JOURNAL OF BALTIC SCIENCE EDUCATION
ISSN 1648-3898

EMPOWERING STUDENTS' METACOGNITIVE SKILLS THROUGH NEW TEACHING STRATEGY (GROUP INVESTIGATION INTEGRATED WITH THINK TALK WRITE) IN BIOLOGY CLASSROOM

Lina Listiana,
Herawati Susilo,
Hadi Suwono,
Endang Suarsini

Abstract. *Metacognitive skills play an important role in various students' cognitive activities. Metacognitive skills can make the students become self-regulated learners. Metacognitive skills in biology teaching can be empowered through the implementation of the appropriate teaching strategies. This research was a quasi-experimental research designed to compare the effect of Group Investigation (GI) strategy, Think Talk Write (TTW), Group Investigation integrated with Think Talk Write (GITTW), and conventional teaching strategy on the students' metacognitive skills empowerment in biology teaching. Sample of this research were 162 students of the first year natural science class of senior high schools in Surabaya, Indonesia, academic year 2014/2015. The students' metacognitive skills were measured using essay questions test, given at the beginning and at the end of the research. The results of the research showed that the implementation of teaching strategies had an effect to empower students' metacognitive skills. GITTW learning strategy had the biggest effect on the metacognitive skills empowerment. TTW learning strategy could improve students' metacognitive skills higher than GI and conventional teaching strategy. This proves that GITTW is one of the teaching strategies that teachers should use to maximise the students' metacognitive skills empowerment.*

Key words: *biology teaching, teaching strategy, group investigation, metacognitive skills, think talk write*

Lina Listiana
University of Muhammadiyah Surabaya, Indonesia
State University of Malang, Malang, Indonesia
Herawati Susilo, Hadi Suwono, Endang Suarsini
State University of Malang, Malang, Indonesia

Introduction

Globalization era in 21st century is known as era of knowledge with the competition in all aspects of live. Human resources in the era of knowledge are required to have high quality skills. Trilling & Hood (1999) stated that the skills are required such as cooperative skill, critical thinking skill, creative thinking skill, cross-culture understanding, communication skill, computer skill, and self-regulated learning. Those skills can be acquired through the learning processes in school, including biology. The biology teaching process emphasizes on the understanding and problem solving related to current and future development of biology issues. This requires high thinking skills. Students' thinking skills are significantly correlated with students 'metacognitive skills. According to Corebima (2010), empowering students' metacognitive skills could help develop the students' thinking skills.

Biology classroom was still dominated with the implementation of conventional teaching strategies, and it could not develop the students' thinking skills and metacognitive skills (Listiana, 2014). This is in line with Corebima's statement (2010) that the lack of empowerment of students' thinking skills in the learning process could cause the cognitive learning outcomes become lower. Therefore, the empowerment of metacognitive skills in biology classroom requires the ability to understand, decide, and set the right strategy. Metacognitive skills were believed to play an important role in many cognitive activities including comprehending, communicating, attending, memorizing (Howard, 2004), and problem solving (Flavell, 1985).

The development of students' metacognitive skills could help students become self-regulated learners (Eggen & Kauchack, 1996). Self-regulated learners can be responsible for their own learning progress and they can determine the best learning strategies to accomplish the task. Peters (2000), said that metacognitive skills enabled the students to develop into self-regulated learners because it encourages the students to be the managers of themselves

and to assess their own thinking and learning. Bahri and Corebima (2015) reported that metacognitive skills have a contribution on cognitive learning outcome. Therefore, it is important to study about metacognitive development and activity to find out how students can learn and apply it through metacognitive control. Thus, the development and empowerment of metacognitive skills are crucial to be implemented in biology teaching.

The implementation of the appropriate teaching strategies is one of the factors affecting the development and empowerment of students' metacognitive skills. This is in line with the results of the research conducted by Prayanti et al. (2014), Tumbel (2011), Bahri (2010), and Jamaludin, (2009) showed that teaching strategies had a significant effect on students' metacognitive skills. Osman and Hannafin (1992) said that metacognitive teaching strategy could be included or integrated into a learning and can be taught separately. Thus, the empowerment of metacognitive skills can be well planned and adapted with the teaching and learning strategy used.

One of the strategies considered appropriate to empower students' metacognitive skills is the cooperative learning strategy. Costa & O'Leary (1992), Johnson & Johnson (1992), and Palinscar (1987) reported that the cooperative learning had been proven to empower metacognitive skills. Cooperative learning strategies can encourage the development of metacognitive skills because the learning strategies focus on the learning process including an evaluation of the group work by each group member, the assessment and improvement of social interaction, and the effort to improve the performance of each group. Slavin (1999) confirmed that the use of cooperative strategy could train the students to ask and work in heterogeneous groups to solve problems through complex tasks.

