

Predict-Observe-Explain Strategy with Group Investigation Effect on Students' Critical Thinking Skills and Learning Achievement

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Abstract

This study aimed to identify the effect of Predict-Observe-Explain (POE) learning strategy with Group Investigation (GI) model on students' learning achievement and critical thinking skills. The method used was Quasi Experimental Design type Control Group Pre-test – Post-test. Instrument for assessing learning achievement was test, while critical thinking skills were measured with observation sheets. Content and construct validity were used to make the instruments valid and reliable. Data analysis techniques used were independent t-test, one tail (right) test, N-gain test, analysis of observation sheet with checklist formula, and product moment correlation test. The study showed that the implementation of POE learning strategy with GI model had significantly effected students' learning achievement and critical thinking skills. Data analysis showed t_{value} was 73.42 which meant the experiment class had higher score than control class. N-gain mean score for experiment class was 0.18, meanwhile control class was 0.9. There were nine students' critical thinking skill profiles which were showed significantly from the observation sheets. Critical thinking skills were also correlated significantly to students' learning achievement. The implementation of POE strategy with GI model in providing benefits to train students to find their new knowledge, to improve their learning achievement and critical thinking skill, as well as to improve the quality of learning was discussed.

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INTRODUCTION

Learning outcomes and critical thinking skills of students in Indonesia are still quite apprehensive. This situation is described by facts that achievement of Indonesia in the 2015 Program for International Student Assessment (PISA), ranked 62 out of 72 participating countries. Indonesia's ranking shows that most students are still weak in their knowledge; an observation conducted in one of elementary schools in Semarang City, SDN Muktiharjo Kidul 01 Semarang on Learning Theme 1 - The Beautifulnes of Togetherness, Sub Theme 1 - Cultural Diversity of My Country. In the process of learning, teacher have implemented the 2013 curriculum. The cognitive learning outcomes of fourth grade students were good enough. But according to teachers, students' critical thinking skills were still low because only some students who have superior reputation in its class were active; many researchers has been done many studies to solve these problems. Most researchers mentioned that the cause of student's low learning outcomes is because the learning process still using traditional methods. The learning is teacher-centered, making the students passive, and not critical in responding to a problem.

Indonesia currently uses the 2013 curriculum, focusing on integrated learning with a scientific approach that requires students to find their own knowledge. The learning process trains students in observing, questioning, trying, reasoning and communicating (Nafi'ah, 2015). This process plays an important role in improving the quality of education in Indonesia. It needs strategies and learning models that can help students being active and stimulate students to think critically. One of learning strategies and models that can support student-centered learning and train students' critical thinking skills through direct observation on the real objects are Predict-Observe-Explain (POE) strategy and cooperative learning model Group Investigation (GI).

Liew (2004), stated that POE learning strategy is effective for teachers in knowing the extent of observation and prediction results

presented by students so that teachers can determine the follow-up for the next learning activities. Many studies have proven the effect of POE in learning process such as studies by Tlala (2011), Teerasong, et al. (2010), as well as Adebayo, and Olufunke (2015).

GI model is a cooperative learning model suitable for discovery learning. According to Sharan and Sharan (in Akçay N. O., 2012), GI has three main advantages namely inquiry, knowledge, and group dynamics. Mun Fie, et al. (2004) explained that GI model is known to be able to create this kind of learning situation well. Several studies have shown positive effects in learning with GI model such as studies by Makhmudah (2012), Pitoyo, et al. (2014), Phil Seok Oh, and Myeong-Kyeong Shin cited by Ulfi (2011), as well as Adora (2014).

From the several studies results described, it can be concluded that the POE strategy and GI model has many benefits. They are to train students to find their own knowledge, practice teamwork, and to improve the quality of learning. However, no study has been done to analyze the effect on learning outcomes and critical thinking skills of elementary students when the strategy and model are combined. Therefore this study aims to determine the POE learning strategy with GI model effect on critical thinking skills and learning achievement on 4th grade elementary school students.

METHODS

This study was using Quasi-Experimental Design type Control Group Pre-test-Post-test. The design chart according to Arikunto (2010) is as follows.

