The Effect Of Guided Discovery Learning Model Assisted By Open-Ended Student Worksheets Towards Mathematical Problem Solving Ability Reviewed Of Student’s Emotional Intelligence

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Abstract. This study aimed to find out whether students’ mathematics problem-solving ability taught using guided discovery learning model assisted by open-ended student worksheets is better than those using conventional learning. This research used a sequential mixed method that combined quantitative and qualitative research. Posttest only control design used for the quantitative data, while descriptive analysis used for the qualitative data. The population of the research was 349 students from the whole tenth grade in state high school of SMAN 5 Denpasar-Bali. In addition, cluster random sampling had done after testing the sample’s equivalent. The data obtained were analyzed using the t-test. The results of quantitative data indicate that: (1) students’ mathematics problem-solving ability taught using guided discovery learning model assisted by open-ended student worksheets is better than those using conventional learning, (2) in the group of higher emotional intelligence level and the group of lower emotional intelligence level, students’ mathematics problem-solving ability taught using guided discovery learning model assisted by open-ended student worksheets is better than those using conventional learning. The results of qualitative data indicate that guided discovery learning model assisted by open-ended student worksheets is able to give a positive contribution towards students’ mathematics problem-solving ability.

Keywords: Guided Discovery Learning, Emotional Intelligence, Problem-Solving Ability

1. Introduction

“Problem solving is one of the most crucial cognitive activities an individual may put into use in a variety of lifestyle-related contexts, particularly in respect to the rapid lifestyle, informational technology revolution and accelerated changes in all aspects of life” [1]. Kolovou [2] said that the main purpose of mathematics education is encourage students to solve problems independently. However, it cannot be denied that Indonesian students ability was apprehensive in solving mathematical problems. Based on the survey conducted in 2015, it was found that from 70 countries participation, the mathematical abilities of Indonesian students were ranked 63. It was far compared to Vietnam which was ranked 12th and Singapore got the first rank [3]. Kartasasmita [4] revealed that Singapore got the first rank in the PISA survey because Singapore’s mathematical teaching was conducted based on story problems and problem solving. Tambychik & Meerah [5] found that students faced difficulties in solving mathematical problems because of their inability to acquire many mathematical skills such as language skills, information skills, mastery of a number of facts, and lack
of cognitive abilities such as the ability to remember, memorize and feel influence problem solving efficiency. Regarding to the Indonesian government, teachers and all educational institutions need to plan better approaches and effective teaching methods. Teaching methods needed were allow students to discover their own patterns or mathematical structures through learning experiences that have been previously owned. The concept of learning was termed the discovery method.

Based on the conditions of education in Indonesia, guided discovery method was more effective invention and it possible to be applied. Yuliani & Saragih [6] said that guided discovery methods had a positive impact on the development of students' critical thinking, helped students develop intellectual discipline, aroused curiosity. Furthermore, guided discovery model was able to encourage students to think and analyze themselves. By doing so, they could find general principles based on the material or data provided by the teacher [5]. The teacher encouraged students to make presumption, intuition and experimentation in this method. Through presumption, intuition and experimentation, students were not expected to accept concept, principles or procedure that have been made in mathematical teaching and learning activities, but students were emphasized in the aspect of discovering mathematical concepts, principles or procedures which influenced the problem solving process. Guided discovery method was a method that requires teacher assistance, so it is possible to be applied in Indonesian students' conditions. Teacher assistance can be started by asking a few questions and by giving information briefly. Supporting alternatives that were considered to direct and guide students with guided discovery methods open-ended worksheet. Sudiara [7] states that open ended mathematical problems are formulated in such a way that they have several or even many correct solutions, and there are many ways to determine the solution. Furthermore, in the study of Inan & Erkus [8], it was explained that the mathematical worksheets prepared based on the multiple intelligences theory had increased student academic performance in general. According to these results it can be said that the preparation of mathematical worksheets in accordance with the intelligence fields of different students can positively influence student academic achievement.