Group Investigation (GI) strategy is a cooperative learning strategy that can be used to encourage and develop metacognitive skills. The results of the research by Danial (2010), reported that the GI strategy could enhance metacognitive skills and concept understanding. GI also had the potential to empower students' thinking skills and abilities (Nasruddin & Azizah, 2010; Listiana, 2013). The results of the research by Akcay & Doymus (2012), and Koc, et al. (2010) reported that there was a difference in the learning results between the students taught by using GI and those taught by using conventional learning. Additionally, Tsoi, et al. (2004) confirmed that the GI effectively improved social skills, responsibility, and problem solving skills. Siddiqui (2013) also stated that the GI increased the learning levels (investigation, participation, interaction, critical thinking, logical thinking, problem solving, decision making, communication skills). GI is also proven to increase motivation (Tan, *et al*. 2007), and creative thinking skills (Suartika, et al. 2013).

The implementation of GI has revealed some advantages and also some disadvantages. The results of the research by Johnson (2002) reported that the implementation of GI required a long time, and was difficult to implement on a wide range of subject areas and grade levels. Another learning strategy is expected to overcome the disadvantages of the GI strategy. The other learning strategy expected to empower and develop metacognitive skills and at the same time cover the disadvantages of GI is Think Talk Write (TTW). TTW strategy was introduced by Huinker and Laughlin (1996) and had the advantage of being more flexible and easier to implement in the classroom and can be applied to all areas of study at various levels, with a very simple syntax. The research by Hidayat (2013) and Yuanari (2011) reported that TTW strategy was proven to increase the critical and creative thinking skill and problem solving skill of student.

Both TTW and GI strategy have been implemented by teachers, but the implementation in the learning process has not been optimal. The disadvantages of TTW learning strategy such as the learning syntax is very simple and the lack of techniques at each stage think, talk, and write become the consideration to integrate it with GI learning strategy. And conversely, the disadvantages of GI learning strategy can be complemented by TTW strategy. Both of these strategies are combined by integrating the syntax of TTW at every stage of GI. The combination of GI learning strategy and TTW learning is abbreviated as GITTW which is packed in the form of cooperative learning, which trains the students to think to investigate a topic of practical or theoretical issues, access information from a variety of sources, observe, analyse, synthesize, present and evaluate it. It can encourage and foster students' metacognitive skills. Based on the elaboration above, it is necessary to conduct a research to investigate the effect of GI, TTW, GITTW, and conventional learning strategy on the empowerment of students' metacognitive skills.

Statement of Problems

The research problem was how to find out the way to cover the weakness of GI implementation. One of the solutions is integrating with TTW strategy. TTW and GI strategy has been implemented by teachers, but the implementation in the teaching and learning process has not been optimal. The research also was carried out to compare the effect of Group Investigation (GI) strategy, Think Talk Write (TTW), Group Investigation integrated with

Think Talk Write (GITTW), and conventional teaching strategy on the students' metacognitive skills empowerment in biology classroom. Implementation of GITTW is expected to maximize the potency of GI and TTW in metacognitive skill empowerment. This research is important to be carried to provide more relevant information about the new teaching strategy to empower students' metacognitive skill. This study is expected to provide more insights relating to teaching strategy to metacognitive skill empowerment for the biology teachers, curriculum developers and policy makers with.

Methodology of Research

General Background of Research

This research was a quasi-experimental research, because there might have been several factors affecting the variables that could not be controlled (Ary, et al. 2011). This research aimed at determining the effect of GI, GITTW and TTW learning strategies on the empowerment of students' metacognitive skills in biology learning in senior high schools in Surabaya, Indonesia. The design of the research was pre-test-post-test control group design (Fraenkel & Wallen, 2009) (Table 1). The independent variable was teaching strategies consisting of the Group Investigation (GI), Think Talk Write (TTW), Group Investigation combined with Think Talk Write (GITTW), and the conventional learning strategy. The dependent variable was students' metacognitive skills. This research was conducted for one semester in the first semester of academic year 2014/2015.

Table 1. Quasi-experimental research design.

Pre-test	Group	Post-test
O1	X1	O2
O1	X2	O2
O1	X3	O2
O1	C	O2

where,
X_1 = GI Strategy; X_2 = TTW Strategy; X_3 = GITTW Strategy; C = Conventional Strategy; O_1 = Pre-test scores
O_2 = Post-test scores

Samples of Research

The population of research consisted of 11 classes of the first year students of natural science distributed in 7 senior high school in Surabaya, Indonesia, academic year 2014/2015 as many as 312 students. The sample of research represented all the population. The classes were selected by using simple random sampling technique by the lottery method from the population and entirely by chance because each class has the same probability of being chosen for the sample of research. The total sample of this research was 162 students. Each teaching strategy was represented by two classes, so that the number of classes used were 8 classes. The classes used as the research samples were initially tested for the equality using the data of placement test. The analysis of the equality test used analysis of variance (ANOVA) using SPSS 17.0 for Windows. The result of this analysis showed that all classes were equal ($p > 0.05$).