E	0 ₁	X	0 ₂
<hr/>			
K	0 ₃	X	0 ₄

Information:

E is experimental group (*POE and GI*)

K is control group (*conventional*)

0₁ and 0₃ are pre-test

0₂ and 0₄ are post-test

The population in this study was all the fourth grade students in SDN Muktiharjo Kidul 01 Semarang which two classes in total. The sample of the study was determined by using non probability sampling technique of saturated sampling type, that was the technique of determining the sample by using all members of the population as samples. All members of the population were used as study samples because the number of population consists of only two classes. Therefore the samples in this study were the students of class IVA as control group and IVB as experiment group that have been tested and both were homogeneous.

The independent variable in this study was POE strategy with GI model. The dependent variable were students' learning achievement and critical thinking skill. The control variables in this study were the parents' educational background and job, the ability of the teacher, the condition of the class, the subject material, the facilities and the infrastructure, and the time lesson.

The instrument for measuring the cognitive aspects of learning achievement was tested, whereas critical thinking skill was measured by observation sheets. In this study the test to be tested was an evaluation test of multiple choice questions.

Data analysis of students' cognitive learning result was calculated with the help of SPSS 16 program using independent t-test with H_0 accepted test criteria if significant value > 0.05 . The difference in post-test score averages of both classes calculated by the right-side test analysis. The effect of POE strategy with GI model on critical thinking skill was measured by observation sheets in the form of checklist can be calculated by the average formula. Improvement of learning achievement after the implementation of POE strategy with the GI model were analyzed based on the ratio of normalized gain values (N-gain) between the experimental and control groups.

The critical thinking skill profiles after the implementation of POE strategy with the GI model was described in accordance with the analysis of the critical thinking skill observation sheets. Correlation or relationship between

students' critical thinking skill and learning achievement after the implementation of POE strategy with GI model was analyzed by product moment correlation formula. The significance test of product moment correlation identified by looking at r product moment table with 5% error rate.

RESULTS AND DISCUSSION

Analysis of learning achievement was done with the help of SPSS 16 program and resulted in t_{value} of 73.423 $> t_{\text{table}}$ with $df = 49$ and $\text{sig (1-tailed)} = 0.05$ was 1.676, it can be concluded that the average score of experiment class was higher than control class. This indicated that the learning achievement of students applied POE learning strategy with GI model were better than those who applied conventional method. Classical passing score with minimum criteria of mastery learning (70) were obtained 76% for control class students, and 92% for experimental class students (Figure 1).

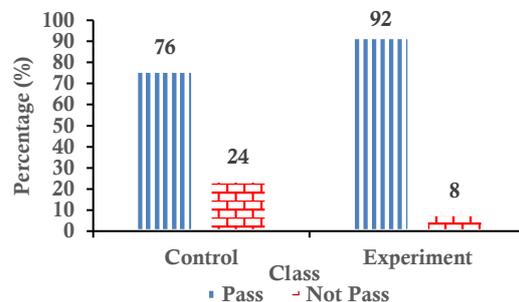


Figure 1. Classical Average Score Percentage

A comparison of the pre-test and post-test scores of the control class and experimental class is presented in Figure 2.

The improvement of students' learning achievement was analyzed based on the ratio of normalized gain values (N-gain) between the experimental and control groups. The calculation result with the N-Gain formula is shown in Table 1.

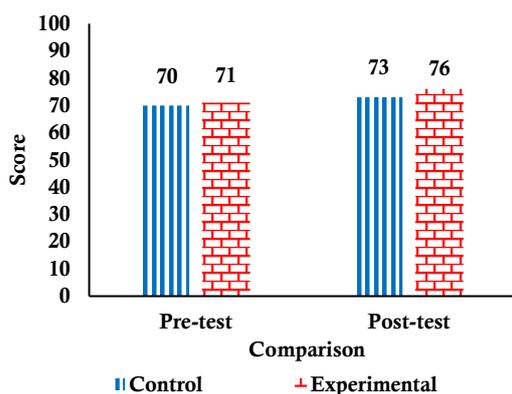


Figure 2. Pre-test and Post-test Scores of Control and Experimental Classes

Table 1. Summary of N-Gain Result of Control and Experimental Classes

Class	n	Average Score	N-Gain	Criteria
Control	25	0.09		Low
Experimental	25	0.18		Low

Learning by applying POE learning strategy with GI model gives better result. This result is in accordance with Yupani's opinion (2013) that this strategy has advantages such as stimulating students to be more creative, especially in proposing predictions, by conducting experiments to test predictions can reduce verbalism. The learning process becomes more interesting, because students not only listen but also observe directly on the object, students have the opportunity to compare between theories (conjecture) with reality. Thus the students are more confident in the fact of learning materials.

