The Improvement of students’ metacognition skills on natural science education using guided inquiry models

K Huda1*, Suyanta1, Y A Priambodo1, D Ardwiyanti1, M Usman1 and D Alvionita2

1Natural Science Education, Universitas Negeri Yogyakarta, Sleman, Indonesia
2Natural Science Education, Universitas Negeri Surabaya, Surabaya, Indonesia

*E mail: khoirulhuda.2019@student.uny.ac.id

Abstract. This research aimed to find out the effectiveness of guided inquiry learning toward student metacognition skill, the level of metacognition skill, learning implementation and student response in science learning. The research was kind of pre-experimental research and using one pretest and postest group design. The population used student VII class of Junior High School 1 of Labang with sample on VII class. The data analysis technique used the Wilcoxon Non-Parametric test because the data were not normally distributed. The research instrument used a Metacognition Awareness Inventory (MAI) questionnaire. There was an influence of guided inquiry learning toward student metacognition skill by the signification level of MSI questionnaire was 0.006. Based on the level of significance of the data, it showed that learning using a guided inquiry model could improve students' metacognition skills. There are three types of distribution of metacognition skills. The level of metacognition skill analysis was obtained from MAI questionnaire after learning as follows: Planning Skill was very good level, Monitoring Skill very good level and Evaluation Skill good level. The implementation of guided inquiry learning has a very high category. Student responses to the guided inquiry model obtained an average indicates a very interesting category.

1. Introduction

Education has an important role in human life. Education can help humans develop themselves, so they are able to face problems that occur in everyday life [1]. Every educational process involves the role of two parties between students and teachers. Teachers need certain skills to manage the teaching and learning process properly in accordance with the material and learning objectives and refer to the applicable curriculum [2]. In the era of globalization, science is a very important science to study, because science is the science that plays the most important role in the advancement of science and technology. Natural Science is a branch of science that has an important role in the development of science and technology which encourages the creation of increasingly qualified human resources [3]. One of the goals in science learning is that it can arouse curiosity to encourage students to carry out a scientific investigation process to get answers to questions developed based on the results of analysis of facts (doing science) [2]. A science learning model that can guide students to conduct learning directly through practicum and observation is needed by students to know the science concept well. Science learning is not only mastery of a collection of knowledge in the form of facts, concepts, or principles, but also a process of discovery [4, 5].

Most of the teachers use the lecture, question and answer, or assignment learning methods in the science learning process. This opinion is supported by the results of observations at SMPN 1 Labang...
that the use of the lecture method is also carried out by teachers in the learning process at school. The lecture method is less effective and efficient because it is less able to encourage students to take an active role in the learning process [6]. Based on these problems, it is necessary to use a learning model that can be a solution to problems in science learning. One learning model that involves student activity is a guided inquiry model [7, 8]. The use of the guided inquiry model aims to enable students to know inquiry skills and metacognition, especially in natural science lessons [2]. Guided inquiry learning model involves students actively in the learning process. The use of guided inquiry learning models is expected to be able to determine the level of students' metacognition skills. Metacognition is knowledge about self-learning or knowledge of how to learn [9, 10]. Metacognition skills are methods for learning, analyzing, or solving problems. The application of metacognition skills is the ability to think about the material that has been studied, then students independently conclude whether students have understood the material or not [11,12]. The process of developing metacognition skills in science learning is able to make a strong and comprehensive understanding of problems in the scope of science with logical reasons [13]. The condition of low metacognition skills occurs at SMPN 1 Labang because many students have difficulty understanding and remembering subject matter especially material about natural science.

Based on this description, a learning model is needed that can determine the level of students' metacognition skills. The guided inquiry model is expected to be an effective learning model to determine the level of students' metacognition. The purpose of this study was to determine the improvement of students' metacognition skills, levels of metacognition skills, learning implementation and student responses to guided inquiry learning.