Instruments and Procedures

The placement test is in the form of multiple-choice tests on the biological materials of junior high school level. The number of the test items was 25 items. The students' metacognitive skills were measured using the essay questions test consisting of 13 numbers. The placement test and the essay questions test were developed by the researcher with the metacognitive skill rubric developed by Corebima (2009). The essay questions test was administered before (pre-test) and after the learning process (post-test). The instruments used were initially validated by experts and by empirical validation. The expert validation covered the content validity and construct validity. The

content validity showed the extent to which the essay test content has been representative of the whole learning material that should have been tested. Construct validity refers to the appropriateness between the test items measuring the thinking aspects and the thinking aspects which become the learning objectives. The results of the validation from three experts showed that the result is 3.54 (valid).

The empirical validation covered validity item test, reliability item test, level of difficulty and distracters. The empirical validation was conducted on 42 students of second year natural science class of senior high school in the first semester. The item validity test means that an item is said to be valid if it has a great contribution toward the total score. A reliability of a test is associated with consistency. A test is said to have a high reliability if the test can provide consistent results. The results of the empirical validation showed that the validity of placement test was in the range of 0.42-0.68 and essay questions test was in the range of 0.47-0.82 meaning that the test was valid, and the reliability of the of placement test was 0.983 and essay questions test was 0.873 (high reliability) meaning that the test had good quality.

Data Analysis

The data of this research were the score of metacognitive skill based on the students' answers on the essay questions test. The data from the test were collected from the pre-test and post-test. The data were then analysed by using Analysis of Covariance (ANCOVA), which were previously performed in the prerequisite tests namely, the normality test using one-sample Kolmogorov-Smirnov test and homogeneity test using Levene's Test of Equality of Error Variances. The data were analysed using SPSS 17.0 for Windows.

Results of Research

The results of normality test of the students' metacognitive skills data using one-sample Kolmogorov-Smirnov test showed that the data were distributed normally ($p > 0.05$) and homogeneity test using Levene's Test of Equality of Error Variances showed that the data were homogeneous ($p > 0.05$).

The results of the ANCOVA test of the metacognitive skills on each biology teaching strategy implemented (GI, TTW, GITTW, and conventional learning) are shown in Table 2, and the results of post hoc test are shown in Table 3.

Table 2. The summary of analysis of covariance on students' metacognitive skills.

Source	Sum of Squares	Degrees of Freedom	Variance Estimate (Mean Square)	F Ratio	Sig.
Corrected Model	15625.721[a]	4	3906.430	53.541	< .001
Intercept	6400.801	1	6400.801	87.728	< .001
XMetacognitiveSkill	3918.086	1	3918.086	53.701	< .001
LearningStrategy	8125.603	3	2708.534	37.123	< .001
Error	11454.951	157	72.961		
Total	404105.217	162			
corrected Total	27080.673	161			

Table 3. The results of post hoc test on the effect of teaching strategy on students' metacognitive skills.

Teaching Strategies	Pre-test Scores	Post-test Scores	Difference	Corrected Metacognitive Skill Scores	Notation LSD0.05
CONVENTIONAL	26.796	34.565	7.768	35.741	a
GI	33.874	49.584	15.710	48.409	b
TTW	29.985	52.652	22.667	53.159	c
GITTW	31.845	56.798	24.953	56.363	d

The results of Ancova test on students' metacognitive skills in Table 1 shows that there was the difference *(p* < 0.05) between GI, TTW, GITTW, and conventional teaching strategy on students' metacognitive skill empowerment. It means that teaching strategies have the significant effect to empower students' metacognitive skills.

The results of LSD test in Table 2 show that the average of the corrected score of the metacognitive skills of the students taught by GITTW strategy was 5.68% significantly higher than the TTW strategy. The *TTW* strategy was 8.94% significantly higher than the GI strategy, and the GI strategy was 26.17% significantly higher than the conventional strategy. It means that the GITTW strategy had the biggest potency to empower students' metacognitive skills than the GI, TTW, and conventional teaching strategies with the change score from pre-test to post-test as much 24.953. The potential of GI strategy to empower students' metacognitive skills was bigger than the conventional strategy, but the potential of TTW strategy was bigger than GI strategy. Conventional strategy had the smallest potency to empower students' metacognitive skill than the other strategy with the change score from pre-test to post-test as much 7.768.

Discussion

The results of this research showed that students taught by using GI strategy, which is a form of cooperative learning, have higher metacognitive skills than the students taught by using conventional teaching strategy. The results of this research are consistent with research findings by Costa & O'Leary (1992); Johnson & Johnson (1992) reported that metacognitive skills could be trained through cooperative learning. Cooperative learning was believed to provide the opportunity for the students to engage in discussion, to use their critical thinking, and to be responsible for their own learning (Gokhale, 1995). In addition, students were provided with complex problems that require the solution through the stages of GI (Sharan & Sharan, 1992). In the conventional learning, students tend to learn individually and more passively receiving information from the teacher or do the exercises on the students' worksheets. Discussion and sharing opinions among friends to complete a task or presenting the results of their work rarely happen. Such learning activities do not empower the students' metacognitive skills.

