Team Assisted Individualization (TAI) in Mathematics Learning Viewed from Multiple Intelligences

I I Siregar1*, Budiyono2 and I Slamet3

1,2 Department of Mathematics Education, Faculty of Education and Teacher Training University of Sebelas Maret, Indonesia

3 Department of Mathematics Education, Faculty of Education and Teacher Training University of Sebelas Maret, Indonesia

*Corresponding author: indraantisiniregar@gmail.com

Abstract. In this era, cooperative learning is very important in learning mathematics. The aim of this study is to find the effect of cooperative learning type TAI on the students’ mathematics achievement viewed from multiple intelligences. This research is quasi experiment. The population of this study is the students of 8th grade Wonogiri district in the academic year 2016/2017. The sample of this research was taken using stratified cluster random sampling technique. The data was collected through the achievement and multiple intelligence tests. Data were analyzed in two ways, ANOVA with unequal cell and scheffe test. The result shows that this learning method has significant value 0.003; it means that students’ mathematics achievement using TAI had successfully given different effects on mathematics learning achievement. While, in multiple intelligences category it has significant value 0.043, it means that there is a different mathematics learning achievement in multiple intelligences. There is no interaction between multiple intelligent and learning models. TAI learning model can be used by the teachers in mathematics learning, which is expected to improve the mathematics achievement.

1. Introduction

Educating student of the 21st century demands a different approach, a deviation from traditional way of teaching [1]. In order to meet the demands of students, education must change with ever-changing student [2]. Applying the effective teaching approaches can help the teachers to support students achieving learning objectives [3]. Mathematics is a science that underlies the development of modern technology and has an important role in developing the human mind power, so that mathematics is given in every level of education from primary school to high school.

According to Slavin [4] the difficulties in learning sciences are not sufficiently solved by conventional method, but can be assisted by cooperative learning method. One of the causes of the poor quality of students’ in mathematics is in classroom learning, teachers are too oriented to procedural and mechanistic things such as teacher-centered learning, mathematical concepts often delivered informatively, and students are trained to complete without a deep understanding [5].

Several approaches that can be done in the classroom, namely: (1) Competition, which involve students in a fight that can determine who win and who lose; (2) Individualism, which ask students to work independently of a particular assigned task and strive alone to achieve the learning goal; and (3) Cooperation, which is to work together in a group and each member of the group is ensure to contribute and understand the task being done [6]. Cooperative learning gives more space and opportunities for students to discuss, solve problems, create solutions, provide ideas and help each other [7]. Through the use of these cooperative learning strategies, the teacher-researcher found that students’ motivation to learn increases tremendously and this may have contributed to them showing higher achievement [8].

There have been many studies proving that cooperative learning could improve the quality of the learning process. Cooperative learning indicated that there is a significant difference in achievement than individual learning [7]. The cooperative learning with STAD strategy combine with TGT showed better student learning outcomes than other learning strategies that include conventional learning strategies [3]. Fui was found that the use of cooperative learning does increase students’ academic achievement, help students to achieve a better understanding of physics concept and increases students; motivation to learn[8]. The result of Effandi study indicate that the cooperative learning approach resulted a higher
Cooperative learning has many variants, one of them are Team Assisted Individualism (TAI). TAI is one of the simple cooperative learning model involving heterogeneous groups. There are several steps of cooperative learning model type TAI (1) Curriculum Materials, students are given the task to study the individual learning materials that have been prepared by the teacher, (2) Placement Test, students are given individual quizzes to get a basic score or an initial score. The results of these tests are used to determine the making of groups, (3) Teams, students consist of several groups where each group consists of 4-5 students with different abilities of either skill level (high, medium, and low). If possible group members come from different races, cultures, tribes and gender equality, (4) Team Study, student learning outcomes are individually discussed in groups. In group discussions, each group member checks each other's answers, (5) Teaching Group, students are facilitated in making summaries, directing, and affirming learning materials that have been studied, (6) Fact Test, students are given individual tests, (7) Team Scores and Team Recognition, teachers reward groups based on the value of improving individual learning outcomes from baseline scores to subsequent quiz scores, (8) Whole Class Unit, the teacher reminded the material to be learned in the next meeting. Teacher closes learning with messages of motivation and prayer.

