Comparison of learning models based on mathematics logical intelligence in affective domain

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Abstract. The purpose of this study was to examine the presence or absence of different effects of multiple treatments (used learning models and logical-mathematical intelligence) on the dependent variable (affective domain of mathematics). This research was quasi experimental using 3x3 of factorial design. The population of this research was VIII grade students of junior high school in Karanganyar under the academic year 2017/2018. Data collected in this research was analyzed by two ways analysis of variance with unequal cells using 5% of significance level. The result of the research were as follows: (1) Teaching and learning with model TS lead to better achievement in affective domain than QSH, teaching and learning with model QSH lead to better achievement in affective domain than using DI; (2) Students with high mathematics logical intelligence have better achievement in affective domain than students with low mathematics logical intelligence have; (3) In teaching and learning mathematics using learning model TS, students with moderate mathematics logical intelligence have better achievement in affective domain than using DI; and (4) In teaching and learning mathematics using learning model TS, students with low mathematics logical intelligence have better achievement in affective domain than using QSH and DI.

1. Introduction
Mathematics is one science that has an important role in the development of logical thinking ability, analytical, systematic, critical, and creative, and can be used to solve the problems faced in everyday life. However, the fact that mathematics is considered as a difficult subject to grasp, causing mathematics achievement is still low, including junior high school students. The low mathematics achievement experienced by junior high school students in the district of Karanganyar.

The low in learning outcomes of mathematics can be seen from the value of the National Examination of junior high school under academic year 2015/2016. The average score of Indonesian language is 76.53, the average score of English is 51.88, the average score of mathematics is 45.71, and the average score of natural science is 56.71. From these values, it can be clearly seen that the value of national examination for mathematics is the lowest when being compared with other subjects. The government has made various efforts to improve learning outcomes in learning mathematics, but it has not be able to achieve the expected results.

Some of the factors that are the most common cause of low mathematics values are ineffective teaching methods, unavailability of teaching materials, foreign language in teaching materials, and the symbolism used in the subject [1]. The learning model is one of the factors that need to be considered in the learning process because it can affect student learning outcomes. The use of learning models tailored to the material and learning objectives will enable learners to understand the existing material so that their learning outcomes can be improved.


1.1. Learning Outcomes
According to Bloom, learning outcomes can be divided into three aspects: cognitive, affective, and psychomotor [2]. The cognitive domain contains intellectual-centered behavior, such as knowledge and thinking skills [3]. As time gone and the development of the era, cognitive domain of Bloom's Taxonomy is evolved [4]. The cognitive domain dimension of the Revised Bloom's Taxonomy is remembering, understanding, applying, analyzing, evaluating, and creating [5]. Bloom's Taxonomy of Educational Objectives on affective domain includes objectives on interests, values, appreciation and attitudes [6]. The first level of the affective taxonomy is referred to as receiving. At this level, the learner is aware of the topic, stimuli, event or issue and is willing and ready to learn about it or respond to it. The second level, responding ranges from compliance by voluntary response to having a sense of satisfaction in doing what is required. The third level is referred to as valuing. At this level the learner voluntarily manifests behaviors that are consistent with certain beliefs. At the fourth level of the taxonomy; organization the learner organizes a set of values into a value system that are used to respond to diverse situations. The fifth level and which is the highest level in the hierarchy of affective taxonomy is characterization by a value or value set and this occurs when a student’s behavior is consistent and predictable as if it has been adopted as a life style [7]. Psychomotor domain contain behavior that centers on the function of manipulation and physical abilities. It was established to address skills development relating to the physical dimensions of accomplishing a task [8]. In this paper, the author will discuss about the affective domain.

1.2. Learning Models
One of the obstacles to improving learning outcomes is teacher-centered learning or textbooks. Several studies in the area of mathematics have shown that instruction, especially at the secondary school level remains overwhelmingly teacher-centered, with greater emphasis being placed on lecturing and textbook than on helping student to think critical across subject area and applying their knowledge to real-worlds situation [9].

