Beyond effective teaching: Enhancing students’ metacognitive skill through guided inquiry

To cite this article: Adnan and Arsad Bahri 2018 J. Phys.: Conf. Ser. 954 012022

View the article online for updates and enhancements.
Beyond effective teaching: Enhancing students’ metacognitive skill through guided inquiry

Adnan & Arsad Bahri*
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Indonesia.
E-mail: arsad.bahri@unm.ac.id

Abstract. This research was quasi experimental with pretest posttest non-equivalent control group design. This research aimed to compare metacognitive skill of students between taught by guided inquiry and traditional teaching. Sample of this research was the students at even semester at the first year, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Indonesia. The data of students’ metacognitive skill was measured by essay test. The data was analyzed by inferential statistic of ANCOVA test. The result of research showed that there was the effect of teaching model towards metacognitive skill of students. Students were taught by guided inquiry had higher metacognitive skill than taught by traditional teaching. The lecturer can use the guided inquiry model in others courses with considering the course materials and also student characteristics.

Keywords: Guided inquiry, learning model, metacognitive skill, biology teaching, effective teaching

1. Introduction

One of many factors which determine the quality of education is successful education in university. Strategy, model, or lecturers pattern are important aspects in education process beside materials to gain the achievement. Learning experiences are gained as long as the lectures ran, really determine on ability and quality from lecturers. So, the lecturers have responsibility to create learning experiences of their students by the implementation of appropriate model or learning strategy.

Science learning is expected to enhance students on how to fulfill 21 centuries skill and one of the skills is learning skill and inovation. Integrated science included Biology can be implemented by scientific inquiry to grow up the thinking skills, and could change from passive learning to active learning. So, the process of Animal Structure course as a part of Biology learning in university, emphasize on learning experiences directly through implementation and development of skill of thinking included metacognitive.

The result of observation showed that empowerment of student metacognitive skill was still unsufficient. Metacognitive skill should be trained so student so they could perform their affection and skills in terms of manage their learning [1]. Teaching method which implemented, less of giving chances and learning experiences to construct the concepts which is learned through thinking process. Metacognitive skill needs a metacognitive strategy to be taught. Metacognitive strategy can be described as routine activity, which represented managing the mental process, as a part of complexity process and applied of getting goals [2]. Metacognitive related also with thinking level, cognitive style, and learning style of students. Thinking level, cognitive style, and learning style of students have an influence on metacognitive of students [3]-[6].

Metacognitive skill was very important to be applied because student who knew the effective strategy to learn, tend to have good learning achievement [7]. Metacognition was the strong variable...
to affect academic successful [8][9]. The research showed that there was positive contribution of metacognitive skill towards learning outcomes of students [10][11].

Based on that problem, need to apply the learning model that can empower the metacognitive skills of students in learning process. One of learning model based on constructivistic for instance guided inquiry. Implementation of guided inquiry trained the students to do many activities, for example observation, investigation, experiments, and compare one experiments with other experiments, ask a question, and find answer of self question. Guided inquiry learning aims to give chance for students to build their intelectual behaviour and motivated to give ideas when teacher give a problem.

2. Methods

This research was a quasy experimental designed to compare effects of guided inquiry and traditional teaching towards metacognitive skill of students in the first year, even semester in Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Indonesia. Research design was Pretest-Posttest Nonequivalent Control Group Design [12] as showed in Table 1.

| Table 1. Quasy experimental design research  |
|---------------------------------------------|
| Pretest Group Posttest                      |
| T₁  X₁  T₂  |
| T₃  X₂  T₄  |

T₁ & T₃: Pretest
T₂ & T₄: Posttest
X₁: Guided Inquiry
X₂: Traditional Teaching

The sample of research randomly choosed, consists of 125 students in 4 classes which take Animal Structure course. Each teaching model would represent by 2 classe. The sample of research in each group consists of students with equal academic ability, based on grouping test. Before giving a treatment, 2 groups of students with classes given essay test which developed by researcher to measure metacognitive skill of students. Instrument was validated before implemetation. During 2 months, 4 classes taught with different learning model. Then, they were given final test. Data analyzed by statistical inferencial as ANCOVA test using SPSS for windows 22.

3. Results and Discussion

The results of normality and homogenity test shows that the data were normally distributed and homogeny. Normality test showed p value of pretest > 0.05 (p = 0.302) and p value for posttest = 0.312. Homogenity test showed p value > 0.05, pretest p value = 0.117 and posttest p value = 0.428.

