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Original Research Article

Metacognition skill development in genetic lecture at the State University of Malang Indonesia

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This study was conducted to uncover student metacognition skill increase in genetic course II at odd semester 2013/2014 by implementing RQA and PjBL learning model in the Biology Department of the State University of Malang, Indonesia. The study was conducted in pre-experimental design from late August to early December 2013, involving 24 students programming the genetic course II. Student metacognition skills were measured from questioning based on summarising result and its related answers. The assignment results were scored based on the specific rubrics. Initial and final metacognition skill difference was analyzed using student's paired comparison test. The value of initial metacognition skills and those of the final one were very different. Student metacognition skills have increased very significantly from the initial measurement. Implementing the RQA and PjBL learning models was successful in increasing students' metacognition skills.

Key words: Answering, genetic lecture, metacognition skills, questioning, summarising.

INTRODUCTION

In Biology discipline, genetics is a basic course as it is the base of all biological sciences. Theodosius Dobzhansky stated that "*nothing in Biology is understandable except in the light of genetics*" (Ayala and Kiger, 1984). Snustad and Simmons (2012) also stated that genetics was a relatively young science, but has grown in scope and significance so much so that it now has a prominent and, some would say, commanding position in biology. Therefore, it is easy to understand, that the knowledge of genetics will greatly enhance the understanding and development of other biological sciences.

In the Department of Biology, State University of Malang (UM), genetic lecture is carried out in two courses; Genetics I and II. The structure of the genetic course in the Biology Department practices the conceptual approach and not a historical approach as commonly found in genetic courses at various other universities. By such approach, it is believed that the students actually will have the opportunity to learn this science based on it's logical structure.

The development of genetic lectures in the Biology Department of the State University of Malang started in 1987 – until today. Since 1987, genetic teaching has been conducted in theory as well as in practice lecture. The development of the theory lecture includes among others, especially the implementation of learning strategies such as reading, questioning and answering (RQA) and project based learning (PjBL) as well as learning methods such as questioning, assigning, and sharing supported by other efforts such as writing handouts, modules, dictates and books; concept maps learning have also been implemented (Corebima, 2010).

The RQA learning model was designed and implemented at the genetic lecture in the Biology Department, State University of Malang, Indonesia by AD Corebima. The syntax of RQA learning model is presented as follows (Corebima and Bahri, 2011):

1. The students are assigned to write the learning material found at certain reference that will be taught on the following classes (e.g, in the next weeks). The

references that may be chosen, such as a text book, handout or any reference downloaded from the internet.

2. Based on the text that has been read, the students are further assigned to write a summary related to the material read.

3. Based on the text read and summarized, the students are assigned to write some related questions especially high-order questions.

4. The students are assigned to write down their answers related to those questions.

5. The students are assigned to present their work carried out (summary, questions and answers), followed by class discussion.

6. Lecturer conducts clarification, repair and improvement related to all the learning materials presented and discussed (assignment results in the form of a summary and questions and answers are collected to be assessed).

A quasi-experimental research was carried out to uncover the influence of the RQA learning model on student metacognition skills in the Department of Biology, State University of Makassar (Bahri, 2010). The results of the study showed that the metacognition skills of students who underwent lectures implementing RQA models increased by 22.77% compared to the skills in the control group (conventional); metacognition skills of low academic students also increased by 57.4% compared to the control group.

Project based learning was carried out in the practice lecture conducted as a research project where it's procedure is pursued by students facilitated by the assistant. The syntax of project based learning applied to the practical lecture of genetics course in the Department of Biology, State University of Malang is presented in Figure 1.

Another effort of practical lecture development is practice report writing (like a simple research report) characterized by invention and then the report is presented at a seminar session. Many efforts related to genetic lecture development since 1987 are in accordance with many philosophies, approaches and models or strategies. One example is that the practice lecture developed meets many characteristics of constructivist philosophy. The theory lecture that applies the RQA learning model also meets the characteristics of constructivism philosophy.