Each component of cooperative learning model type TAI brings benefit to the teachers, students, high groups and low groups who work together completing the academic tasks, namely: the clever students take the responsibility to help the weak group. Thus, they can develop their abilities and skills together.

The application of this method has been proven to have a significant effect on the learning. The ability of the students of the Department of Forestry and Environmental Sciences taught by TAI type cooperative learning model is better than the students who are taught using conventional learning, with TAI strategies get an average 60.09 and conventional strategies get 53.67 [10]. The mathematics communication ability has a significant correlation with the cooperative learning type TAI, because the class using the cooperative learning, the students are expected to help each other, to mutually discuss and argue, to sharpen the knowledge they have at the current time, and to overcome the gap in the understanding among students [11].

As outlined by Gardner [12] there are nine different types of intelligences that are examined in this study, namely verbal-linguistic, logical-mathematical, visual-spatial, musical, interpersonal, intrapersonal, kinesthetic, naturalistic and existential. Every child has strong and weak sides no matter what his intelligence is, on condition that only one or two of these intelligence areas are used, the students whose intelligences types don’t take place among the ones used at school cannot be able to improve their brilliant sides, complete learning in a long period without enjoying or managing to learn [13]. According to Thobroni [14] multiple intelligences is a dual ability to solve problems encountered in life. But in this study type of multiple intelligences we will limit to three types namely logical mathematical, Linguistic intelligence, Interpersonal intelligence.

Logical mathematical intelligence is the understanding and use of logical structures, including patterns and relationships, statements a proposition through experimentation, quantification, conceptualization and classification [15]. Linguistic intelligence is a kind of language capacity to achieve an aim and capability to use language learning ability in terms of writing and speaking effectively [16]. Interpersonal intelligence is the capacity of understanding, distinguishing and welcoming the emotions, aspirations and need of surrounding people [17]. Research conducted by Samsudi [18] showed a relationship between multiple intelligence and the preferred science teaching. There is a significant difference between the experimental group that taught according to the multiple intelligences theory and the control group which taught according to the traditional method; and this difference has been found to be in favor of the experimental group [13].

Based on the background, the purpose of the researcher is to find the effect of cooperative type of TAI on student mathematics achievement viewed from multiple intelligences in grade VIII in Wonogiri.

2. Method
This research used a quasi-experimental research with factorial design 2x2. The aim of this research was to know the influence of two independent variables to dependent variable. The independent variables in this research were models learning which TAI as an experimental class and direct learning as control class, and then three multiple intelligence logic mathematics, linguistics and interpersonal intelligence categorize by using questionnaires. While the dependent variable was the student’s mathematics learning achievement. The population of this research was all the students of eight grades in Junior High School in

achievement than the traditional teaching approaches and also indicate that the cooperative learning approach increase attitude towards mathematics [9].
Wonogiri in 2016/2017, and the samples were three schools in Wonogiri that categorized into high, moderate and low school. The sample was taken by using cluster random sampling. This research used three methods in collecting the data. They were documentation method used to get student’s profile data, the test method used to obtain student’s mathematics learning achievement data that contains the indicators of geometry materials in the form of multiple choice questions and using questionnaires to categorize the multiple intelligences of students. This research hypothesis used two ways analysis of variance (two – way ANOVA ) with unequal cells which the research data should be qualified for the normality and the homogeneity.