Hipothesys test with ANCOVA test showed that the learning model give affect towards metacognitive skill of students (p < sig. 0.05). The summary of ANCOVA test of metacognitive skill of student showed on Table 2.

| Tabel 2. Summary of ANCOVA test of metacognitive skill of student. |
|---------------------------------------------------------------|
| Type III Sum of Squares df Mean Square F Sig.                |
| Corrected Model 8765.919* 2 4382.959 34.104 <0.001          |
| Intercept 9207.351 1 9207.351 71.643 <0.001                |
| XmetacogSkill 7111.269 1 7111.269 55.334 <0.001            |
| Model 1556.508 1 1556.508 12.111 0.001                     |
| Error 15678.993 122 128.516                                 |
The result of research showed that metacognitive skill of students successfully improved through guided inquiry model higher than conventional teaching. It is stated that result gained by students with this inquiry model could enhance their metacognitive skill. Guided inquiry is one of learning model whereas lecturer provided materials, subject, and problem for investigation [13]. Student plan their procedural to overcome the problem. Steps in inquiry learning model were observation to found problem, create core of problem, make a hypothesis, plan the problem solving, do the experiments, make observation and collect data, data analysis, and make inferential [14]. Those activity will train skill of student on how plan, manage, and evaluate their learning. Result of this research in line with reference [15] found that guided inquiry affect on metacognitive skill of students.

Metacognitive skills refers to three essential skill were planning skills, monitoring skills, and evaluating skills [16]. Steps in guided inquiry learning model had reflected metacognitive skill aspects. Founding problem phase, creating core of problem, make a hypothesis, and plan the problem solving (design experiments) in guided inquiry are planning aspects in metacognitive skills. Doing experiments phase, observation and data collection, and data analysis in guided inquiry learning are monitoring aspects in metacognitive skill. Making inferential phase in inquiry are evaluation aspects in metacognitive skill. This shows that guided inquiry have integrated with metacognitive strategy and can be used to empower metacognitive skill of student.

At the planning phase, the students explore their thoughts to find out what previous knowledge they have, that will help them to complete the task, the students know what needs to be done first in order to help in completing the task, and the students plans the time management in planning the task [17]. When the students working on a sheet of metacognitive skills, students have used their prior knowledge to help in completing task. The prior knowledge is the knowledge, which students have gained in the material they have learned. Furthermore, in doing the problem of metacognitive skills, students know and formulate what things need to be done first in completing the task. Students have also arranged their time in working out the metacognitive skills question that can be seen from the timeliness of students in collecting answers about metacognitive skills.

Students also perform planning skills in completing tasks. As long as the students are planning (planning skills), students will ask themselves what information should be known based on the questions provided and the time needed to solve the problem [18]. If the student can know exactly the information provided in the question, then the student can determine what strategy is used to solve the problem.

In monitoring activity (monitoring skills), students take action to solve the problems, remember important information, and check whether it is on the right track. As long as the student performs the monitoring, the student will ask himself or herself what related information is important to remember and what to do to solve the problem. Furthermore, based on the information known in the question, the student can determine the further steps that must be done so that the problem can be solved.

In evaluating activity (evaluation skills), the student will check the conformity between what is known and the steps used to solve the problem. Students can ask themselves how well they have solved the problem. It is indicated by the expression of the students’ reasons in determining the steps to solve the problem based on prior knowledge.

In Biology learning, guided inquiry is a very closely related to the laboratory activities. The inquiry presents students’ involvement in laboratory using their own thinking process. These learning phases include focusing on students and explaining inquiry processes, presenting problems or phenomena, helping students formulate hypotheses to explain that problems or phenomena, encouraging students to collect data, formulate explanations, reflect problem situations and thought processes [13]. These activities require students to find their own concepts in solving problems related to animal structure.
materials. It can empower students' metacognitive skills in thinking how they learn and understand the course material.

Laboratory activities require the existence of an active role of students to prove the hypothesis and analyze the results of practice in accordance with existing theories so that students can build their own understanding. It was stated that a learning model was required to help students involve in the lab activity [19]. Through guided inquiry, lecturers help students to investigate the problem and discover and construct the concept by themselves. It can build metacognitive skills of students. In the process of discovery of the concept, students are encouraged to conduct monitoring of each stage carried out in guided inquiry. Because the inquiry stages of the students occur over and over again, the self-learning monitoring process also occurs more than once. Such conditions can stimulate the students' metacognition skills empowerment. It can cause the application of guided inquiry can improve students' metacognitive skills.

In line with this result of research, reference [20] concluded that the application of guided inquiry in chemistry learning enhanced metacognitive skills, particularly the planning skills. Associated with metacognitive awareness as measured by MAI (metacognitive awareness inventory), planning skills show the most dominant performance. To further improve students' thinking skills, metacognitive skills need to be trained periodically on subsequent lessons.

