the problem solver give a reason and explain what they are doing to solve the problem. After one problem is solved, both sides exchange tasks. Thus, all students have the opportunity to become problem solver or listener.

The Strengths and the Weaknesses of TAPPS

As well as other models learning, TAPPS learning model also has advantages and disadvantages as described by researchers. According to the experts, namely:

- a) Each member of TAPPS pairs can learn from each other's problem-solving strategies so that they are aware of their respective thought processes; [6]
- b) TAPPS requires a problem solver to think while explaining so that their thinking patterns are more structured,
- c) A model of this can help students in the process of cognitive more complex in term or solve a problem [21]
- d) The dialogue between problem solver and listener can help in it to be more aware of again to the importance of the thought process [17]

In addition to having the advantages [6] argued that TAPPS also has shortcomings, among others:

- a) Thinking while explaining to others is not an easy thing. Someone will surely have the ability to choose a word, especially for someone who is not used to speaking;
- b) Being a listener who must guide problem solver solve the problem and monitor everything done by the problem solver without thinking to deal with the problem itself is also not easy, especially if listener thinks he will be able to solve the problem better:
- c) An average of time in solving problem using the TAPPS model this longer because it is not all students had the good problem solving.

The Steps of Using TAPPS Model

Below are the general steps of TAPPS models [14]:

- 1) Asking the students to make groups in pairs and explaining to them the roles of problem-solver and listener. The role of the problem solver is to read the problem aloud and to talk through the reasoning process in attempting to solve the problem. The role of the listener is to encourage the problem-solver to think aloud, describing the steps to solve the problem. The listener may also ask clarification questions and offer suggestions but should refrain actually solving the problem.
- 2) Asking the students to solve a set of problems, alternating roles with each new problem.
- 3) Calling completion when the students have solved all problem.

In achieving effective learning, innovations are necessary, one of which is by using learning model. One of them is TAPPS learning model or Thinking Aloud Pair Problem Solving. According to some expert [15,16,17,18] this model is stating that TAPPS is a collaborative learning model where students work in pairs, and each student has their respective roles as problem solver and listener to solve a problem. In this model, there are two student roles where one student acts as problem solver and the other as listener. The roles also has task who has described by [18] its mean that TAPPS model very purposeful if viewed from the tasks such as impossible tas problem solver taken over by yhe listener likewise instead. The implementation of this model according to [14] in more detail are as follows:

- **Pair**
 1. Students are divided into groups.
 2. Each group consists of 2 members.
 3. Students are asked to sit in pairs and face each other.
 4. Each member of the group determines who first becomes the problem solver and who is the listener.
- **Thinking and Aloud**
 5. After that, the teacher provides a problem to each group.
 6. The role as a problem solver should be clearly read to the listener.
 7. Furthermore, before the problem solver gives his idea of the problem, he must first make a reasoning on the questions given by the teacher.
- **Problem Solving**
 8. After that, the problem solver delivers the results of his reasoning to the listener.

9. Listener is in charge of listening to what the problem solver explains and understanding every step, answer, and analysis provided.
10. Listener is not allowed to add the answer of the problem solver because listener here only has the right to show the errors in the problem solver analysis.
11. If an issue or a problem has been solved by the problem solver then they immediately change the task. Problem solver changes into listener and listener becomes problem solver
12. After they exchange duties, the teacher gives a new problem to be solved by the new problem solver. This is done so that each student has the opportunity to give their analysis result and also the opportunity to become a listener.

From the model steps applied very clear that where when students it pair, thinking aloud, and problem solving and TAPPS learning model is particularly useful for improving students' cognitive skills as some studies have suggested that TAPPS learning model can assist students in understanding a lesson and can improve problem-solving skills. It has an effect on problem-solving skills [19,20,21]. In addition, it improves the students' verbal and Mathematical communication skills as revealed by [21,22] that the Mathematics communication of the students in both categories. In terms of the verbal ability, there are differences between problem solver and listener. Both roles mutually require in terms of the implementation of TAPPS model, and also according [24] in applied TAPPS model will be able to help students to be aware of the importance of the thought process as well as can increase the problem solving. Thus, TAPPS model can help to improve those skills.

Each learning model also has advantages and disadvantages such as the research conducted by [22] which mentions that the weakness of TAPPS model, one of which is very time-consuming as delivered by [6]. Nevertheless, this model can improve student learning outcomes and deeper material understanding. Therefore this model very well used in mathematics learning.

CONCLUSION

Based on the description of the can we therefore conclude that the model TAPPS veri nice applied in mathematics learning because the TAPPS model is a collaborative learning model where students work in pairs, and each student has their respective roles as problem solving and listener to solve a problem. Therefore, TAPPS model is very well used in improving students' cognitive abilities. In addition, there are advantages and disadvantages. One of the advantages is that every member in the TAPPS pair can learn from each other's problem-solving strategies so that they are aware of the thinking process of each. The weakness of this model is that to think while explaining is not easy for students, especially for those not really accustomed to. TAPPS model takes a lot of time, so it is recommended for school teachers to pay attention to the time in the implementation of this model.