3. Result and Discussion

3.1 Decryption of Student Score in TAI model and Direct Learning

Table 1. The following is the result of students’ value in cooperative model type TAI and direct learning

| Statistics          | Value Statistics |
|---------------------|------------------|
| Total Sample        | 80               |
| Lowest Value        | 70.710           |
| Highest Value       | 76.273           |
| Average Value       | 73.84            |
| Standard Deviation  | 13.314           |

| Statistics          | Value Statistics |
|---------------------|------------------|
| Direct Learning     | 81               |
| Lowest Value        | 64.844           |
| Highest Value       | 70.345           |
| Average Value       | 67.63            |
| Standard Deviation  | 12.476           |

3.2 Categorization of Students’ Multiple Intelligences in Each Learning Model
The instrument to categorize the multiple intelligences of students is using questionnaires. The questionnaire used 15 items for each intelligence category. At the end, the students were categorized into a particular type of intelligence which was seen from the most dominant score among the three scores of questionnaires.

Table 2. Categorization of Student Multiple Intelligence

| Learning Method  | Intelligent          | N   |
|------------------|----------------------|-----|
| TAI              | Logic Mathematics    | 24  |
|                  | Linguistics          | 25  |
|                  | Interpersonal        | 31  |
| Direct Learning  | Logic Mathematics    | 28  |
|                  | Linguistics          | 28  |
|                  | Interpersonal        | 25  |

3.3 Normality and Homogeneity Test
Prior to the two-way ANOVA test, normality and homogeneity were performed the data with significance level 5% by using SPSS. The result of normality test of student’s mathematics learning achievement showed that from experimental class and control class the sig. Value > 0.05 that were 0.904>0.05, and 0.623> 0.05. This indicated that the sample of students’ mathematics achievement test came from a normality distribution population.

The result of homogeneity test of student’s mathematics learning achievement between experiment class and control class showed the sig. Value>0.05 that was 0.155>0.05. This indicated that the population has the same or homogeneous variance.

3.4 Two Ways ANOVA

Table 3. The Result of Two-Ways ANOVA with Unequal Cells

| Tests of Between-Subjects Effects | Source       | Type III Sum of Squares | df | Mean Square | F    | Sig. |
|----------------------------------|--------------|-------------------------|----|-------------|------|------|
| Corrected Model                  | 3733.147a    | 5                       | 746.629 | 4.768       | .000 |
| Intercept                        | 794956.716   | 1                       | 794956.716 | 5076.203     | .000 |
| METHOD                           | 1388.780     | 1                       | 1388.780 | 8.868       | .003 |
| INTELLIGENT                      | 1005.861     | 2                       | 502.930 | 3.211       | .043 |
METHOD * INTELLIGENT

| Method       | Mean  | Std. Error |
|--------------|-------|------------|
| TAI          | 73.491| 1.408      |
| Direct Learning | 67.594| 2.392      |

### Table 5. Multiple Intelligence

| Interpersonal Level    | Mean   | Std. Error |
|------------------------|--------|------------|
| Logic mathematics      | 72.402 | 1.741      |
| Linguistics            | 66.987 | 1.722      |
| Interpersonal          | 72.239 | 1.682      |

### 3.5 Estimated Marginal Mean

**Table 6. Post Hoc Test with Scheffe on Multiple Intelligence**

| Intelligence       | Intelligence | Sig.  |
|--------------------|--------------|-------|
| Logic Mathematics  | Linguistics  | .010  |
| Linguistics        | Interpersonal| .028  |
| Interpersonal      | Logic Mathematics| .038 |