In the early stages of GI, students work in groups to organize and determine the subtopics or problems. In the second phase, the group plans the investigation and divides the work within the group members to determine the necessary resources, regulate and define strategies to solve problems. In the third stage, the groups do the investigation. At this stage the group finds the information from various sources, collecting the data, discussing and analysing the findings, interpreting and integrating it. In the fourth stage, the groups prepare and plan a presentation, synthesizing the results of discussions to be presented. In the fifth stage, the group makes a presentation. At this stage the students in groups actively share the results of their investigation through discussions and question and answer session in the classroom forum. The last stage is the evaluation. At this stage, the groups and teachers evaluate and correct any misconceptions of the final results. This is in line with the opinion of Mitchell, et al. (2008) that the GI strategy encouraged the students to monitor and evaluate their work.

The students' activities during the implementation of GI strategy clearly involve metacognition. Sharan & Sharan (1990) asserted that the GI involved the students in investigating a particular topic, studying the topic, planning and sharing tasks among themselves, and then preparing and presenting the results in class. The activities such as planning the completion of tasks, monitoring and evaluating the cognitive development are metacognitive activities. According to Imel (2002), metacognitive skills enabled the students to plan, follow and monitor the development of their learning process. Similarly, Danial (2010) reported that the GI strategy could improve students' metacognitive skills and concept understanding. The research conducted by Listiana (2016) revealed that the implementation of GI has a big contribution on metacognitive skills as much as 82%. GI was proven to encourage students' curiosity and trained the students to control their own learning (Sharan & Sharan, 1990), to express themselves, to be responsible and to be independent (Zingaro, 2008).

GI strategy could motivate the students (Tan, et al. 2007) to participate and do something productive when facing problems related to everyday life. Students' activities in planning and sharing tasks encourage the students in the group to skilfully manage and control their duties. When the students investigate, they organize the data, discuss and analyse the findings. This activity trains the students to control their thinking process, thinking skills and the skills to determine the best strategy to complete tasks. The process of discussion and sharing the final results in the presentation proves that each member of the group is responsible for their idea. Furthermore, the evaluation of the results of the presentations involving the students and teachers in the group become a means

to train the students to assess the weaknesses and mistakes of their own group. The stages of GI strategy allow the metacognitive activity to occur that encourages the students to become self-regulated learners.

The results of this research also showed that the metacognitive skills of the students taught by TTW strategy were higher than those of the students taught by conventional learning strategy. In TTW learning strategy, firstly, the students are given the opportunity to start their learning by understanding the problems, and then involve in group discussions actively. And finally they wrote the results of their learning with their own words (DePorter, 1992). Whereas in conventional learning, the concept understanding is simply the results of the transfer of information from the teacher, so that the students are not actively involved in the learning process. The results of the previous research showed that TTW strategy was proven to improve comprehension, problem solving, learning activities, writing skill, and critical thinking skills of students (Ansari, 2004). Research by Hidayat (2012) reported that TTW strategy improved the students' critical thinking skills and creative thinking. The research by Supriyono (2011) also proved that the TTW strategy practically and effectively improved students' activity, communication and achievement.

TTW strategy begins with stage "think", where students are thinking or talking to themselves after they read. And then, the students "think" of a strategy to resolve the problem or task. After that, in stage "talk", the students talk, explain, listen, and share ideas with friends in the group. This activity is more effective when implemented in a heterogeneous group with 3-5 students. The final stage is "write". In this stage, the students were asked to make a small note about the results of the group discussions (Huinker and Laughlin, 1996). These activities are thinking skills or learning skills that contribute on the empowerment of metacognitive skills. This is in line with the statement of Slavin (2000) on the basis of Butler and Winn (1995); Pressley, Harris & Marks (1992); Presley, et al. (1990), which stated that the thinking skills and learning skills were the examples of metacognitive skills in which students could learn to think about their thinking processes and implement the learning strategies.

At the stage think, the students think. According to Marzuki (2006) thinking process covered five dimensions, one of which is metacognition. Eggen and Kauchak (1996) suggested that metacognition was a person's awareness about his/her thinking process when performing certain tasks, and then use this awareness to control what he is doing. Through the stage of think, thinking activity in accomplishing tasks requires specific strategies, so that students are trained to control their thinking process. The students become more motivated to find the solutions to accomplish the tasks. These activities empowered students' metacognitive skills needed to understand how to fulfil their tasks (Rivers, 2001; Schraw, 1998). In the next stage, talk, the students talk, discuss, share with their friends in groups. This activity gives the students the opportunity to speak verbally to convey their ideas, decide and clarify a statement. The students are required to empower their thinking skills, so that in conveying the idea the students become more focused and directed. In the final stage, write, the students write the results of the discussion in the form of solutions of the problems. Writing activity requires the thinking skills such as how to plan, organize and control a task or job that will be reported in the written form, so that the results of the writing become complete, easy to read and understandable. Thus, TTW strategy has the potential to empower students' metacognitive skills.

