Students’ learning achievement using Knisley learning model with Brainstorming method

N Anaguna¹,* and S Suhendra²

¹ Departemen Pendidikan Matematika, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
² Departemen Pendidikan Matematika, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

*anaguna@upi.edu

Abstract. This study aims to determine whether there is an influence of using Knisley learning model with Brainstorming method toward students’ mathematics learning achievement. This experimental research conducted in one of junior high schools in South Sulawesi, Indonesia by taking a class randomly from the eighth grade. The research was carried out during seven meetings consisted of one pre-test meeting, one post-test meeting and five preferential treatment meetings. Data were analyzed using descriptive and inferential statistical analysis. Based on the score of pre-test and post-test, the students scores show an improvement from low to high category. The average of students score in post-test was complete which was approximately three-fourth of the total percentage, while in reverse, a hundred percent of students’ score in pre-test showed students failure to reach a standard completeness score set by school. Furthermore, gain normalization analysis illustrated a well increase of students learning achievement because its values experienced high category. According to those progress and supported by the result analysis of teacher and students activities sheets and students responses sheets to the learning, it can be concluded that that there is an influence of using Knisley learning model with brainstorming method as its result shows a positive change toward the students’ mathematics learning achievement.

1. Introduction

Majority of students in Indonesia have a difficulty to grapple with mathematics and science. An international survey address that Indonesia ranks second bottom position from sixty five joined countries in the survey of students’ mathematics, reading and science skills [1]. It shows that students in Indonesia require much more attention on a betterment of education particularly on mathematics aspect as such subject hit the lowest point. To overcome that problem, many principals have been dealing with various efforts either revising the national education system or improving teachers’ capability in teaching. This research was conducted in purpose of giving a contribution to cope that matter. One possible solution is attempting to improve the students’ learning achievement by bringing an innovation into the state of teaching and learning process in schools. Teachers in this case have a responsible to make it happen.

There are several roles that teachers should take into consideration such as being: (1) Educators who have to instil norms and values to their students, (2) Teachers, must organize and manage all components and competencies of teaching and learning, (3) Mentors, should provide guidance (academic, social, individual, work, leisure) to students, (4) Demonstrators, should always master the material and be able
to demonstrate what was being taught didactically, (5) Trainers, should be able to develop skills in students, (6) Administrators, should administer well the components in the classroom (knowing and creating teaching programs, managing classes and so on), (7) Mediators, should have sufficient knowledge, understanding and skills about educational media and become intermediaries in human relationships, (8) Facilitators, should set up the best facilities for the achievement of educational goals, (9) Evaluators, should be able to master and skill fully carry out an evaluation of education [2]. If those mentioned responsibilities of teachers can be applied in schools then hopefully students will get more enjoyable learning, have curiosity about knowledge being taught as well as obtain the meaning of learning.

However, the expectation is still beyond the reality because several teachers are more likely using traditional approach to teach [3]. The impact is inevitable that students are bored with the regular situation in classroom. It leads to a lack of intensive communication between teachers and their students and even worst if students get stuck in solving mathematics problems, they will afraid of discussing with their teachers about the way of finding solutions. A suitable method of learning to tackle that problem is using brainstorming because of several reasons. Despite of using traditional method, brainstorming comes up with an innovative method invented by Alex F. Osborn to help people in group solving problems with novel ideas [4]. It is able to trigger the students in showing their creative ideas off [5]. Brainstorming is also effective for teachers to play their roles as a facilitator [6]. In accordance with it, the achievement of students’ education can also be emerged by using brainstorming method which consists of five stages as follows: (1) making students be acquainted with the rules of brainstorming method, (2) proposing several thought-provoking questions in relation to the topic of learning so as to make students think in depth, (3) expressing ideas by the students, (4) exhibiting ideas, and (5) evaluating ideas [7].

To complete the process of teaching, a model of learning is imperative to be applied together with the brainstorming method as a practitioner said that a model is more than specific method or strategy that is exactly appropriate to be used in achieving learning objectives [8]. Model matched with the brainstorming method is a model adopted from Kolb learning style. The stages of learning in Kolb are concrete-experience (CE), abstract-conceptualization (AC), reflective-observation (RO), and active experimentation (AE). People who undergo the Kolb learning style will obtain knowledge through a transformation of experience from certain stages to another as follows: (1) CE to AC: experiencing; (2) AC to RO: reflecting; (3) RO to AE: thinking; and (4) AE to CE: acting [9]. Students’ thinking appears sequentially as Diverges, Assimilator, Converges, and Accommodator in the Kolb learning stages [10]. According to the Knisley perspective, Kolb learning cycles is able to be interpreted as mathematics learning stages that are divided into four stages of learning named concrete-reflective, concrete-active, abstract-reflective, and abstract-active [11]. The main activities of teacher and students respectively in Knisley learning phases are becoming: Story-teller and Allegories, Motivator and Integrator, Informant and Analyzer, Coach and Syntheziser. In every stage of Knisley learning model will be inserted brainstorming method so as to achieve the aforementioned learning goals. Thus by conducting this research, two aspects will be questioned. First is about how the description of students’ learning achievement significantly before and after taught by using Knisley learning model with brainstorming method? The latter will be asked about is there any influence of using Knisley learning model with brainstorming method toward students’ learning achievement?