Inan & Erkus [8] said that paying attention to the psychological condition of students especially student intelligence based on multiple intelligences theory is something that cannot be ignored. Based on the results of Awai & Ogori [9], intelligence plays an important role in students' academic achievement in mathematics is emotional intelligence. Emotional intelligence is understood as competence [10]. They define emotional intelligence competencies as the ability of individuals to realize, understand and use their own emotional that leads to effective performance. Salovey and Mayer [11] defined emotional intelligence as “The ability to monitor one’s own and others’ feelings, to discriminate among them, and to use this information to guide one’s thinking and action”. According to Goleman [12], “There are five components making up emotional intelligence; hence, emotional intelligence is a multidimensional construct. These five components are self-awareness, self-regulation, motivation, empathy, and social skills”.

Furthermore in Deniz [13] study found that emotional intelligence was found to be significantly correlated with problem solving. According to D’Zurilla and Goldfried [14], problems are defined as all situations that occur in everyday life that cause a person's adaptive and effective behavior. The situation can be interpreted as a problem that makes someone feel disturbed because it prevents them from reaching their next destination [15]. The problem solving function is to resolve the situation and control the emotional stress caused by it [16]. If a person can solve problems effectively, then he can reduce the psychological stress that arises and is also able to control his negative emotions [17].

Based on the above arguments, the researchers are interested in contributing to scientific contributions in the form of Mixed Research entitled “The Effect of Guided Discovery Learning Model Assisted by Open-Ended Student Worksheets towards Mathematical Problem Solving Ability reviewed of Student’s Emotional Intelligence”.

2. Methods and Procedures
2.1. Approach
This study used a mixed method with sequential explanatory design because it has two objectives, namely (1) to determine whether mathematical problem solving abilities of students who follow the guided discovery learning model assisted by Open-Ended student worksheets were better than students who follow conventional learning models, and (2) to find out how the guided discovery learning model assisted by Open-Ended student worksheets can improve students' mathematical problem solving abilities, and a combination of both questions [18]. The quantitative phase is an experiment that uses the post-test only control group design as described in Table 1.

Table 1. Design of quantitative phase

| Learning Model (A) | Guided Discovery Learning Model assisted by Open-Ended Student Worksheets (A₁) | Conventional Learning Model (A₂) |
|--------------------|---------------------------------------------------------------------------------|---------------------------------|
| Emotional Intelligence (B) |                                                                                   |                                 |
| High Emotional Intelligence (B₁) | A₁B₁                                                                  | A₂B₁                     |
| Low Emotional Intelligence (B₂)  | A₁B₂                                                                  | A₂B₂                     |

Meanwhile, the qualitative phase is a descriptive approach [19]. The purpose of the qualitative phase is to find out how the guided discovery learning model assisted by Open-Ended student worksheets can improve students' mathematical problem solving abilities. Further details about the qualitative phase were shown in Table 2.

Table 2. Qualitative phase

| Num. | Kind of Data                        | Instruments                        | Time Plot               |
|------|-------------------------------------|------------------------------------|-------------------------|
| 1    | Students responses                   | Interview sheet, student response questionnaire | At the end of research |
| 2    | Group discussion activities          | Observation sheet                  | On research process     |
| 3    | Students products                    | Notes                              | At the end of research |

2.2. Dataset
This study involved all grade ten students of SMAN 5 Denpasar in academic year 2017/2018. There were 349 students in grade ten. The quantitative research sampling was done by cluster random sampling technique. There were 24 students in the experimental class and 24 students in the control class. Next step followed by an equality test for the two classes. The equality test was carried out by t-test [20]. However, the first step was analyzed by the t-test. A prerequisite test was carried out in the data distribution normality test using the Kolmogorov-Smirnov test and the variance homogeneity test of the data with the Levene test [20]. Qualitative sampling was done by purposive sampling technique.