The other important findings of this research reported that the metacognitive skills of the students taught by using TTW learning strategy were higher than those of the students taught by using GI strategy. It caused that TTW strategy having the simple syntax of think, talk, and write was more easily implemented in the classroom and applied to all areas of study at various levels (Huinker & Laughlin, 1996). TTW strategy is more flexible and simpler than the GI learning strategy which has quite complex syntax and which requires a relatively large amount of time on its implementation in the classroom.

The optimization of the students' metacognitive skills empowerment can be achieved by integrating the stages of TTW strategy with the stages of GI strategy. This was proven by the results of research showing that the metacognitive skills of the students taught by using GITTW strategy were higher than the other three learning strategies. The improvement of the metacognitive skills of the students taught by GITTW strategy could not be separated from the GI stages in it. In addition to the GI stages in GITTW strategy, the optimization of the empowerment of students' metacognitive skills could not be separated from the TTW stages. The integration of TTW and GI strategies are to overcome weaknesses and at the same time to optimize the potential of the two strategies to empower students' metacognitive skills.

GI and TTW strategies in the GITTW strategy equally develop a self-regulated learning, so that the students are responsible for their own learning in completing a difficult task, organizing and controlling their learning activities. These activities help the students become self-regulated learners. The advantages of GITTW strategy

are that students learn to perform self-assessing, as one component of metacognitive skills. This can be seen in the final stage of GI syntax, which is the evaluation stage, in which the students evaluate and correct the things they already know or misconceptions. Furthermore, the students also identify what they do not know, and how to empower the knowledge that has been gained after the teachers give the clarification at the end of the learning activity. During this process, the students are trained to do a self-evaluation or a group evaluation, and it is better to determine the subsequent follow-up study, to correct any misconceptions. This is supported by research conducted by Rivers (2001) and Schraw & Dennison (1994) which concluded that the skilled learners who perform self-assessments were aware of their ability, to act more strategically, and better than those who are not skilled.

The other advantages of GITTW strategy are to build a learning community by training to learn in groups. Learning in a group is a method to encourage maximum involvement of students in learning. GI or TTW strategy are the cooperative learning strategies that require cooperation in the completion of the task. Slavin (2008) stated that the GI strategy trained the students with integrated projects related to activities of acquisition, analysis, synthesis of information to solve complex problems. It will provide an opportunity for group members to contribute in finding solutions to the problems. Through the syntax of GI and TTW, the students are trained to use metacognitive strategies, and it encourages the empowerment of metacognitive skills.

Each stage in GITTW shows the efforts to make the students get accustomed to understanding what learning strategies or resources have to be used in the completion of the task, how and when to use the learning strategy or the source of the information. For example, as a learning strategy in completing the task, the students are trained to think, discuss, and further write down the results of the discussion. This is consistent with the statement of Flavel (1985) in Howard (2004) that there were three sets of skills involved in metacognitive skills, namely the skill to understand what, how and when the strategy or resources are used. These three skills provide the opportunities for students to develop their metacognitive skills. Eggen and Kauchak (1996) said that the development of students' metacognitive skills was a valuable educational goal, helping them become self-regulated learners.

The implication of the results of this research is that metacognitive skills cannot just appear on students, but there should be a process of habituation or training in every learning activity in the classroom. The empowerment and development of metacognitive skills during the learning process can be integrated at any stage of the syntax of the implemented learning strategies. Osman and Hannafin (1992) stated that empowerment of metacognitive skills could be integrated in a subject, and it may also not depend on the content of the learning material. In this case the implementation of appropriate learning strategies plays an important role in bringing up and empowering students' metacognitive skills. The efforts of metacognitive skills empowerment are intentionally done through the implementation of metacognitive strategies in student-centred strategies like GITTW.

Conclusions

Based on the research findings and discussion, it can be concluded that the integration of GI and TTW could cover the weakness of GI. The implementation of GITTW teaching strategy was proven that it could maximize the empowerment of students' metacognitive skills. It shows that the score of metacognitive skill of students taught by GITTW was the highest. TTW learning strategy can improve students' metacognitive skills higher than GI and conventional strategies. This may be an evidence that the GITTW as a new teaching strategy can be considered as one of the variations in teaching strategies that can empower metacognitive skills. Further research need to consider the measurement of metacognitive skill, because in this research using essay questions test was difficult for the researcher to use this measurement test in a big class. Also, it is necessary to investigate the effect of the GITTW strategy related to other variables such as students' critical thinking skills, problem solving and creative thinking skills.

References

Akcay, N. O., & Doymus, K. (2012). The effect of GI and cooperative learning techniques applied in teaching force and motion subjects on students academic achievements. *Journal of Educational E-Journal, 2* (1), 109-123.

Ary, D. Jacobs, L. C, & Razavieh, A. (2011). *Pengantar penelitian dalam pendidikan* [Introduction to educational research]. Translated by Arief Furchan. Surabaya, Indonesia: Usaha Nasional.

