



Developing Mathematics Learning Model of Thinking Empowerment by Question (TEQ) with TAI Setting to Improve Students' Metacognition Ability

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Abstract

The method used in the development of mathematics learning model of Thinking Empowerment by Question (TEQ) with TAI setting is R & D through 4-D steps, i.e., define, design, develop and disseminate. The subjects in the implementation of the model are the seventh-grade students of one of the junior high schools in Yogyakarta in the academic year 2017/2018 on the plane material. The method used in the model implementation is the quasi-experimental one group pretest-posttest design. Metacognition ability obtained used closed questionnaire. This model is based on the value of count proven to improve students' metacognition ability.

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INTRODUCTION

Based on Permendikbud No 68 the year 2013, one of the characteristics of learning for SMP / MTs is to develop a balance between the development of spiritual and social attitudes, curiosity, creativity, cooperation with intellectual and psychomotor skills. Intellectual ability is one of the important things. Thus, the achievement of competence by students becomes important (Parmin, *et al.*)

Besides the achievement of competence or good learning outcomes, there is another competence that must be possessed by students in learning mathematics, that is metacognitive ability. Mahmudi (2013: PM-52) reveals that metacognitive ability is one of the important abilities that students must possess. The metacognitive ability will help them organize the process of thinking in learning so that it makes the learning process better. In addition, it is also mentioned that the metacognitive ability brings positive effects on the success of students in various areas of life. White & Frederiksen (1998: 6) reveals that "the need for curricula is designed to scaffold the development of students' inquiry, modeling, and metacognitive skills and knowledge." Contrary to how it should be, metacognitive ability became a problem in mathematics learning. This is supported by Risnanosanti (2008: 2-116) which revealed that not much research in Indonesia that reveal about students' metacognitive ability in learning mathematics. In addition, based on observations in Junior High School of Aisyiyah Bantul, it obtained the fact that there has never been researched that seeks to reveal the metacognitive ability of students in learning mathematics in the school. In addition, the students' metacognitive abilities in the school still tend to be low.

Thinking Empowerment by Questioning (TEQ) is a learning strategy that seeks to empower thinking skills. TEQ can trigger the development of students' thinking skills to improve understanding skills (Corebima, 2007). This strategy comes from Crown's thinking (1989) which explains that learning should be an activity of thinking. The focus of thinking activities in learning is to think high level. TEQ is one of the learning strategies developed by Aloysius Duran Corebima since 1985. TEQ is developed based on Diane M. Bunce's thinking that is still related to teaching science the way student learn. According to Bunce (1996) looking for answers to questions, the students must be a participant in the lesson.

The learning steps of TEQ are to provide, do, think, evaluate, and direct. Do is an extension or deepening of the discussion/group work. Think is a summary of the entire student sheets. The learning step requires students to think deeply about the questions provided on the TEQ sheet. Provide contains instructions for preparing study materials on the composition of the population by age and sex in their respective areas). Do contains commands to draw the shape of the population pyramid from the data provided and calculate the sex ratio and dependency ratio. The thinking section contains questions which are the conclusions of the subject matter of population. Evaluation contains questions with the aim of consolidating materials obtained by students. In the direction, the section contains the points of what students do to complete the activities or questions on the TEQ sheet. Students learn more effectively with the TEQ strategy because they are actively involved in organizing and discovering the relationship between the information they are learning rather than passively accepting the knowledge provided by the teacher. Eggen and Kauck (1996) explain that "effective learning will lead the students to the attainment of material understanding."

The advantage of learning with TEQ is the composition of the question which helps students learn the material systematically. Systematics in learning appears in the demands of the TEQ sheet questions which are answered by students and the results of answers which were presented by group representatives. The TEQ sheet contains the questions in accordance with TEQ strategy activities: provide, do, think, evaluate, and lead. The TEQ sheet can keep students focused, systematic and not noisy while learning. Djamarah (2002: 95) explains that "structured questioning has the advantage of developing thinking power and memory and making the students' attention focus on the learning ". The demands of questions given by teachers on the TEQ sheet help students to focus their attention on the material.