2.3. Instrument
Quantitative data was students' mathematical problem solving abilities collected by using a test consisting of 7 items in the description and emotional intelligence scores of students were collected using a questionnaire consisting of 44 items. The indicators of testing students' mathematical problem solving abilities were: (1) understanding the problem, (2) making problem solving plans, (3) solving problems, (4) checking, (5) generalization [21]. The indicators of emotional intelligence were: (1) recognizing one's own emotions, (2) managing emotions, (3) motivating yourself, (4) recognizing the emotions of others, (5) fostering relationships with others [12]. Instruments are considered valid if they pass two prerequisite tests, namely validity and reliability [22]. Before the instrument was used, content validity was tested by two mathematical education experts.

Trough the validity and reliability test, it was found that 7 items about students' mathematical problem solving ability were valid with Alpha Cronbach value of 0.56. The qualitative data were
collected in several steps such as (a) observation sheet was used to collect data on group discussion activities, (b) interview techniques and student response questionnaires were used to determine student responses to guided discovery learning models assisted by open-ended student worksheets, and (c) record students' answers to explain how the guided discovery learning model assisted by open-ended student worksheets could improve students' mathematical problem solving abilities. The validity of qualitative instruments was tested using source triangulation. It was done by interviewing math teachers and students who get the highest and lowest scores after the final exam.

2.4. Algorithms

2.4.1. Quantitative data. Quantitative data were analyzed using SPSS software. The following was the data used:
- A₁: Groups of students who take guided discovery learning were assisted by open-ended student worksheets.
- A₂: Groups of students who take conventional learning.
- B₁: Groups of students with a higher level of emotional intelligence.
- B₂: Groups of students with lower level of emotional intelligence.
- A₁B₁: Groups of students in the experimental class who have high emotional intelligence who participated in guided discovery learning were assisted by open-ended student worksheets.
- A₁B₂: Groups of students in the experimental class who had low emotional intelligence and participated in guided discovery learning were assisted by open-ended student worksheets.
- A₂B₁: Groups of students in the control class who have high emotional intelligence and follow conventional learning.
- A₂B₂: Groups of students in the control class who have low emotional intelligence and follow conventional learning.

Quantitative data analysis was performed using t-test. Before conducting the t-test, the data variables were tested, normality and homogeneity of variance. The normality test was analyzed using the Kolmogorov Smirnov technique. Homogeneity of variance was analyzed using Levene's test [20].

2.4.2. Qualitative data. Qualitative data analysis was carried out in three stages, namely data reduction, presentation, and verification [23]. The last stage was done using triangulation to ensure the credibility of the data [23]. The triangulation used was source triangulation. In the interpretation of quantitative data and qualitative data will be compared, matched to get a comprehensive picture and conclusion, so it becomes a unit.

3. Result and Discussion

Data obtained from the post-test results were presented in Table 3.

| Num. | Variable | A₁ | A₂ | A₁B₁ | A₁B₂ | A₂B₁ | A₂B₂ |
|------|----------|----|----|------|------|------|------|
| 1.   | N        | 24 | 24 | 12   | 12   | 12   | 12   |
| 2.   | Y        | 74.25 | 64.88 | 76.50 | 72.00 | 66.75 | 63.17 |
| 3.   | SD       | 9.00 | 12.00 | 8.12 | 9.62 | 13.17 | 10.21 |

As shown in Table 3, the average mathematical problem solving ability of students in the experimental group was higher than the control group, both for students who had a higher level of emotional intelligence and for students who had a lower level of emotional intelligence. The normality test was carried out at a 5% significance level and can be seen in Table 4.
One-Sample Kolmogorov-Smirnov Test

|       | A1   | A2   | A1B1 | A1B2 | A2B1 | A2B2 |
|-------|------|------|------|------|------|------|
| N     | 24   | 24   | 12   | 12   | 12   | 12   |
| Normal Parametersa | | | | | | |
| Mean  | 74.2500 | 64.8750 | 76.3333 | 72.1667 | 66.7500 | 63.1667 |
| Std. Deviation | 9.00362 | 1.19975E1 | 8.52092 | 9.35009 | 1.31711E1 | 1.02055E1 |
| Most Extreme Differences | | | | | | |
| Absolute | .162 | .130 | .208 | .202 | .175 | .199 |
| Positive | .116 | .101 | .155 | .172 | .147 | .168 |
| Negative | -.162 | -.130 | -.208 | -.202 | -.175 | -.199 |
| Kolmogorov-Smirnov Z | .792 | .639 | .721 | .701 | .608 | .690 |
| Asymp. Sig. (2-tailed) | .557 | .809 | .677 | .709 | .854 | .728 |

a. Test distribution is Normal.