Ansari, B. I. (2004). *Implementasi model pembelajaran Think Talk Write (TTW) terhadap pemahaman dan komunikasi matematik* [The Implementation of Think Talk Write (TTW) toward learning comprhension and mathematics communication]. (Unpublished dissertation). University of Pendidikan Indonesia Bandung, Indonesia.

Bahri, A. (2010). *Pengaruh strategi pembelajaran RQA pada perkuliahan fisiologi hewan tehadap kesadaran metakognitif, keterampilan metakognitif dan hasil belajar kognitif mahasiswa jurusan biologi FMIPA UNM* [The Effect of Reading, Questioning, Answering/RQA in animal physiology course toward metacognitive awareness, metacognitive skill, and cognitive learning results of students at the Department of Biology, Faculty of Mathematics and Natural Science, State University of Makassar, Indonesia]. (Unpublished thesis). State University of Malang, Indonesia.

Bahri, A., & Corebima, A. D. (2015). The contribution of learning motivation and metacognitive skill on cognitive learning outcome of students within different learning strategies. *Journal of Baltic Science Education, 14* (4), 487-500.

Corebima, A. D. (2009). *Metacognitive skill measurement integrated in achievement test.* Paper presented at COSMED, RECSAM, Penang, Malaysia.

Corebima, A. D. (2010). *Berdayakan keterampilan berpikir dan kemampuan metakognitif selama pembelajaran sains demi masa depan kita* [Empower thinking skills and metacognitive skills during science learning for our future]. Paper presented at the National Science Seminar in State University of Surabaya, Indonesia January 16 th , 2010.

Costa, A. L., & O'Leary, P. W. (1992). Co-cognition: The cooperative development of intelect. In N. Davidson & Worsham (eds). *Enhancing thinking through cooperative learning.* (pp. 41-65). New York: Teacher College Press.

Danial, M. (2010). *Pengaruh strategi pembelajaran PBL dan GI terhadap metakognisi dan penguasaan konsep kimia dasar mahasiswa Jurusan Biologi FMIPA UNM* [The Effects of PBL and GI learning strategies on metacognition and the mastery of concepts of basic chemistry of UNM students of Department of Biological Science]. (Unpublished dissertation). State University of Malang, Indonesia.

DePorter, B. (1992). *Quantum learning.* Bandung, Indonesia: Kaifa publisher.

Eggen, P. D., & Kauchak, D. P. (1996). *Strategies for teachers*. Boston: Allyn and Bacon.

Flavel, J. H. (1985). *Cognitive development.* (2nd ed). Englewood Cliffs, NI: Prentice Hall Inc.

Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in* education. *Sevent edition.* New York: McGraw Hill Companies.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Electronic Journals:Journal of Technology Education, 7* (1). Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v7n1/gokhale.jte-v7n1.html?ref=Sawos.Org.

Hidayat. (2012). Meningkatkan kemampuan berpikir kritis dan kreatif matematik siswa SMA melalui pembelajaran kooperatif think talk write (TTW) [Improving the critical thinking skills and creativity of senior high scool students on mathematics through TTW]. *Proceedings of the National Seminar of Educational Research and implementation on Mathematics and Natural Science. Yogyakarta, Indonesia Juny 2nd, 2012*. Retrieved from https://www.google.com/search?q=hidayat%2C+wahyu+TTW+journal+pdf&ie=utf-8&oe=utf-8#q=hidayat%2C+wahyu+TTW+prosiding+pdf

Howard, J. B. (2004). *Metacognitive inquiry*. School of Education. Elon University. Retrieved from https://org.elon.edu/t2project/pdf_docs/sp_metacognitive.pdf.

Huinker, D., & Laughlin, C. (1996). Talk you way into writing. In. P. C. Elliot and M.J. Kenney (Eds). Years Book 1996. *Communication in Mathematics K-12 and Beyond.* USA: NCTM. Retrieved from http://eric.ed.gov/?id=ED398069.

Imel, S. (2002). *Metacognitive skills for adult learning.* Clearinghouse on Adult, Career and Vocational Education. Trends and Issues Alert No. 39. Retrieved from http://eric.ed.gov/?id=ED469264.

Jamaluddin. (2009). *Pengaruh pembelajaran PBMP dipadukan strategi kooperatif dan kemampuan akademik terhadap keterampilan metakognitif, berpikir kreatif, pemahaman konsep ipa-biologi dan retensi siswa SD di Mataram* [The effects of PBMP learning strategy combined with cooperative learning strategy and academic ability on metacognitive skills, creative thinking, concept understanding of science-biology and the retention of elementary school students in Mataram]. (Unpublished Dissertation). State University of Malang, Indonesia.

Johnson, D. W. (2002). *Meaningfull assessment a manageable and cooperative process.* USA: Allyn and Bacon.

Johnson, D. W., & Johnson, R. (1992). Positive interdependence: Key to Effective Cooperation. In R.Hertz Lazarowitz and N. Miller (Ed.). *Interaction in Cooperative Group: The Theoretical Anatomy of Group Learning*. (pp. 174-199). Cambridge, England: Cambridge University Press.