Giambatista Vico (1710) (first constructivist philosopher) said that "one only knows something if one can explain it" (Hanley, 1994). Similarly, Immanuel Kant argued that "human beings are not passive recipients of information; learners actively take knowledge, connect it to previously assimilated knowledge and make it theirs by constructing their own interpretation"(Hanley, 1994). Furthermore it is said that "the learner must actively construct new information into his/her existing mental framework for meaningful learning to occur"; as well as "the activities are student-centered and students are encouraged to ask their own questions, carry out their own experiments, make their own analogies and come to their own conclusions".

Such developments of genetic lectures from time to time have shown several results among which is increase in the percentage of lecture passing. On the other hand, students passing grade performance was still not satisfactory because it was still very much dominated by the value, C, whereas evaluation applied to genetics lecture was authentic evaluation based on authentic assessment. These facts clearly prove that students are not much interested in implementing the paradigm of constructivism and metacognition theory, though it is possible that there are also other explanations.

Genetic lectures in the Biology Department of UM until now, have been studied by two dissertation research (Khairil, 2009; Sumampouw, 2011). Khairil (2009) studied among others metacognitive awareness, metacognition skills and scientific work between students of Biology Education and Biology Program; students of high academic ability and those of low academic ability; as well as between genetic course I and genetic course II. Sumampouw (2011) studied among others, metacognition skills and higher order thinking skills between students of Biology Education and Biology Program. In this connection, it is clear that the study of changes in student metacognition skills from the beginning to the end of genetic course I as well as of genetic course II has never been done. Information about how much change in student's metacognition skills from the beginning to the end of the course will be important for developing the genetics lectures in future.

The study was conducted to determine the percentage increase in metacognition skill of students from the beginning to the end of Genetic course II during the odd semester 2013/2014. Operationally, difference test was conducted at the beginning and end of the genetic course with regards to students' metacognitive skills. Results of this study would be used as a more measureble basis for developing the genetic lecture in future. Finally, this research result will be very important in improving the RQA learning model and to be more measureble, as well as to design a new model of genetic learning.

METHODOLOGY

The study was conducted in pre-experimental design called One Group Pretest Post-Test Design (Shadish et al., 2002) as follows;

O_1----------X----------O_2

Where: O1: observation before treatment; X: implementation of RQA learning (in theoretical lectures) and Project Based Learning (in practice lecture); O2: observation after treatment.

The pre-experimental design was applied due to the fact that there was no control class used in this research. Moreover, the research goal was to measure the increase percentage of student's metacognition skills (due to treatment) from the beginning to the end of the course.

This study was conducted on genetic lectures in the Biology Department State University of Malang from late August to early December 2013. The sample was 24