Cooperative learning model type TAI (Team Assisted Individualization) was developed by Slavin. According to Slavin (2005), this type combines the benefits of cooperative learning and individual learning. This type is designed to overcome student's learning difficulties individually. Therefore, learning activities are more widely used for problem-solving, the characteristic of this TAI learning model is that each student individually learns the learning materials that have been prepared by the teacher. Individual learning outcomes are brought to groups to be discussed and mutually discussed by group members, and all group members are responsible for the overall answer as a shared responsibility.

Within the application of TAI learning model, students are grouped into small groups (5 students) heterogeneously and are led by a group leader who has better ability and knowledge than his/her members. In addition, teachers have the flexibility to move from group to group or from individual to individual; then the students can check each other's results of their work. Identifying problems that appear in the group can be handled alone or with the help of teachers if needed.

Miftahul (2011) suggests that in the TAI learning model, students are grouped according to their varying abilities. Each group consists of 5 students and is assigned to complete learning materials or homework. In the TAI learning model, each group is given a series of specific tasks to work on together. The points in the assignment are distributed sequentially to each member. All members should check each other's friends' answers and help each other when needed. Each group should ensure that all its members are familiar with the material already discussed.

Each member is given an individual test without the help of another member. During this individual test, the teacher should pay attention to each student. Scores are not only judged by the extent to which students can undergo the test, but also the extent to which they can work independently (not cheating).

The rewards are given to the group that can answer the questions correctly and can finish the homework well. The teacher gives extra points to the students who can obtain an average score that exceeds the minimum score (KKM) on the final exam. Because in the TAI learning model, students must check each other's work and do tasks based on a series of specific questions, teachers can casually provide explanations about the problems that are mostly considered complicated by students. In this TAI learning model, individual accountability, equal opportunity for success, and motivational dynamics are key elements that teachers must emphasize.

The steps of cooperative learning model of TAI type are as follows: 1) Placement Test: Gives the initial test in the form of questions to students which is done individually; 2) Teams: Divide students into groups of 4-5 people based on results; 3) Teaching Group: Explaining the material briefly; 4) Student Creative: Emphasizes students that individual success is determined by the success of the group; 5) Team study; 6) Fact Test; 7) Whole Class Unit.

METHODS

The method used in the development of mathematics learning model of Thinking empowerment by the question (TEQ) with TAI setting is R & D through 4-D steps, i.e., define, design, develop and disseminate (Thiagarajan, et al., 1974). The procedure of research and development of mathematics learning model Thinking empowerment by the question (TEQ) with TAI setting as done by Mariati (2011) is 1) defining: analyzing requirement by collecting various information related to the product which will be done through literature study and field study. 2) The results of the literature study were used as materials to design early models of mathematics learning Thinking empowerment by the question (TEQ) with TAI settings. ; 3) Product development is conducted by discussing with the teacher as expert validation and a limited-scale trial; 4) The dissemination is done on a limited scale that is applied in the Aisiyiah Bantul Junior High School and seminar at Adintercome 2017.

The method used in a limited-scale trial is quasi-experiment with design One group pretest-posttest design. The subjects of the study were junior high school students of academic year 2016/2017. The instrument used is a questionnaire of metacognition ability with problems. Questionnaire covers indicator

that is declarative knowledge which is interpreted as student's knowledge about strategy (concept) which will be used in solving problem, procedural knowledge which is interpreted as student's knowledge about how problem-solving step by using certain strategy (concept), conditional knowledge which is interpreted as the students knowledge of why they use certain strategies (concepts) in solving the problem, the monitoring is interpreted as the students' awareness of whether the strategy (concept), they used in solving the problem is going well or not, and the evaluation which is defined as the student's activity in assessing things they have done during the problem-solving activities.