The significance level used was 0.05. Based on table 4, all data show a greater value than the significant level. It can be concluded that all data on problem solving abilities for each case came from populations that were normally distributed. The results of the homogeneity of variance were summarized in Table 5 below.

Table 5. Summary of test result of the homogeneity variance

| Test of Homogeneity of Variances | A1 & A2 | A1B1 & A1B2 | A2B1 & A2B2 |
|----------------------------------|--------|-------------|-------------|
| Levene Statistic                 | 2.390  | 4.213       | .020        |
| df1                              | 1      | 1           | 1           |
| df2                              | 46     | 22          | 22          |
| Sig.                             | .129   | .052        | .888        |

The significance level used was 0.05. Based on table 5, all data showed a greater value than the significant level. So, it was concluded that the data group had a homogeneous variant. After all the prerequisite tests were carried out, then the final test was carried out by the t-test. The following were a summary of the results of the t-test.

Table 6. Summary of Testing Hypotheses 1, 2 and 3

| Independent Samples Test | Levene’s Test for Equality of Variances | t-test for Equality of Means |
|--------------------------|----------------------------------------|-----------------------------|
|                          | F | Sig. | T | Df | Sig.(2-tailed) | Mean Difference | Std. Error Difference |
| Hypothesis 1             | Equal variances | 2.390 | .129 | 3.062 | 46 | .004 | 9.37500 | 3.06190 |
| Hypothesis 2             | assumed | 4.213 | .052 | 2.116 | 22 | .046 | 9.58333 | 4.52846 |
| Hypothesis 3             | assumed | .020 | .888 | 2.252 | 22 | .035 | 9.00000 | 3.99558 |

Based on table 6, the first hypothesis was obtained by t-count of 3.062. The t-table value at the 0.05 significance level with 46 degrees of freedom was 1.679. When it compared, the t-count was more than the t table. So, it can be concluded that the mathematical problem solving abilities between students who followed the guided discovery learning model assisted by open-ended student worksheets were better than students who followed the conventional learning model. This is in line with research conducted by Makoolati et al. [24] found that increased learning at a cognitive level was higher, especially in students who took the guided discovery learning model compared to lecture.

In the second hypothesis, tcount is 2.116. The value of table at the 0.05 significance level with 22 degrees of freedom is 2.074. When it compared, the t-count was more than the t-table. So it can be concluded that in the group of students who have a higher level of emotional intelligence, mathematical problem solving abilities of students who used guided discovery learning assisted by open-ended student worksheets were better than students who used conventional learning. Other
findings Akanmu & Fajemidagba [25] also show that there are significant differences in the mathematical performance of students who are taught using guided discovery learning strategies for students who are taught using free discovery strategies.

Furthermore, in the third hypothesis, t-count is 2.252. The t-table value at the significance level of 0.05 with 22 degrees of freedom is 2.074. When it compared, the t-count was more than the t-table. So it can be concluded that in groups of students who have a low level of emotional intelligence, mathematical problem solving abilities of students who used guided discovery learning assisted by open-ended student worksheets were better than students who get conventional learning. Correspondingly, research by Yurniwati & Hanum [26] shows that guided discovery learning can improve the ability of observation, discussion and knowledge acquisition which can ultimately improve student learning outcomes.