Based on the calculation in Table 3, the effect of learning model on mathematics learning has obtained value of $F = 8.868$ with sig. Value 0.003<0.05, so $H_0$ rejected and $H_a$ accepted. It can be concluded that there was difference effect using learning model in mathematics learning achievement. In experimental class in Table 4 had mean score 73.491 and in control class had mean score 67.594 so it concluded that TAI is greater than direct learning in student’s mathematics learning achievement. The effect of interpersonal intelligence on mathematics learning achievement has a value of $F$ obtained of $F=3.211$ with sig. Value 0.043 < 0.05, so $H_0$ rejected and $H_a$ accepted. It can be concluded that there was a difference between logic mathematics, linguistics, interpersonal in multiple intelligence, so it will be continued with scheffe test. Based Table 6 result using Post Hoc Test with Scheffe, the result of logic mathematics intelligence differed significantly with and linguistics intelligence, in Table 5 logic mathematics had mean score 72.402 and linguistics intelligence score 66.987 so it can be concluded that learning method effectively improve students’ logic mathematics intelligence than linguistics intelligence. Then, the result of linguistics intelligence differed significantly with and interpersonal intelligence, in Table 5 linguistics had mean score 66.987 and interpersonal intelligence score 72.239 so it can be concluded that learning method effectively improve students’ interpersonal intelligence than linguistics intelligence. The result of interpersonal intelligence differed significantly with and logic mathematics intelligence, in Table 5 interpersonal had mean score 72.239 and logic mathematics intelligent score 72.402 so it can be concluded that learning method effectively improve students’ logic mathematics intelligence than interpersonal intelligence. In Table 3 showed the sig. Value of method intelligent 0.083, so $H_0$ accepted and $H_a$ rejected. It can be concluded that there was no interaction between method of learning and multiple intelligence to mathematics learning achievement.

In direct learning, teachers give explanations and narratives to the students verbally, while students listen carefully, and record the principal expressed by the teacher. The TAI learning model is a learning model that forms a heterogeneous small group with different backgrounds and ways of thinking to help each other in need. Suppose a responsible student guides a weak or clever student, otherwise it can increase student participation in small groups. The learning model of TAI provides better learning achievement compared to direct learning model. Based on two way variance analysis with unequal cell for row effect obtained $H_0$ rejected. This shows that there is influence of learning model on mathematics
learning achievement. The learning model of TAI provides better mathematics learning achievement than direct learning. This is in accordance with research conducted by Slavin [19], he compared this kind of learning with direct learning, TAI can improve learning achievement and solve math problems.

The second result of this study is that students with mathematical-logical intelligence have better mathematics learning achievement than students with linguistic intelligence and interpersonal intelligence; students with interpersonal intelligence have better mathematics learning achievement than students with linguistic intelligence. Based on a two-way variance analysis with unequal cells for column effects obtained H0 rejected. This shows that there is the influence of multiple intelligences (mathematical-logical, linguistic and interpersonal intelligence) on mathematics learning achievement. According to Gardner [12] because different terms of intelligence, then one individual with the other is not the same ability to solve encountered problems. To find out which multiple intelligences provide better mathematics learning achievement, it is necessary to compute average between columns. From the comparative test average between the columns obtained the conclusion (1) logical mathematical intelligence provides better learning achievement of mathematics linguistic intelligence. The results of this study are consistent with studies conducted by Endang [20] that conclude learners with mathematical categories provide better mathematical learning achievement than linguistic categories (2) interpersonal intelligence gives higher achievement than linguistic intelligence, because students with interpersonal intelligence like work in the group and easy to interact so that students can gain understanding from other students. Students with linguistic intelligence only have the ability to explain in good language, (3) logic mathematics intelligence provides higher achievement than interpersonal intelligence, because logical mathematical intelligence students tend to work with numbers, patterns, solve problems and analyze any situation either in group or alone learning activities.

4. Conclusion
Based on the result and data analysis, it can be concluded that there were differences in learning achievement between classes that were studied with TAI a direct learning strategy. This suggests that learning strategies affect the learning achievement. Further test result (Scheffe), showed the multiple intelligences category, students’ mathematics achievement with logical language intelligence have better results than those with language intelligence category and students’ mathematical achievement with language intelligence has better results than those with interpersonal intelligence category. TAI learning model can be used by the teachers in mathematics learning, which is expected to improve the mathematics achievement.

5. References
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