Teaching-centered learning or often we call the Direct Instruction model does not require students to be active in digging information in learning. It is an instructional model that focuses on the interaction between teachers and students. Key components of direct instruction include modeling, reinforcement, feedback, and successive approximations [10]. During the use of active learning, students move from being passive recipients of knowledge to being participants in activities. Active learning, through which students become active participants in the learning process, is an important means for development of higher level thinking [11]. The one of the active learning that can improve the affective domain is the cooperative learning model. Cooperative learning is concerned with framing student interaction in ways that are likely to raise positive interdependence and promotive interaction [12]. The result came up with five additional main components that a cooperative learning approach should have to be instrumental and these were: (1) positive interdependence; (2) individual accountability; (3) face-to-face interaction; (4) interpersonal and small group skills; and (5) group processing [13]. To be effective, cooperative learning must be well planned and structured with suitable learning materials and guidelines given to all participants [14]. It is explained that cooperative learning model Talking Stick type has usability such as making the students more focused when following the learning activities because at the time of the scepter the students must be involved in the learning activities [15]. The step of the Talking Stick learning model is the formation of heterogeneous groups, the students are given daily problems to solve, the rods are rolled out, the students who get the sticks are assigned to the presentation of the results of the discussion, and the group awards. Question is a sign of the complexity and fascination of life, a sign of cognitive vitality, of freedom of the mind [16]. The step of the learning model Question Student Have is the formation of heterogeneous groups, each student writing everyday problems on a piece of paper, the best issues will be selected and exchanged for completion by other groups, the results of the discussions presented, and the group awards.
1.3. Logical Mathematical Intelligence

Another factor that affects the affective domain is multiple intelligence. According [17], Gardner argues for nine relatively autonomous intelligences, there are linguistic intelligence, logical mathematical intelligence, musical intelligence, bodily kinesthetic intelligence, spatial intelligence, interpersonal intelligence, intrapersonal intelligence, naturalist intelligence, and existential intelligence.

Gardner described logical/mathematical intelligence as the ability to study problems, to carry out mathematical operations logically and analytically, and to conduct scientific investigations. Gardner identified mathematicians, logicians, and scientists as persons who would possess high levels of this hypothesized intelligence. The kinds of processes used in the service of logical-mathematical intelligence include categorization, classification, inference, generalization, calculation, and hypothesis testing. People who prefer to use their logical-mathematical intelligence usually do well on standardized comprehension/written language tests. They like to solve abstract problems and often do so by trial and error [18].

2. Research Method

This research is quasi experimental using 3x3 of factorial design. The dependent variable is affective domain and the independent variables are learning models (Talking Stick, Question Student Have, and Direct Instruction) and mathematics logical intelligence. The population of this research was VIII grade students of junior high school in Karanganyar under the academic year 2017/2018. Two schools were taken as samples using stratified cluster random sampling technique which are SMP Negeri 2 Karanganyar and SMP Negeri 2 Gondangrejo. Three classes from each school are taken as experimental classes.

3. Result and Discussion

3.1. Normality Test

The normality test is performed to determine whether the selected sample is from a normally distributed population. In this study used the Lilliefors method for normality test.

Table 1. Normality Test Data

| Sample | $L_{\text{observation}}$ | $L_{0.05;183}$ | Decision | Conclusion |
|--------|--------------------------|----------------|----------|------------|
| TS     | 0.0732                   | 0.1109         | $H_0$ is not rejected | Normal    |
| QSH    | 0.0962                   | 0.1099         | $H_0$ is not rejected | Normal    |
| DL     | 0.0896                   | 0.1109         | $H_0$ is not rejected | Normal    |

Based on Table 1, it appears that $L_{\text{obs}}$ for each sample does not exceed $L_{\text{table}}$ so that $H_0$ is not rejected, it means that each sample comes from a normally distributed population.

3.2. Homogeneity Test

The homogeneity test is conducted to determine whether the variance of a number of populations is equal or not. To test it used Barlett test.

Table 2. Homogeneity Test Data

| Sample | $X^2_{\text{observation}}$ | $X^2_{0.05;2}$ | Decision | Conclusion |
|--------|-----------------------------|-----------------|----------|------------|
| TS, QSH, DI | 3.418 | 5.991 | $H_0$ is not rejected | Homogen |

Based on Table 2, it appears that $X^2_{\text{obs}}$ does not exceed $X^2_{\text{table}}$ so that $H_0$ is not rejected, it means that the variance of some populations is the same or homogeneous.
3.3. Two Ways Analysis of Variance with Unequal Cells

Two ways analysis of variance with unequal cells was performed to test whether or not there were significant differences in effect on some treatments on the affective domain.