2. Research method

The research design used was Pre-Experimental Designs with One Group Pretest and Postest Design techniques. This technique was used to determine the results of the treatment (treatment) in one experimental class. The form of treatment in the experimental class used guided inquiry learning. The research design using the One-Group Pretest-Posttest Design [14]. Research took approximately one month. The research was carried out in three stages, namely the planning, implementation, and preparation stages. The place used in the implementation of the research was SMPN 1 Labang, Labang District, Bangkalan Regency, and East Java Province. The study population was all students of class VII SMPN 1 Labang. The sample selection technique used was non-probability sampling with purposive sampling type. The research sample to be used is class VII H with a total of 17 students, because in that class the students are more active and disciplined.

The hypothesis in this study was as follows:

- (H₀:µ₁ = µ₂) Guided inquiry learning has no effect on metacognition skills of students of SMPN 1 Labang in science subjects
- (H₁:µ₁ ≠ µ₂) Guided inquiry learning affects the metacognition skills of students of SMPN 1 Labang in science subjects

The research instrument used in the study was the learning implementation instrument and the data collection instrument. The learning implementation instrument consists of the syllabus, lesson plans, and worksheets. The data collection instruments consisted of student response questionnaires, implementation sheets and Metacognition Awareness Inventory (MAI) questionnaires.

3. Results and Discussion

3.1. Validity test

The stage before data collection, a validation test was carried out to determine the appropriateness and reliability of the research instruments to be used. The validation test is carried out by three experts according to their fields with Aiken's following formula [15]:

\[ V = \frac{\sum s}{n(c-1)} \]  

(1)
\( s = r - l_0 \) \hspace{1cm} (2)

The results of the Aiken’s V validation show that the results of the MAI validation are 0.86 so that it is included in the valid category [15].

3.2. MAI questionnaires test

The MAI questionnaire analysis was used to determine the level of students' metacognition skills [16]. The MAI questionnaire is a questionnaire instrument created by researchers based on the formulation of a metacognition inventory to determine the level of students' metacognition skills. The equation used to determine the value of metacognition skills using the MAI questionnaire is using standard equation for searching the average of value [17]. The MAI questionnaire data was obtained through distributing questionnaires to class VII-H students of SMPN 1 Labang after the learning process. Students are asked to provide responses to the implementation of guided inquiry learning that has been carried out by the teacher on environmental pollution material. The data from the MAI questionnaire processing results are then categorized based on the aspects of metacognition skills consisting of planning skills, monitoring skills and evaluation skills. The results of the distribution of metacognition skills are shown as follows:

**Table 1.** Aspects of metacognition skills.

| No | Aspects of Metacognition Skills | Percentase (%) |
|----|--------------------------------|----------------|
|    |                                | MAI Pretest    | MAI Posttest  |
| 1. | Planning Skill                 | 73.90          | 83.20         |
| 2. | Monitoring Skill               | 65.50          | 86.60         |
| 3. | Evaluation Skill               | 41.20          | 71.60         |
|    | Average                        | 60.29          | 80.88         |

Table 1 shows the results of the study using the MAI questionnaire which consists of the Planning Skill aspect. Skill Monitoring and Skill Evaluation also experienced a significant increase. High metacognition skills can improve student learning outcomes and understanding. This is in line with the function of metacognition skills proposed by Danial, explaining that metacognition skills are skills that lead to student awareness of how students learn, the ability to assess the difficulty of a problem, the ability to observe self-understanding, the ability to use various information to achieve goals, and ability to assess learning progress on their own [9]. The data from the processing of the metacognition questionnaire were then analyzed using the normality test, homogeneity, and hypothesis testing. The normality test is carried out to determine whether the data is normally distributed or not. The following are the results of the normality test for the MAI questionnaire that has been processed using the SPSS 20 application.

**Table 2.** The result of normality test.

| NAME        | Kolmogorov-Smirnov\(^a\) | Statistic | df | Sig. |
|-------------|---------------------------|-----------|----|------|
| Value       | Pre MAI                   | 0.125     | 17 | 0.200|
|             | Pos MAI                   | 0.229     | 17 | 0.019|

Based on the Table 2, it is known that the data is not normally distributed, because the significance is less than 0.05 [17]. Based on the test results, the hypothesis test is to use the Wilcoxon Non-Parametric test. The next test is the homogeneity test. The homogeneity test is used to determine whether the two samples used have the same variance or not. Based on the results of the homogeneity test for the MAI, it produces the following data:
Table 3. The result of homogeneity test.