RESULTS AND DISCUSSION

Initial phase Development of learning model of mathematics thinking empowerment by the question (TEQ) with TAI setting to improve students' metacognition ability is comparing TEQ and TAI stages. The results are presented in the following table:

Table 1. Comparison of Stages between TEQ and TAI

Learning Stages of TAI	Learning Stages of TEQ
Placement Test	
Teams	
Teaching Group	
Student Creative	
Team study	Provide do think evaluate direct
Fact Test	Evaluation
Whole Class Unit	Coaching

The explanation of learning using the model of learning the mathematics of Thinking Empowerment by Question (TEQ) with the TAI setting on the plane material is as follows:

Table 2. Mathematics learning model of Thinking Empowerment by Question (TEQ) with TAI setting

Teachers' Activities	Students' Activities
Placement Test	Placement Test,
Providing the initial test in the form of questions to the students is done individually	Working on the questions given by the teacher individually
Teams	Teams
Dividing students into groups of 4-5 people based on results	Joining their groups
Teaching Group	Teaching Group
Explaining the material about the quadrants and triangles briefly	Paying attention to the teacher
Student Creative	Student Creative
Emphasizing students that individual success is determined by the success of the group	Working well together
Team study	Team study
PROVIDE	PROVIDE
Distributing the worksheets to each group.	Each group gets the worksheet to be

The teachers ask the students to prepare learning books and worksheet that have been distributed.	completed. Students prepare learning textbooks and student worksheet
DO	DO
Allow time for students to learn together to solve problems on LKS and discuss them Teachers facilitate students in identifying problems on student activity sheets. Providing individual assistance to students in need.	Working on the student worksheet and discussing with group mates. Students carry out identification of problems on the student worksheet Questioning if the students face difficulties in solving the problems
EVALUATE	EVALUATE
LKS. Teachers ask the students to analyze problems through questions provided in the student worksheet. Teachers ask the students to evaluate the problems in the student worksheet. Teachers ask the students to tell the problems they have not understood.	The students analyze problems through questions provided in the student worksheet The students evaluate the problems in the student worksheet. The students tell the problems they have not understood.
THINK	THINK
Teachers ask the students to discuss in groups to make conclusions from problems in the worksheet. Teachers ask the representative of each group to present the conclusion they have made. Discussion led by teachers to complete the students' incomplete answers.	Students conclude groups. Students present the conclusion as the result of the discussion. Students listen to the teachers' explanation and repair the incomplete answers.
EVALUATION	EVALUATION
Fact Test	Fact Test
Giving a quiz done by the students individually.	Doing the quiz given by the teachers.
COACHING	COACHING
Whole-Class Units	Paying attention and questioning the unclear things.
Giving positive feedback and oral reinforcement.	

Testing effectiveness of applying mathematics Thinking Model Empowerment by Question (TEQ) with TAI setting to metacognition ability was referred to the data before and after treatment. The test result of normality, homogeneity and average difference are presented in the following table:

Table 3. The result of normality test, homogeneity of pre-test average, and the post-test of metacognition ability

Tet Type	Significance	Conclusion
The Normality Test of Pre-Test of Metacognition Ability	0.982	Normal
The Normality Test of Post-Test of Metacognition Ability	0.056	Normal
Homogeneity Test	0.487	Homogenous

Based on the above table, the data meet the normal and homogeneous requirements. Furthermore, the t-test is done to test the effectiveness of model implementation on metacognition ability based on the pretest and post-test data. The results obtained $t_{\text{able}} = 1.761$ and $t_{\text{count}} = -1.877$. It can be concluded that H_0 was rejected, so the application of the model is effective to improve to metacognition ability.

CONCLUSION

A model of learning mathematics of Thinking Empowerment by Question (TEQ) with TAI setting has been developed. This model is based on the value of count proven to improve students' metacognition ability.

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