2. Method
This experimental research utilized one-group of pre-test and post-test design [12]. After giving pre-test, students would be taught using the combination between Knisley learning model with brainstorming method on Pyramids and Prisms subject. Then, post-test was given in the end of meetings. The study was conducted in one of junior high schools in South Sulawesi in the eight grade. In terms of choosing class, the researcher used random sampling technique to take a class and analyzed the data from pre-test and post-test results, observation sheets and questionnaires.
3. Results and discussion

The influence of Knisley learning model with brainstorming method can be seen by looking at the analysis of descriptive statistics and inferential statistics. For the description of statistics analysis, four components will be elucidated such as about teacher activities in managing class, students activities and students responses toward the teaching and learning process, and the result analysis of students’ learning achievement.

Classroom management done by teacher was successful as it reached high category in total average from all sub-components. There are three components analyzed from teacher activities, those are opening activities, centerpiece activities and closing activities. As conventional method of teaching, in the opening session, teacher did several activities like welcoming students, checking attendance, telling subject and objectives of lesson that would be taught, and also grouping students into four small group discussion (held only in the first meeting). After that, there is core activities in which teacher has to apply Knisley learning model with brainstorming method. This session was divided to four phases. First phase was concrete-reflective where teacher lead students to remember again what previous lesson. Teacher started by giving a story about custom home at certain area in South Sulawesi. Teacher made students thinking about the shape of its building. Then, teacher showed a photograph of Muttart conservatory, a creative buiding contained several kinds of plants from around the world. Its buiding is in Canada and its shape looks like a pyramid. From the photograph, students could identify the characteristics of rectangular pyramids which consists of a base, triangular faces, five vertices and eight edges. The second phase is concrete-active where teacher gave motivation to their students. The motivation drove students connecting concept of rectangular prism with triangular prism. Teacher also gave questions to trigger a discussion among teacher and students.

The third phase is abstract-reflective. Teacher in this session gave mathematics problem and students worksheets to their students. Teacher was a narasumber at that time and the content of subject was explained in this phase. Last phase is abstract-active where teacher controlled discussion and heard the students explanation. From the analysis of descriptive statistics in managing classroom, teacher succeed in all the phases. Furthermore, the closing activities done by teacher also showed a good report. Teacher did well in drawing conclusion, doing reflection, reminding students to learn the next topic related to the subject taught and closing the process of teaching.

Turning to the students activities, the average of students activities was good. Students in learning process were cooperative and they did brainstorming regularly in each stage of Knisley learning model. When students got stuck, they asked teacher or their friends. Interestingly, when students listened about the story of custom house, their responses were vary as they obviously have different types of rooftop. Some students felt confused, they could not imagine the shape of triangular prism because their rooftop shape is flat. However, majority of students were interactive in learning about integrating previous and new concept particularly in formulating the concept of triangular prism area based on the formula of rectangular prism area.

Based on the students responses, several information were obtained in terms of students state in learning. Those were: (1) students were interested in learning by using brainstorming method; (2) students felt that classroom state was interesting, (3) students were triggered by various ideas in solving mathematics problem; (4) students were more active in questioning; (5) worksheets were done from the result of discussion in group; (6) students could figure out the new concept from knowledge of previous concept; (7) students could compare the previous concept and the new concept; (8) students were more likely happy to solve problems which have sequential settlement; (9) students liked the way of teacher taught; (10) students felt a progress in learning.

Table 1. Students’ learning achievement score.

| Statistics    | Value |
|---------------|-------|
| Sample size   | 15    |
| Mean          | 30.40 80.13 |
|               | Pre-test 30.40  Post-test 80.13 Gain 0.72 |
In this section, we also describe a result of students' learning achievement statistically from comparing the score of pre-test and post-test as well as measuring normalization-gain values as seen in table 1. Based on table 1, there are differences between pre-test and post-test result. The students scores varied from 16 to 40 in the pre-test session while the score in post-test spread in a range between 72 and 84. By using similar instrument on the subject of pyramids and prisms, students learning results are different and showing an improvement. Thus, there is an influence of using Knisley learning model with brainstroming method.