Similarly, research found that the metacognitive skills of students experience improvement in each face to face when taught by guided inquiry [19]. Research found that metacognitive skills have a positive relationship to learning outcomes. It means that the improvement of students' metacognitive skills will followed by the improvement of cognitive learning outcomes [10][21]. Its found that after implementation of guided inquiry, there was an improvement from pretest score to posttest of self-regulation skills, especially aspects of monitoring, followed by evaluation and planning [22].

Guided inquiry makes students construct concepts and discuss in concept discovery so that students gain more meaningful knowledge in the long term. Based on the results of the research, it suggested that metacognitive skills should be trained continuously so that students are accustomed to control the students' thinking, including self-planning, self-monitoring, and self-evaluation. Thus the students will be trained to become self-regulated learners. This is in line with arguments that metacognitive skills were useful for making the students become self-regulated learners, encouraging them to become their own managers as well as assessing their own thoughts and learning [23]. Therefore, lecturers need to apply learning strategies that not only emphasize cognitive development but more metacognitive aspects are also important to be empowered during learning process.

4. Conclusion

Based on the results of research and discussion, it can be concluded that there was the effect of implementation of guided inquiry toward students’ metacognitive skills. The implementation of guided inquiry proved able to empower students' metacognitive skills higher than traditional learning. Lecturers can apply guided inquiry in other courses by considering the course material and students’ characteristics.

References
[1] Corebima A D 2009 Proc. National Seminar of Biology Education (Indonesia: Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar)
[2] Hacker D J 1998 Definitions and Empirical Foundations. In Hacker D J, Dunlosky, and Graesser A (Eds.) Metacognition in Educational Theory and Practice (Mahwah, NJ: Erlbaum) p 1–23
[3] Rahman, A. & Ahmar, A.S. 2016. Int. J. of Env. & Sci. Edu., 11(14). 7278-7285.
[4] Mulbar, U., Rahman, A., & Ahmar, A. S. 2017. World Transc. on Eng. and Tech. Edu., 15(1), 68-73. doi:10.26858/wtetev15i1y2017p6873
[5] Rahman, A., Ahmar, A.S, & Rusli. 2016. World Transc. on Eng. and Tech. Edu., 14(3), 425-430.
[6] Rahman, A., & Ahmar, A. S. 2017. Relationship between learning styles and learning achievement in mathematics based on genders. World Transc. on Eng. and Tech. Edu., 15(1), 74-77. doi:10.26858/wtetev15i1y2017p7477

[7] Dunning D, Johnson K, Ehrlinger J and Kruger J 2003 Current Directions in Psychological Science 12 88-87

[8] Magno C 2010 Learning, memory and cognition 36 255-262

[9] Kruger J and Dunning D 1999 J. Pers. Soc. Psychol. 77 1121-1134

[10] Bahri A and Corebima A D 2015 J. of Baltic Sci. Edu. 14 487-500

[11] Bahri A 2016 Proc. Int. Conf. on Mathematics, Science, Technology, Education, and their Applications (Indonesia: Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar) p 156-162

[12] Borg W L and Gall M D 1983 Educational Research, An Introduction. 4th Edition (New York and London: Longman Inc.)

[13] Arends R I 2009 Learning to Teach (New York: Mc Graw Hill)

[14] Suryanti 2008 Model-Model Pembelajaran Inovatif (Surabaya, Indonesia: Universitas Negeri Surabaya Press)

[15] Irawati F, Kurniawan H C, Primandiri P R and Santoso A M 2015 Proc. National Seminar of Biologi Education XII (Indonesia: Faculty of Teacher Training and Educational Science, Universitas Negeri Sebelas Maret, Solo) p 483-487

[16] Woolfolk A 2009. Educational Psychology: Active Learning Edition. 10th Edition. Part Two. (Boston: Pearson Education, Inc.)

[17] North Central Regional Educational Laboratory 1995 Metacognition. (online) http://www.ncrel.org/sdrs/areas/issues/students/learning/lr1metn.htm.

[18] The Teaching Excellence in Adult Literacy 2012 Metacognitive Processes (American Institutes for Research)

[19] Mu’minin S K F and Azizah U 2014 UNESA J. of Chemical Education 3 67-74

[20] Aprilia F and Sugiarito B 2013 UNESA J. of Chemical Education 2 36-41

[21] Kristiani N, Susilo H, Roham F and Aloysius D C 2015 Int. J. of Educational Policy Research and Review 2 113-120

[22] Hidayah R 2014 Proc. of Int. Conf. on Research, Implementation and Education of Mathematics and Sciences (Indonesia: Universitas Negeri Yogyakarta) p 91-96

[23] Peters M 2000 J. of Nursing Education 39 166-170

Acknowledgment
This project was funded by the Universitas Negeri Makassar, Indonesia (Contract of PNBP Research No. 256/UN36.9/PL/2017).