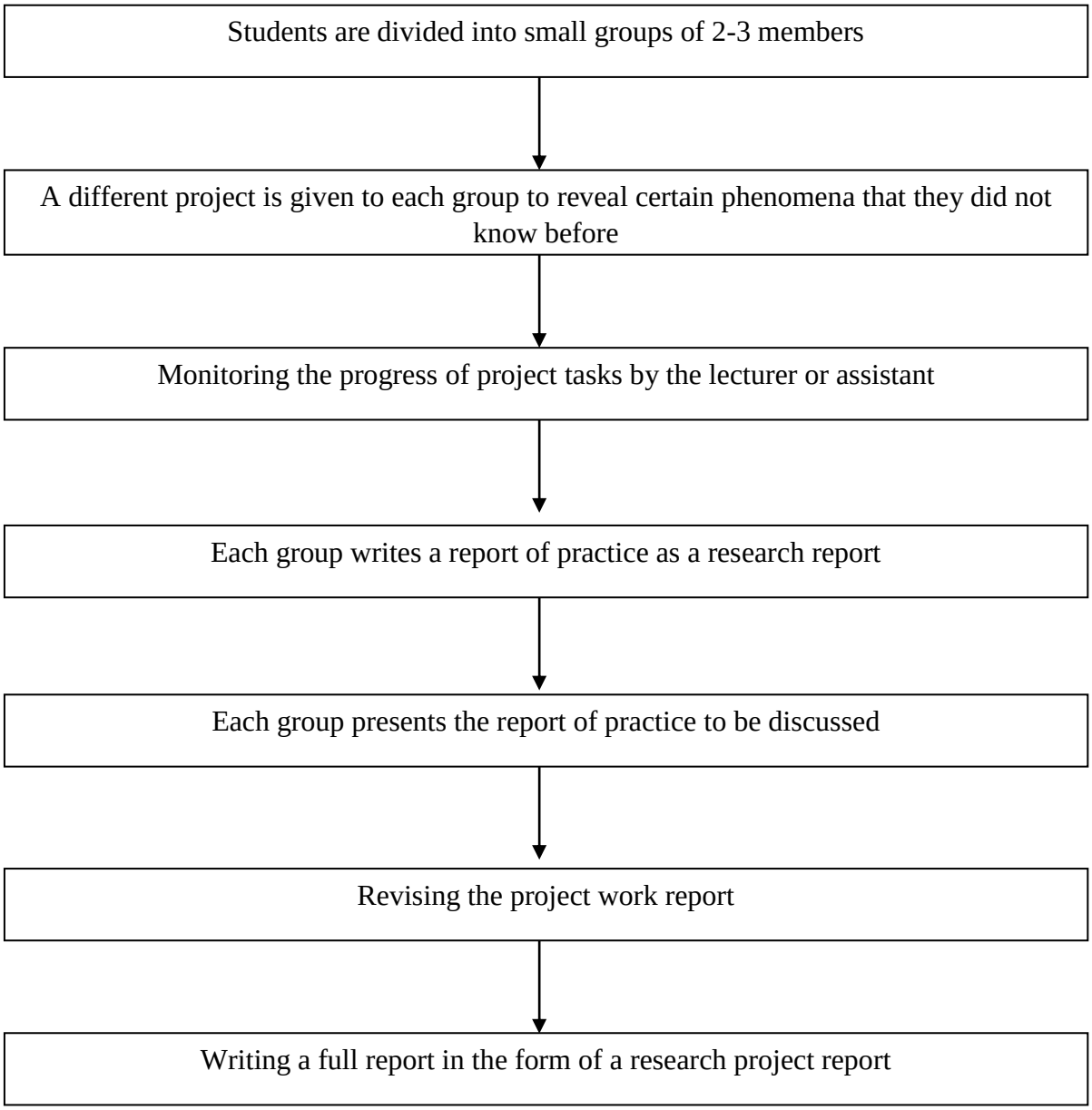

Figure 1: The syntax of project based learning conducted.
Source: Corebima (2000).

students who programmed the Genetic course II at the odd semester 2013/2014.

The research instruments were the syllabus, lesson plans, as well as the test. Assignments were conducted orally in theory as well as in practical lecture, not supported by a written instrument. Test used was an essay test.

Metacognition skills were measured from the results of summarizing and questioning assignments based on the summarizing result, and answering related to each question. The assignment results were scored based on the rubrics designed for this purpose. Measurement of metacognition skills was done from the first assignment to the last assignment. The rubrics of metacognition skills related to a summary, question and an answer are shown in Tables 1 and 2. Initial and final metacognition skills difference was analyzed by difference test of paired comparison Student test. Information about the magnitude of the metacognition skill increase was based on the initial and final score. The change of metacognition skill data from the beginning to the end of the lecture was analyzed too descriptively.