**Table 3. Marginal Average Data**

| Learning Model (A) | Logical Intelligence (B) | Mathematical Intelligence (C) | Marginal Average |
|--------------------|--------------------------|-----------------------------|------------------|
| TS                 | 126.59                   | 123.59                      | 128.87           |
| QSH                | 122.92                   | 120.50                      | 113.00           |
| DI                 | 117.65                   | 110.81                      | 107.69           |
| Marginal Average   | 122.01                   | 118.87                      | 116.19           |

**Table 4. Two Ways Analysis of Variance with Unequal Cells Data**

| Source | Sum of Square | df | Mean of Square | $F_{observation}$ | $F_{0.05}$ | Decision |
|--------|---------------|----|----------------|-------------------|------------|----------|
| (A)    | 5973.99       | 2  | 2987.00        | 28.4388           | 3.00       | $H_{0A}$ is rejected |
| (B)    | 1057.40       | 2  | 528.70         | 5.0337            | 3.00       | $H_{0B}$ is rejected |
| (AB)   | 1268.30       | 4  | 317.08         | 3.0188            | 2.37       | $H_{0AB}$ is rejected |
| Error  | 18275.62      | 182| 105.03         | -                 | -          | -        |
| Total  | 26575.31      | 190| -              | -                 | -          | -        |

Based on Table 4 can be summarized as follows: (a) $H_{0A}$ is rejected, hence there are difference of affective domain to model of learning, (b) $H_{0B}$ is rejected, then there are different of affective domain to students mathematical logical intelligence, and (c) $H_{0AB}$ is rejected, then there is the interaction between the learning model and the intelligence of mathematical logic to the affective domain students. Due to $H_{0A}$, $H_{0B}$, and $H_{0AB}$ are rejected, it is necessary to test further anava with Scheffe method to know which have significantly different mean. In Table 5, the results of the calculation of further tests of intercross rows and the results of the mean further test calculation between the columns in Table 6.

3.4. Double Comparison Test

Double comparison test is a follow up of the analysis of variance if the result of variance analysis shows that $H_0$ is rejected. This test is used Scheffe method to see which gives significantly different mean.

**Table 5. Inter-Line Comparison Test Results**

| $H_0$ | $F_{observation}$ | $2F_{0.05;2,183}$ | Critical Value | Decision |
|-------|--------------------|-------------------|----------------|----------|
| $\mu_1 = \mu_2$ | 11,6264            | 6.00              | $\{F|F > 6.00\}$ | $H_0$ is rejected |
| $\mu_1 = \mu_3$ | 49,5824            | 6.00              | $\{F|F > 6.00\}$ | $H_0$ is rejected |
| $\mu_2 = \mu_3$ | 13,5004            | 6.00              | $\{F|F > 6.00\}$ | $H_0$ is rejected |

Based on Table 5, it was clear that all of the hypothesis is rejected. This means that there is a significant effect between learning models and affective domain. In the current research, teaching and learning with model Talking Stick lead to better achievement in the affective domain than Question
Student Have, teaching and learning with model Question Student Have to lead to better achievement in the affective domain than using Direct Instruction.

Table 6. Inter-Columns Comparison Test Results

| $H_0$ | $F_{observation}$ | $2F_{0.05;2,183}$ | Critical Value  | Decision |
|-------|-------------------|-------------------|-----------------|----------|
| $\mu_1 = \mu_2$ | 3.1718 | 6.00 | $\{F | F > 6.00\}$ | $H_0$ is not rejected |
| $\mu_1 = \mu_3$ | 8.9284 | 6.00 | $\{F | F > 6.00\}$ | $H_0$ is rejected |
| $\mu_2 = \mu_3$ | 1.9529 | 6.00 | $\{F | F > 6.00\}$ | $H_0$ is not rejected |

Subsequently, we looked into overall results for Table 6. If $H_0$ is not rejected, then there is no significant effect between the intelligence of mathematical logic and affective domain. The only exception is hypothesis $\mu_1 = \mu_3$, there is a significant effect between the intelligence of mathematical logic and affective domain. In this case, students with high mathematics logical intelligence have better achievement in the affective domain than students with low mathematics logical intelligence.