REFERENCES

1. Byaman, M, "Literacy Practice: Investigating Literacy in Social Contexts" (Longman: London, 1995)
2. Ennis, R.H, "Critical Thinking" NJ: Prentice-Hall, Upper Saddle River, 1996a)
3. Ennis, R.H, "Critical Thinking Disposition: Their nature and Assability" 18.2 & 3, 165-182 (Informal Logic, 1996b)
4. Trilling, B & Fadel, C, "21st Century Skills: Learning For Life in Our Times" 45-56. Online (Jessey-Bass: San Farnicisco) (<http://www.21stcenturyskillsbook.com>) in access on 4 September 2017 11.11 wib
5. National Council of Teacher of Mathematics (NCTM), "Principles and standart for school mathematics" (Reston , VA: The National Council of Teachers of Mathematics. Inc , 2000)
6. Johnson. D, S & Chung, S, "The Effect of Thinking Aloud Pair Problem Solving (TAPPS) on the Troubleshooting Ability of Aviation Technician Students", *Journal of Industrial Teacher Education*. Vol. 37 No 1) accessed: 18 mei 2017. 19:58 (1992) (<http://scholar.lib.vt.edu/ejournals/JITE/v37n1/john.html>)
7. Ulfah, M, "Eksperimentasi Model Pembelajaran Kooperatif Tipe Thinking Aloud Pair Problem Solving (TAPPS) dan Teams Assisted Individualization (TAI) Dengan Pendekatan Sainifik Pada Materi Operasi Aljabar Dtinjau Dari Gaya Belajar Siswa Kelas VIII SMP Di Kota Surakarta Tahun Ajaran 2014/2015". Thesis. Universitas Negeri Surakarta. Unpublished (2015)
8. Krulik, S., & Rudnick, J. A, "The New Sourcebook for Teaching Reasoning and Problem Solving in Elementary School. A Longwood Professional Book" (Allyn & Bacon, 111 Tenth St., Des Moines, IA 50309, 1995)
9. Dahar, R.W, "Teori-Teori Belajar". (Erlangga: Jakarta, 1989).

10. Sumarmo, U, “*Pengembangan Model Pembelajaran Matematika untuk Meningkatkan Kemampuan Intelektual Tingkat Tinggi Siswa Sekolah Dasar*”. A Research Report from FPMIPA IKIP Bandung. Unpublished (2000).
11. Gok, T. & Silay, “*The Effect of Problem Solving Strategies on Students’ Achievement, Attitude and Motivation*”, *Latin-American Journal of Physics Education*. 4 (1). pp 7012, (2010).
12. Selcuk, G, S. Caliskan, S, & Erol, M, “*The Effect of Problem Solving Instruction on Physics Achievement, Problem Solving performance and Strategy Use*”. *Latih American Journal Physics Education*. 2(3). pp 151-166, (2008)
13. Sujono, “*Pengajaran Matematika Untuk Sekolah Menengah*”.(Departemen Pendidikan dan Kebudayaan: Jakarta, 1988).
14. Barkley, Elizabeth. F., Cross, K. Patricia., Major, Claire. H, “*Collaorative Learning technique: A handbook for College Faculty*”, (Jossey-Bass: A Willey Imprint, 2012).
15. Joice, Bruce and Weil, Marsha, “*Model of Teaching (5.Ed)*”. (Allyn & Bacon: Boston , 1996).
16. Pate, M.L., Wardlow, G.W., & Johnson, D.M, “*Effects of Think–Aloud Pair Problem Solving on The Troubleshooting Performance of Undergraduate Agriculture Student’s in a Power Technology Course*”, *Journal of Agricultural Education* Vol 45, Number 4: 1-11, (2004)
17. Pate, M.L & Miller. G, “*Effects of Think–Aloud Pair Problem Solving on Secondary–Level Students’ Performance in Career and Technical Education Courses*”, *Journal of Agricultural Education* Vol 52, Number 1: 120-131 (2011)
18. Pestel, Beverly C. *Teaching Problem Solving Without Modeling through “Thinking Aloud Pair Problem Solving”*. Rose-Human Instituteof Technology. Terre Haute.Science Education 77(1): 83-94. (1993)
19. Johnson, D.S., & Chung., Shih-Ping, “*The Effect of Thinking Aloud Pair Problem Solving (TAPPS) on the Troubleshooting Ability of Aviation Technician Students*”, *Journal of Industrial Teacher Education*. Vol. 37 No 1 accessed: 18 mei 2017 at 19:58 (1999) (<http://scholar.lib.vt.edu/ejournals/JITE/v37n1/john.html>)
20. Stice, J. E, “*Teaching problem solving. STICE, JE Teachers and Students-Sourcebook*”. Section, 4. diakses: 13 September 2017 at 16.56 . (2007) Provided (http://educa.univpm.it/problemsolving/stice_ps.html)
21. Jeon, K., Huffman, D., & Noh, T, “*The Effects of Thinking Aloud Pair Problem Solving on High School Students Chemistry Problem-Solving Performance and Verbal Interactions*”. *Journal of Chemical Education*. Vol 82. No 10. 1558-1564 (2005)
22. Nikmatul, M., et al, “*Effectiveness of TAPPS Learning Model Assisted Worksheet Toward Problem Solving Ability On Circle Topic*”. *Jurnal pendidikan matematika dan sains tahun II*. No 1 (2014)
23. Ratnasari, et al, “*Penerapan Model Pembelajaran Thinking Aloud Pair Problem Solving (TAPPS) untuk Meningkatkan Hasil Belajar Fisika pada Siswa Kelas XI IPA Negeri 8 Palu*”. *Jurnal Pendidikan Fisika Tandulako*, Vol. 2 No. 1. 28-32. ISBN 2338 3240
24. Kani, N.H.A., & Sharill, M, “*Applying The Thingking Aloud Pair problem Solving Strategy in Mathematics Lesson*” . *Asian Journal of Management Sciences and Education*. Vol 4 (2) (2015)