Qualitative data in this study were obtained through observation, interviews, questionnaires and documentation of student work results. In the observation process obtained data about students' mathematical problem solving abilities. Judging from the data on the activity of mathematical problem solving abilities students in the experimental class obtained at each meeting experienced were increase. In general, The enchament activity of students' mathematical problem solving abilities for each meeting in the experimental class was classified in good category. In addition, there were also several important findings that support the activities of mathematical problem solving abilities of students in the experimental class. In this finding students could understand the presented problems, plan solutions, perform calculations and re-examine the results obtained correctly. This is in line with research conducted by Kurniawan et.al [27] which states that the ability of students given open-ended problems increases, one of which is the ability to solve mathematical problems.

Regarding to the interview, it was found that students felt happy with the method of learning carried out by the teacher. Students were more enthusiastic to solve problems given by the teacher. Students were happy and enjoy each stage of learning with a guided discovery learning model assisted by open-ended student worksheets. In the learning process, students were not only found concepts, but guided to be able to express their ideas in solving problems and are trained to think logically and critically as well. This is in line with research Yuliani & Saragih [6] said that the guided discovery method has a positive impact on the development of students' critical thinking and helps students develop intellectual discipline and arouse curiosity and the skills to find answers from that curiosity.

In addition, students argued that with the guided discovery learning model assisted by open-ended student worksheets required students to find their own concepts. Therefore the students were enthusiastic to prepare themselves at home. The student worksheets provided were helped students understand the concepts because problems on student worksheets required them to remember the basic concepts so that they can build up the old knowledge they have into new knowledge. This finding was also supported by Fatah et.al [28] in their research which showed that increasing the mathematical creative thinking ability of high school students and the self-esteem of students who are taught with an open-ended approach were better than those taught conventionally. The following was the work of students in both groups in learning activities about the ability to solve mathematical problems.
In Figure 1, it can be seen that students were able to solve mathematical problems from the questions given. Students were able to understand the problems presented, this can be seen from the answers of students who wrote things they know from the questions and what things were asked. They were also able to draw illustrations to make it easier for them to understand the problem. Students were able to plan problem solving correctly. They were able to remember concepts and relate them to the problems given. Then the calculation process can be done correctly and got the right results. This showed that students have been able to solve problems given correctly according to indicators of mathematical problem solving abilities.

Triangulation of qualitative research was done by the source triangulation. Data obtained from observations, interviews, and questionnaires were triangulated to obtain credible data. Some steps taken by researchers in this case were interviewing 10th grade math teachers in the experimental class and students with the highest and lowest post test scores in the experimental class. Teachers and students were asked for information and opinions about the results obtained by researchers. Based on the explanation above, learning experiences that require students to find ideas to solve problems make students develop thinking and are supported by group discussions that make them have to exchange opinions to plan problem solving. It also helps students remember the material and concepts in learning and understand the interrelationships. The explanation above illustrates that the guided discovery learning model assisted by open-ended student worksheets has a positive effect on students' mathematical problem solving abilities.

This finding is supported from the research of Korur et al. [29] clearly show that the use of the first combined method, which includes rebuttal texts with worksheets, eliminates students' misconceptions and increases their achievement. In addition, the research by Akanmu & Fajemidagba [25] shows that there is a significant difference in the performance of mathematics students who are taught using guided discovery learning strategies compared to students who are taught using unsupervised discovery strategies. This study shows the potential of guided discovery learning strategies in improving student performance. Furthermore, Deniz [13] study found that emotional intelligence was found to be significantly correlated with mathematical problem solving.
4. Conclusions
This study showed that students' ability in solving mathematical problems that followed by the guided discovery learning model assisted by open-ended student worksheets were better than students who followed conventional learning, in higher levels of emotional intelligence, the ability of math problems solver who follow the guided discovery learning model assisted by open-ended student worksheets were better than those who follow conventional learning, in the lower level of emotional intelligence, mathematical problem solving abilities of students who follow the guided discovery learning model assisted by open-ended student worksheets were better than those who follow conventional learning, and students had positive responses towards assisted guided discovery learning models open-ended student worksheets. Students became more enthusiastic in learning participation and they were easier to remember concepts because they could find out the concepts from the subject matter itself. Students were more enthusiastic in preparing themselves, it was showed the growing sense of independence and fair competition.

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