Koc, Y., Doymus, K., Karacop, A., & Simsek, U. (2010). The effects of two cooperative learning strategies on the teaching and learning of the topics of Chemical Kinetics. *Journal of Turkish Science Education, 7* (2), 52-65.

Listiana, L. (2013). Pemberdayaan keterampilan berpikir dalam pembelajaran biologi melalui model kooperatif tipe GI (Group Investigation) dan TTW (Think Talk Write) [Empowering thinking skills in biology learning through cooperative model of GI (Group Investigation) and TTW (Think Talk Write]. *Proceedings of the National Seminar X Biology, Science, Environment and the Learning. Surakarta July 6, 2013. Volume 1. Page: 410-417.* Faculty of Teacher Training and Education, University of Sebelas Maret Surakarta, Indonesia.

Listiana, L. (2014). Realitas pengembangan keterampilan berpikir dalam pembelajaran biologi: studi pendahuluan di SMA Muhammadiyah se-Surabaya [The reality of the development of thinking skills in biology learning: a preliminary study in SMA Muhammadiyah in Surabaya]. *Proceedings of the National Seminar and Workshop on Biologyl/science and the learning. Malang, 1 - 2 November 2014, Page: 340-347.* Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Malang, Indonesia.

Listiana, L. (2016). Contributions of metacognitive skills toward students' cognitive abilities of biology through the implementation of GITTW (Group Investigation combined with Think Talk Write) strategy. *Proceeding of International Conference on Teacher Training and Education, University of Sebelas Maret, Surakarta, Indonesia, Vol 1, Nomor 1, hal: 411-418, Januari 2016.* Retrieved from http://jurnal.fkip.uns.ac.id/ index.php/ ictte/article/View/7638.

Marzuki, A. (2006). *Implementasi pembelajaran kooperatif (cooperative learning) dalam upaya meningkatkan kemampuan koneksi dan pemecahan masalah matematik siswa* [The implementation of cooperative learning (cooperative learning) in order to increase students' ability to connect and to solvie mathematical problems]. (Unpublished thesis). University of Pendidikan Indonesia, Bandung, Indonesia.

Mitchell, M. G., Hilary, M., Holder, M., & Stuart, D. (2008). Group investigation as a cooperative learning strategy: an integrated analysis of the literature. *The Alberta Journal of Educational Research, 54* (4), 388-395.

Nasrudin, H. & Azizah, U. (2010). Improvement thinking skills and scientific attitude using the implementation of "group investigation cooperative learning" contextual oriented at acid, base and salt topic in junior high school. *Proceedings of the 4th International Conference on Teacher Education; Join Conference UPI & UPSI Bandung, Indonesia, 8th-10th November 2010.* (pp 763-772).

Osman, M. E., & Hannafin, M. J. (1992). Metacognition research and theory: Analysis and implication for instructional design. *Educational Technology Research & Development, 40* (2), 83-89.

Palincsar, A. S. (1987). Resiprocal teaching: can student discussion boost comprehension? *Instructor*, *96* (5), 56-58. Retrieved from http://eric.ed.gov/?id=EJ346339.

Peters, M. (2000). Does constructivist ephystemology have a place in nurse education. *Journal of Nursing Education, 39* (4), 166-170.

Prayanti, P.D., Sadra, W. & Sudiarta, P. (2014). Pengaruh strategi pembelajaran pemecahan masalah berorientasi masalah matematik terbuka terhadap kemampuan pemecahan masalah ditinjau dari keterampilan metakognitif siswa kelas VII SMP Sapta Andika Denpasar [The effects of problem-solving oriented on open mathematical problem learning strategy on the problem-solving ability viewed from the metacognitive skills of class VII junior high school students of Sapta Andika Denpasar]. *Online Undiksha Postgraduate Research Journal, 3* (1). Retrieved from http://pasca.undiksha.ac.id/e-journal/index.php/JPM/article/view/1345.

Rivers, W. P. (2001). Autonomy at all costs: an ethnography of metacognitive self-assessment and self-management among experienced language learners. *The Modern Language Journal, 85* (2), 279–290.

Schraw, G., & Dennison, R. S. (1994). Assesing metacognitive awareness. *Contemporary Educational Psychology, 19*, 460-475.

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science, 26,* 113–125.

Sharan, Y., & Sharan, S. (1990). *Group investigation expanding cooperative learning.* New York: Teachers College Press. (pp. 17-21).

Sharan, Y., & Sharan, S. (1992). *Expanding cooperative learning through group investigation*. Teachers College Press, 1234 Amsterdam Avenue, New York, NY. Retrieved from http://eric.ed.gov/?id=ED367509.

Siddiqui, M. H. (2013). Group investigation model of teaching: enhancing learning level. *Paripex-Indian Journal of Research, 3* (4), 78-80.