RESULTS

The initial and final metacognition skill data of the students are presented in Table 3. Descriptive analysis obtained from the average values related to metacognitive skills of

Table 1. The rubric of the metacognition skills related to a summary

4	Main points of the materials summarized are captured successfully as well as properly. The materials presented are summarized systematically The language and the sentences used are of their own The language and the sentences used are based on correct and good grammar
3	Main points of the materials summarized are captured successfully and properly The materials presented are less systematically summarized The language and the sentences used are of their own as well as of the script Some language and the sentences used are poor based on correct and good grammar
2	Main points of the materials summarized are captured successfully or unsuccessful arrested but tends to be true The materials presented are less systematically or unsystematically summarized Most of the language and the sentences used are of the script Most of the language and the sentences used are poorly based on correct and good grammar.
1	Main points of the materials are not captured The materials presented are not systematically summarized All of the language and the sentences used are of the script The language and the sentences are not based on correct and good grammar.
0	No result of the assignment is submitted

each student task showed an increase in the overall average; the metacognition skills of students increased from the first to the last task, although the score daround the last task decreased slightly. The decrease is especially related to the fact that the assignments around those last tasks are written in Indonesian language having very systematic structure, so that the students tend to take it directly from the sources without prior processing in their own words.

The results of data analysis carried out by paired comparison t-test (Table 4) show that counted t value is -6.658 (p = 0.000). This result indicates that the value of early metacognition skills and those of the final one vary significantly. Thus it can be stated that metacognition skills improved significantly from the initial to the last measurement.

DISCUSSION

Based on the data analysis, it is clearly seen that metacognition skills have increased from the beginning until the end of the learning process. This fact suggests that the RQA and PjBL learning models are able to train student's metacognition skills. The same finding had been reported by Khairil (2009) stating that the RQA learning model influenced and increased student metacognition skills.

This research result is in line with the syntax of RQA (Reading, Questioning and Answering) model. Metacognition skills can not appear by themselves therefore, there must be various deliberate efforts carried out to enforce them, one of which is the implementation of learning models applied during the learning process. One of the learning models that have the potency to improve metacognition skills is the RQA learning model. Corebima (2010) stated that related to the syntax of the RQA learning model, it was reasonable to believe that the learning model had a great potency to empower student metacognition skills.

RQA reading activity is the basis for students to acquire knowledge. By reading, the learners could be trained in mastering their reading ability, so that they can understand the ideas in the reading. According to Carrell et al. (1998), examples of specific metacognitive strategies in reading may include: a) establishing objectives in reading; b) evaluating reading materials; c) repairing miscomprehension; d) evaluating the ongoing understanding of the text; e) analyzing the text and paragraph structure to clarify the author's intention; f) adjusting reading speed and selective cognitive strategies accordingly and; g) engaging in self questioning to determine if the objectives have been reached. It is stated further that reading is a metacognitive, as well as a cognitive process. Furthermore, knowledge obtained by these students were formulated by themselves in the form of a summary. Doran and Cameron (1995) stated too that related to metacognitive approaches in the classroom, one of the several strategies that have been shown by More (1991) is summarising. By summarizing, the students are trained to process the results of their learning in long-term memory so that their metacognition skills will be trained.

After reading and summarizing the results of the reading, the students are assigned to formulate some questions

Table 2. The metacognition skill rubric related to the question and answer.

7	The question asked is related to the main content of the materials summarized The question is classified as a high order question The question sentence obeys the rules of good and correct grammar The answer is correct/less correct and obeys the rules of good and correct grammar
6	The question asked is related to the main content of the materials summarized The question is classified as a low order question The question sentence obeys the rules of good and correct grammar The answer is correct/less correct and obeys the rules of good and correct grammar
5	The question asked is related to the main content of the materials summarized The question is classified as a high order question or low order question The question sentence less obeys or does not obey the rules of good and correct grammar The answer is correct or less correct and less obeys or does not obey the rules of good and correct grammar
4	The question asked is less related or unrelated to the main content of the materials summarized The question is classified as a high order question The question sentence obeys the rules of good and correct grammar The answer is correct or less correct, and obeys the rules of good and correct grammar
3	The question asked is less related or unrelated to the main content of the materials summarized The question is classified as a high order question The question sentence less obeys or does not obey the rules of good and correct grammar The answer is correct or less correct, and less obeys or does not obey the rules of good and correct grammar
2	The question asked is less related or unrelated to the main content of the materials summarized The question is classified as a low order question The question sentence obeys the rules of good and correct grammar The answer is correct or less correct but obeys or less obeys the rules of good and correct grammar
1	The question asked is less related or unrelated to the main content of the materials summarized The question is classified as a low order question The question sentence less obeys or does not obey the rules of good and correct grammar The answer is less correct or incorrect, and less obeys or does not obey the rules of good and correct grammar
0	No questions