Table 7. Inter-Cell Comparison Test Results on the Same Line

| $H_0$ | $F_{observation}$ | $8F_{0.05;8,183}$ | Critical Value  | Decision |
|-------|-------------------|-------------------|-----------------|----------|
| $\mu_{11} = \mu_{12}$ | 0.9196 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{11} = \mu_{13}$ | 0.3939 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{12} = \mu_{13}$ | 2.6246 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{21} = \mu_{22}$ | 0.6195 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{21} = \mu_{23}$ | 9.4807 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{22} = \mu_{23}$ | 4.9213 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{31} = \mu_{32}$ | 4.8935 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{31} = \mu_{33}$ | 8.9204 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{32} = \mu_{33}$ | 0.8427 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |

Table 7 presented all of the hypothesis is not rejected. In this regard, there is no interaction between affective domain and mathematic logical intelligence viewed from each learning models.

Table 8. Inter-Cell Comparison Test Results on the Same Columns

| $H_0$ | $F_{observation}$ | $8F_{0.05;8,183}$ | Critical Value  | Decision |
|-------|-------------------|-------------------|-----------------|----------|
| $\mu_{11} = \mu_{21}$ | 6.0860 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{11} = \mu_{31}$ | 7.4317 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{21} = \mu_{31}$ | 3.1649 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{12} = \mu_{22}$ | 1.0734 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{12} = \mu_{32}$ | 18.9304 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is rejected |
| $\mu_{22} = \mu_{32}$ | 9.1587 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
| $\mu_{13} = \mu_{33}$ | 19.1002 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is rejected |
| $\mu_{13} = \mu_{33}$ | 33.0632 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is rejected |
| $\mu_{23} = \mu_{33}$ | 2.2148 | 15.52 | $\{F | F > 15.52\}$ | $H_0$ is not rejected |
After analyzing Table 8, the result showed that hypothesis is not rejected expect hypothesis for $\mu_{12} = \mu_{32}$, $\mu_{13} = \mu_{23}$, and $\mu_{13} = \mu_{33}$. In the hypothesis $\mu_{12} = \mu_{32}$, $H_0$ is rejected. It means that when viewed by students who have the intelligence of middle-class mathematical logic, there is a significant influence on the learning model of Talking Stick and Direct Instruction against the affective domain of mathematics. Be based on Table 3, in teaching and learning mathematics using learning model Talking Stick, students with moderate mathematics logical intelligence have better achievement in the affective domain than using Direct Instruction.

Hypothesis $\mu_{13} = \mu_{23}$ is rejected. It signifies that the interaction between the learning models (Talking Stick and Question Student Have) and the intelligence of mathematical logic that affects the affective domain mathematics. By looking at the average in Table 3, it can be concluded that the Talking Stick model is more effective in the affective domain than the Question Student Have model if given to students who have low mathematical logic intelligence.

Finally, Scheffe method also reported hypothesis $\mu_{13} = \mu_{33}$ is rejected. It declared the affective domain of mathematics is influenced by the model of learning and the intelligence of mathematical logic. In teaching and learning mathematics using learning model Talking Stick, students with low mathematics logical intelligence have better achievement in the affective domain than using Direct Instruction.

4. Conclusion

Based on the results of the research and the discussion that has been done, it can be concluded that:

(1) Teaching and learning with model Talking Stick lead to better achievement in affective domain than Question Student Have, teaching and learning with model Question Student Have lead to better achievement in affective domain than using Direct Instruction; (2) Students with high mathematics logical intelligence have better achievement in affective domain than students with low mathematics logical intelligence have; (3) In teaching and learning mathematics using learning model Talking Stick, students with moderate mathematics logical intelligence have better achievement in affective domain than using Direct Instruction; and (4) In teaching and learning mathematics using learning model Talking Stick, students with low mathematics logical intelligence have better achievement in affective domain than using Question Student Have and Direct Instruction.

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