Slavin, R. E., & Cooper, R. (1999). Improving intergroup relations: Lessons learned from cooperative learning programs. *Journal of Social Issues, 55* (4), 647. Retrieved from (file:///F:/JURNAL%20KOOPERATF%20GI/SLAVIN%201999%20Coopertive%20.htm.

Slavin, R. E. (2000). *Educational psychology. Sixth Edition*. Boston: Allyn and Bacon Thomas, J. W. 2000. *A review of research on project-based learning*. Retrieved from (http://www. autodesk.com/foundation).

Slavin, R. E. (2008). *Educational psychology: theory and practice*. Boston: Pearson Education Inc.

Suartika, A., & Setiawan, (2013). Pengaruh pembelajara model kooperatif tipe group investigation (GI) terhadap pemahaman konsep biologi dan keterampilan berpikir kreatif siswa SMA [The effect of cooperative model of Group Investigation (GI) learning on biology concept understanding and creative thinking skills of senior high school students]. *E-Journal Graduate Program Ganesha Education University Studies Program IPA*, *3* (1), 1-12. Retrieved from http://pasca.undiksha.ac.id/e-journal/index.php/jurnal_ipa/article/view/759.

Supriyono. (2011). Developing mathematical learning device using TTW (Think Talk Write) Strategy Assisted By Learning Cd To Foster Mathematical Communication. *Proceeding International Seminar and Fourth National Conference on Mathematics Education, "Building the Nation Character through Humanistic Mathematic Education" Department of Mathematics Education, State University of Yogyakarta, Yogyakarta, Indonesia July 21th-23rd 2011 (p.73-84).*

Tan, I. G. C., Sharan, S., & Lee, C. K. E. (2007). Group investigation effects on achievement, motivation, and perceptions of student in Singapore. *Journal of Education Research, 100* (3), 142-154. DOI:10.3200/JOER.100.3.142-154.

Trilling, B., & Hood, P. (1999). Learning, technology, and education reform in the knowledge age or "we're wired, webbed, and windowed, now what?" *Educational Technology, 39* (3), 5-18. Retrieved from http://eric.ed.gov/?id=EJ588185.

Tsoi, M. F., Goh, N. K., & Chia, L. S. (2004). Using group investigation for chemistry in teacher education. *Asia-Pacific Forum on Science Learning and Teaching, 5* (1), 1-12.

Tumbel, F.E. (2011). *Pengaruh strategi pembelajaran cooperative script dipadu problem posing dan kemampuan akademik siswa terhadap keterampilan metakognitif, kemampuan berpikir dan pemahaman konsep biologi pada SMA di Kota Bitung Sulawesi Utara, Indonesia* [*The effects of cooperative learning script combined with problem posing and students' academic ability on metacognitive skills, thinking skills and biology concept understanding of senior high school students in Bitung, North Sulawesi, Indonesia].* (Unpublished dissertation). State University of Malang, Indonesia.

Yuanari, N. (2011). *Penerapan strategi TTW (Think Talk Write) sebagai upaya meningkatkan kemampuan pemecahan masalah dan disposisi matematis siswa kelas VIII SMPN 5 Wates Kulon Progo* [The implementation of Think Talk Write learning strategy as an effort to increase the problem solving skill and mathematical disposition of class VIII of junior high school 5 in Wates Kulon Progo, Indonesia]. (Unpublished Thesis). State University of Yogyakarta, Indonesia.

Zingaro, D. (2008). *Group investigation: Theory and practice*. Ontario Institute for Studies in Education, Toronto, Ontario. July 18th 2008, (p.1-8). Retrieved from (On-Line) http://www. danielzingaro.com/gi.pdf.

Received: *May 04, 2016* Accepted: *June 29, 2016*

Lina Listiana	Master of Health, Department of Biology, Faculty of Mathematic and Natural Science, State University of Malang, Indonesia, Jl. Semarang 5, Kota Malang, East Java, Indonesia; Study Program of Biology Education, Faculty of Teacher and Educational Science, University of Muhammadiyah Surabaya, Indonesia, Jl. Sutorejo 59, Surabaya, East Java, Indonesia. E-mail: linahamdani22@yahoo.com Website: http://www.um-surabaya.ac.id
Herawati Susilo	M.Sc., Ph.D., Professor, Department of Biology, Faculty of Mathematic and Natural Science, State University of Malang, Indonesia, Jl. Semarang 5, Kota Malang, East Java, Indonesia E-mail: herawati_susilo@yahoo.com Website: http://www.um.ac.id
Hadi Suwono	Dr., Master of Science, Department of Biology, Faculty of Mathematic and Natural Science, State University of Malang, Indonesia, Jl. Semarang 5, Kota Malang, East Java, Indonesia E-mail: hadisuwonodr@gmail.com Website: http://www.um.ac.id
Endang Suarsini	Dr., Master of Medical Science, Department of Biology, Faculty of Mathematic and Natural Science, State University of Malang, Indonesia, Jl. Semarang 5, Kota Malang, East Java, Indonesia E-mail: suarsini2001@yahoo.com Website: http://www.um.ac.id