Implementation of GI model can cover the shortage of POE because for elementary students to explain ideas in the form of writing can be a barrier. Students also find it difficult to explain the reasons for their predictions. To overcome these difficulties, the learning activities in explaining the idea or prediction are done in groups with the stages of the GI model.

In the control class that used the conventional method, the learning achievement were lower than that of experiment class. This was because teacher used lecture method and directly gave the exercises, so that learning was more teacher-centered. In teaching and learning

activities, the role of teacher was as a lecturer giving the subject material, while students were just listened, wrote, and did the task. According to Van de Walle (2008), the main focus of students on conventional learning is getting answers. Teachers still guide students how to use the material they learned to do the exercises. The students rely on the teacher to determine whether the answer is right or wrong. As a result, students are kept away from the sources of knowledge that are important to them. Ruseffendi (2005) suggests that conventional learning generally has more memorizing than understanding, emphasizing calculate skills, emphasizing outcomes rather than processes, and teacher-centered teaching. According to Djamarah, and Zain (2006), the weakness of the conventional learning model are the students become passive, the lesson is dominated by the teacher and students don't get much feedback or tend to be unidirectional, and also the students don't understand the material presented by the teacher.

Improvement of students' cognitive learning achievement was still low, but their critical thinking skill were very good. This means that there has been a change in students themselves as a result of learning activities. According to Widoyoko, E. P. (2011), the changes that occur in students as a result of learning activities are non-physical such as changes in attitude, knowledge, and skills.

Effectiveness of students' critical thinking skill was analyzed by two instruments of observation sheets which results can be seen in Table 2.

Table 2. Summary of Analysis Result of Students' Observation Sheets

Observation sheet	Average score	Average value	Criteria
Implementation of POE strategy with GI model	9.04	3.62	Very good
Critical thinking skill	5.56	3.18	Good

The achievement of the aspects in the two observation sheets is described in Table 3 and Table 4.

Tabel 3. Achievement of The Aspects of POE Strategy with GI Model Implementation

Aspects of POE with GI Implementation	Number of students	Percentage (%)
Active and have role in the group	25	100
Predict the problem	25	100
Predict the problem solving solution	25	100
Doing observation to collect data	25	100
Doing observation to prove the prediction	25	100
Write observation report	25	100
Doing presentation in front of the class	16	64
Explain of the findings of an observation	16	64
Explain the comparison between the prediction and the findings	19	76
Explain their new knowledge	25	100

Based on the calculation of the observation sheet of POE strategy with GI model implementation, the average value obtained is 3.62 and included in the 'very good' criteria.

Table 4. Achievement of The Aspects of Critical Thinking Skill

Aspects of Critical Thinking Skill	Number of Students	Percentage (%)
Asking about a problem	11	44
Answering the teacher's or friend's question about the material	25	100
Able to differentiate between facts and claims	17	68
Seeking various sources as a reference to the findings	25	100
Giving opinion and explain the reason	19	76
Conclude and evaluate the findings	25	100
Explain well and orderly	16	64

Based on the calculation of the observation sheets of critical thinking skills, the average score obtained was 3.18 and was included in the good criteria. Therefore it can be concluded that the critical thinking skills of fourth grade students who experience POE strategy with GI model was considered good.

Learning with POE strategy had a great advantage in training students' critical thinking skills. Predicting activities could be used by teachers to know the students' initial understanding of a problem. Observation activities helped students to prove the truth of their prediction so that students could differentiate between claims and facts as well as made decisions about problem solving solutions. Explaining activities was useful for conveying students' understanding and new knowledge to their teachers and friends. POE strategy is in accordance with the definition of critical thinking according to Ennis (in Susanto, 2011) which states that critical thinking is a think with the goal of making sensible decisions about what is believed or done. Combined with the GI model that can help students more active in learning activities with their groups and bring various opinions into one conclusion proves that these

strategy and model have a positive effect in training students' critical thinking skills.