Table 1. Cont.

|               | Median | Standard Deviation | Variance | Range | Minimum | Maximum |
|---------------|--------|--------------------|----------|-------|---------|---------|
|               | 30.00  | 6.05               | 36.68    | 24.00 | 16.00   | 40.00   |
|               | 80.00  | 3.42               | 11.69    | 12.00 | 72.00   | 84.00   |
|               | 0.71   | 0.04               | 0.002    | 0.16  | 0.62    | 0.78    |

Table 2. Students completeness in test taking.

| Students Learning Achievement | Standard Score | Percentage of Classical Completeness |
|------------------------------|----------------|-------------------------------------|
| Pre-test                     | 80             | 100%                                |
| Post-test                    |                | 73.33%                              |
|                              |                | 26.67%                              |

Table 2 describes the percentage of students completeness in pre-test and post-test. As shown in table 2, about a hundred percent of students failed in pre-test, while approximately 73.33% students succeed in post-test result. Moreover based on normalization-gain value, resulted in table 3, the influence of using Knisley learning model is able to be observed.

Table 3. Kolmogorov-Smirnov test.

| Statistics          | Df | Sig  |
|---------------------|----|------|
| Normalization-gain  | 27 | 0.20 |

Based on table 3, it can be seen that the p-value for the normalization-gain is 0.20 greater than $\alpha = 0.05$. Thus it can be concluded that the data of students normalization-gain is normally distributed. Turning to the hypothesis test, it was analyzed by using normalization-gain students and utilizing software SPSS with analysis of one sample t-test and significance level $0,05$. The results is shown in table 4 and table 5.

Table 4. One sample statistics.

| Normalization-gain | N    | Average | Standard Deviation |
|--------------------|------|---------|--------------------|
|                    | 27   | 0.7147  | 0.04422            |

Table 5. One sample test.

| Normalization-gain | Test Value = 0.3 |
|--------------------|------------------|
|                    | T    | Df   | Sig. (2-tailed) |
|                    | 36.320 | 14   | 0.000          |
According to table 4, the mean value of the normalization-gain is 0.7147, more than 0.3. This means students’ learning achievement increase to the high category. Meanwhile, table 5 shows that the value of the Sig (2-tailed) is 0.000, less than 0.05. It concludes that significantly, there is positive influence of using Knisley learning model with brainstorming method on students’ mathematics learning achievement. The results of the study shows that using Knisley learning model with brainstorming method has an influence on students’ mathematics learning achievement.

The Knisley learning model with brainstorming method is a mathematical learning model which have four stages of learning that concrete-reflective, concrete-active, abstract-reflective and abstract-active whereby in each of these phases brainstorming method is applied. Using the combination of Knisley learning model and brainstorming method took an extra time particularly in part of developing intensive communication between teacher and students. By experimenting the research, students were being trained to discipline, diligent, responsible, communicative, creative, democratic, have the respect and attention, as well as having a religious character.

At the first meeting, students were given pre-test on Pyramids and Prisms subject. Then, the next five meetings were done with experimenting Knisley learning model and brainstorming method. After that, students were given post-test to know students’ learning achievement after being taught with Knisley learning model and brainstorming method. Students learning achievement have elevated after seeing a comparison of the mean value of pre-test and post-test students. Students experienced an increase in the average score in solving different problems with the same level of indicators.

As for the qualitative descriptive analysis result, Knisley learning model with brainstorming method indeed gave an influence on students’ mathematics learning achievement because of several supported result analysis. First, the result of the data analysis on teacher activities in managing learning got high category with an average aspect 3.79. The data analysis of students activities by observation gained an average score 3.54 means peak the excellent category. Moreover, 88.91% of students in total gave a positive response to the Knisley learning model with brainstorming method. As a result, it is undoubtably that using Knisley learning model with brainstorming method has an influence on an improvement of students’ learning achievement as it is proven from both descriptive statistics analysis and inferential statistics analysis.

4. Conclusions
Overall, there is an influence of using Knisley learning model with brainstorming method on students’ mathematics learning achievement in eight grade on Pyramids and Prisms subject. Based on the research findings, the researchers suggest three main suggestions as follows: (1) Brainstorming should be more widely used in the process of learning mathematics in order to increase the closeness between teacher and students as well as among students, (2) The use of the Knisley learning model with brainstorming method in mathematics lesson requires a longer time. So it is recommended for teachers to practice using brainstorming before going to the classroom. (3) Advanced research is needed to examine the Knisley learning model with brainstorming method on other subjects so as to get a depth exploration.

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