| Value                          | Levene Statistic | df₁ | df₂ | Sig.  |
|-------------------------------|------------------|-----|-----|-------|
| Based on Mean                 | 3.666            | 1   | 32  | 0.064 |
| Based on Median               | 3.130            | 1   | 32  | 0.086 |
| Based on Median and with adjusted df | 3.130          | 1   | 31.492 | 0.087 |
| Based on trimmed mean         | 3.699            | 1   | 32  | 0.063 |

Based on the Table 3, the significance of the MAI questionnaire is 0.064 so that the data is declared homogeneous because the significance is ≥ 0.05 [18]. The results of the normality and homogeneity tests were continued to the hypothesis testing. As for knowing whether or not the effect of guided inquiry learning on students' metacognition skills in science learning at SMPN 1 Labang, it is necessary to test the MAI questionnaire hypothesis. The explanation of the hypothesis test results is presented in Table 4.

Table 4. The result of hypothesis testing.

| Postest – Pretest | Z          | Asymp. Sig. (2-tailed) |
|-------------------|------------|-----------------------|
|                   | -3.202b    | 0.001                 |

Based on the Table 4, it is known that the significance of the Wilcoxon Non-Parametric Test has a significance result of 0.001. Based on the significance in Table 4, it is known that 0.001 is less than 0.05, so H0 is rejected and H1 is accepted. Drawing conclusions based on this significance value is that there is an effect of guided inquiry learning on students' metacognition skills. The results of the MAI questionnaire showed that there was an increase between the pretest and posttest proving that guided inquiry learning was able to develop students' level of metacognition skills, even though students had different levels of metacognition skill development [19]. This is in accordance with Vygotsky's Scaffolding theory. Vygotsky put forward the scaffolding theory as follows: students have different individual development limits [20]. Each child will go through the learning process with the help of friends and teachers so that they can master it by themselves, as in the learning used in research is guided inquiry learning [1,16]. The learning process using guided inquiry learning requires teacher assistance to guide the student learning process [4].

The use of guided inquiry learning has been proven to be able to improve students' metacognition skills, because the learning seeks to guide students according to the syntax of initiation, selection, exploration, formulation, collection and presentation [2]. In addition, inquiry learning is able to prepare situations for students to carry out their own experimental activities and seek answers to their own questions so as to improve their learning outcomes efficiently [16,17,18]. The improvement of the results of students' metacognition skills using guided inquiry learning in accordance with the theory of Self-Regulated Learning [6,19,20], when the level of student metacognition is high, students can plan, organize, organize, control, and evaluate goals. In addition, one of the reasons for the success of improving students' metacognition skills using the guided inquiry model is due to the conformity with the guided inquiry syntax which consists of the stages of initiation, selection, exploration, formulation, collection and presentation [2,13,26]. In addition, increasing metacognition skills will also be able to increase the level of metacognition skills as well as being able to improve student learning outcomes [16].

3.3. The results of the implementation of learning
Learning implementation observation tests are used to determine teacher activities. The results of observations of the implementation of learning can be seen in the Table 5. Based on the table, it is known that the average value of learning implementation is 91.7%. The value that has been generated belongs to the very high category.
### Table 5. The result of implementation of learning.

| No | Learning activities | Observer 1 (%) | Observer 2 (%) | Average (%) | Category  |
|----|---------------------|----------------|----------------|-------------|-----------|
| 1  | Meeting 1           | 83.3           | 83.3           | 83.3        | Very high |
| 2  | Meeting 2           | 91.7           | 91.7           | 91.7        | Very high |
| 3  | Meeting 3           | 100            | 100            | 100         | Very high |
|    | Average             |                |                | 91.7        | Very high |

### 3.4. The result of student response questionnaire

Student response data were obtained through distributing questionnaires to class VII-H students of SMPN 1 Labang after the learning process was completed for three meetings. Students provide responses to the implementation of guided inquiry learning carried out by the teacher on environmental pollution material. The data that has been obtained are then analysed using the Likert scale assessment. The following is the result of the analysis of the student response questionnaire which the resume is displayed in the Table 6.