(Questioning) related to the reading materials and to answer the questions by themselves (Answering); the activity is indirectly believed to train the metacognition skills so that the students are trained to ask questions beginning from the lower levels of cognition to high level cognition. In fact, the questioning average score of the students increased from the first to the last assignment. Corebima (2010) explained that in order to create a substantial question about a certain topic or subtopic, the students must first carefully read the learning materials and summarize to find a substantial meaning. Furthermore, based on the substantial meaning found, the students were able to create good questions that they would find the answers to easily. Terney (1993) stated that by creating questions, the students could improve their understanding of the text being read.

In general, student's metacognition skills increased from the beginning until the end of the learning process by 19.8%. An increase of 19.8% looks relatively small which is because students metacognition skills had already been empowered in genetic lecture I of the previous semester; genetics lecture I implements the RQA learning model.

Learning processes that implement the RQA learning model have been proven to be potent in increasing students' metacognition skills related to summarizing skill level up to questioning and answering skill levels in accordance with the learning syntax. Corebima (2010) stated that the syntax of RQA model forces the students to accustom themselves to think on a higher order level.

Learning processes that implement the RQA model can train self-assessing student because they are accustomed to read, think about the questions planned to be formulated, then ask questions corresponding to the basic idea of the learning materials studied and finally answer the questions created and carry out classroom discussions in order to confirm their understanding as well as to clarify their uncleared understanding. Coherent thought supported by the RQA syntax trains metacognition skills of students.

Table 3. The metacognition skill data of the students at initial and final measurements

No.	Student name	Initial Measurement	Final Measurement
1	Kr	70.24	83.93
2	Ry	85.71	73.21
3	Gr	60.71	83.93
4	Qr	68.45	82.74
5	Pr	66.07	80.36
6	Al	73.21	80.36
7	Em	60.71	83.93
8	Ay	70.24	82.74
9	AP	70.24	83.93
10	Ad.	60.71	85.12
11	Vi	73.21	80.36
12	Ar	73.21	80.36
13	Vi	60.19	80.36
14	Ik	61.57	82.74
15	Ma	73.21	83.93
16	Zu	77.78	73.21
17	Ti	68.98	80.36
18	Dw	59.72	80.36
19	Es	60.19	82.74
20	Li	52.78	85.12
21	En	73.21	80.36
22	An	60.19	80.36
23	Ho	73.21	83.93
24	Lu	77.98	80.36
	Average	67.99	81.45

Table 4. The results of paired comparison t-Test

					95% Confidence Interval of the Difference				
Paired differences		**Mean**	**Std. deviation**	**Std. error mean**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	PraMet - PostMet	-13.375	9.841	2.009	-17.531	-9.219	-6.658	23	.000

Bahri (2010) explained that the pattern of metacognitive strategic training was proven to improve students' metacognitive skills. The findings of other studies related to metacognitive strategies reported by Kuiper (2002), Daley (2002) and Peters (2000) show how learning emphasizes knowledge construction and may contribute to the metacognitive skill development.

CONCLUSIONS AND SUGGESTIONS

Implementing the RQA and PjBL learning models in Genetic Lecture II in the Department of Biology, State University of Malang was successfull in increasing students' metacognition skills by as much as 19.8%. The relative low increase in students' metacognitive skill is caused by the fact that the skills had already been empowered in Genetic Lecture I from the previous semester.

By implementing the RQA learning model, students' metacognition skills were empowered in the genetic lecture. Related efforts, including through the improvements of RQA implementation constantly pursued with respect to the presentation of RQA results in the class discussion.

Competing interests

The authors declare that they have no competing interests

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