### Table 6. The resume of student response questionnaire.

| No | Aspects of student response | Score (%) |
|----|-----------------------------|-----------|
| 1  | Students' attitudes towards guided inquiry learning | 82.59     |
| 2  | Students' understanding of the subject matter when using guided inquiry | 84.94     |
|    | Average                      | 83.76     |

The average student response questionnaire in participating in guided inquiry learning shows that students respond with a high average score. The average score of the student response questionnaire which shows an average score of 83.2% falls into the "Very Interesting" category [14]. Students respond very well because students get treatment with this type of guided inquiry learning.

### 4. Conclusion

Guided inquiry learning is effective for knowing the metacognition skills of students as proven by the Wilcoxon test with the MAI questionnaire signification of 0.006 which indicates that guided inquiry learning has a positive effect on students' metacognition skills. The level of metacognition skills is known as follows: Planning Skill is very good level, Monitoring Skill is very good level and Evaluation Skill is good level. The implementation of learning using the guided inquiry model produces an average value indicated with a very high category. The results of the student response questionnaire showed an average indicated with the very interesting category. Based on the aspects of students' attitudes towards guided inquiry learning.

### References

[1] Chakraborty A, Singh M P and Roy M 2018 *Int. J. Progress. Educ.* **14** 122–9
[2] Sukma, Komarullah L and Syam M 2016 *Saintifika* **18** 59–63
[3] Iin N I, Y and Sugianto B 2012 *Unesa J. Chem. Educ.* **1** 78–83
[4] Yunanti E 2016 *BIOEDUKASI (Jurnal Pendidik. Biol.*) 7* 81–9
[5] Yaumi, Wisanti and Admoko S 2017 *E-Journal Pensa* **5** 38–45
[6] Nindiasari H, Kusumah Y S, Sumarmo U and Sabandar J 2014 *Edusentris* **1** 80
[7] Chiappetta E L and Koballa T R 2010 Science Instruction in The Middle and Secondary Schools Developing Fundamental Knowledge and Skills (USA: Pearson Inc.)
[8] Dwidjantoro M I S, Rosana D and Widodo E 2013 1–6
[9] Danial M 2010 Chemica 11 1–10
[10] Biasutti M and Frate S 2018 Educ. Technol. Res. Dev. 66 1321–38
[11] Zimmerman B J 2010 Educ. Psychol. 25 3–17
[12] Kusumaningtyias A, Zubaidah S and Indriwati S E 2013 DISERTASI dan TESIS Progr. Pascasarj. UM 33–47
[13] Zimmerman B J 1995 Educ. Psychol. 30 217–21
[14] Sugiyono 2014 Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, dan R&D) (Bandung: Alfabet)
[15] Azwar S 2015 Reliabilitas dan Validitas (Yogyakarta: Pustaka Pelajar)
[16] Lajoie S P 2008 Educ. Psychol. Rev. 20 469–75
[17] Sugiyono 2014 Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D (Bandung: Alfabet)
[18] Prastowo A 2012 Metode Penelitian Kualitatif: dalam Prespektif Rancangan Penelitian (Yogyakarta: Ar- Ruzz Media)
[19] Haeruddin, Prasetyo Z K, Supahar, Sesa E and Lembah G 2020 Eur. J. Educ. Res. 9 215–25
[20] Purwanto, Lilawati W H R 2013 Prosiding Pertemuan Ilmiah XXVIII HFI.
[21] Moutinho S, Torres J, Fernandes I and Vasconcelos C 2015 Proc. - Soc. Behav. Sci. 191 1871–5
[22] Koyunlu Ünlü Z and Dökme İ 2019 Int. J. Assess. Tools Educ. 6 125–37
[23] Schraw G, Crippen K J and Hartley K 2006 Res. Sci. Educ. 36 111–39
[24] Cera R, Mancini M and Antonietti A 2014 ECPS - Educ. Cult. Psychol. Stud. 115–41
[25] Kaplan A 2008 Educ. Psychol. Rev. 20 477–84
[26] Alexander P A 2008 Educ. Psychol. Rev. 20 369–72

Acknowledgments
The Author would like to thank LPDP RI (Lembaga Pengelola Dana Pendidikan Republik Indonesia) for providing tuition fees with contract number KET-463/LPDP.3/2019 and ID LPDP number 20193110814101.