Based on Table 3, the average score for the observation sheet of the POE strategy with GI model implementation was 3.62 which means it has very good criteria. There were some indicators that ran optimally and got 100% percentage. They were student activities and their play role in group, conducting prediction the problem, predicting problem solving solution, conducting observation to collect data, conducting observation to prove prediction, writing observation report, and explaining their new knowledge. Implementation of POE strategy with GI model encouraged students to demonstrate scientific and critical behavior in these indicators.

As for the indicator of student did the presentation in front of the class and the indicator of student explained the findings of an observation, the researcher limits one student to get one chance doing the presentation. Therefore only 64% of students did that because the learning time did not allow all students to come in front of class. Similar to indicator of student explained the comparison between previous predictions and findings, only 76% of students had an opportunity to explain.

The second observation sheet is critical thinking observation sheet. Based on Table 4, there appears to be a significant effect of POE strategy with GI model implementation on students' critical thinking skills which was viewed from the aspects that had achievement up to 100%, which were the aspects of answered the question of teacher or friend related to the material, looked for various sources as the reference of the findings, summarized and evaluated its findings. In all three aspects, all students fulfill the indicators because at the beginning of learning the teacher did question and answer about the material, then the students conducting discussion in doing worksheets and together with their group to find the source as the reference of their findings. Once the source was obtained, students together concluded and evaluated the findings.

In addition to the three aspects above, there were some aspects that has not ran optimally. In the aspect of asking about a problem, only 44% of students did it. This was because students were more actively answering questions than asking questions. Then in the aspect of student ability to differentiate between facts and claims, 68% of students did it. This was known from question and answer session after the learning process ends. The aspect of giving an opinion and explaining the reason, there were 76% of students did it. This was seen when the teacher gave directions about the activities that the students will do and when the student representative progresses to do presentation. Many students gave similar opinions and reasons, but some were different. In the aspect of explaining well and orderly, there were 64% of students did it. This was seen during question and answer session and presentation. There were some students who only explained briefly, there were also students who gave clarified explanation accompanied by their personal opinion.

Broadly speaking, the critical thinking skills of students applying POE strategy with GI model was considered good. Aspects that had not been ran optimally can be maximized by the teacher's effort in provoking students to ask questions, giving feedback that stimulates

students' curiosity, then giving many opportunities to the students to answer, give opinions, and explain the reasons for the solution or new knowledge obtained. Activities like this need to be done continuously so that students can practice their critical thinking skills.

Learning by POE strategy with GI model required students to seek a temporary answer or prediction of a problem. This is in line with the opinions of White, and Gunstone (1992), Kearney, and Young (2007), as well as Wah and Treagust (2004) that students can use their knowledge to discover concepts. Then the students do group discussion and observation to prove the prediction and determine the solution of problem solving. This is also in accordance to Kearney, and Young (2007) and Nurjanah (2009) that the POE strategy can help students to understand the concept through direct observation and observation activity is an explanation or an answer to the problem. Kalayci (in Duran, et al. 2012) stated that the best way to equip individuals with problem-solving skills is to integrate them with critical and creative thinking, and decision making.

The GI model also plays an important role in improving students' critical thinking skills. Discussion and observation in groups encourage students more open in issuing opinions and active in learning. Opinions gathered from the group can be taken into consideration in decision making. This is supported by research conducted by Meilia, and Disman (2016) which stated that the implementation of GI model can improve students' critical thinking skills. From the explanation above, it can be concluded that the implementation of POE strategy with GI model can show the students' critical thinking skills profiles.

Correlation analysis was done to find out the correlation between students' critical thinking skills with learning achievement. The result of calculation by using correlation formula Product Moment got r_{value} equal to $0.987 > r_{\text{table}} 0.396$ ($n = 25$ and error level 0.05), so it can be concluded that there was significant relation between students' critical thinking skills with learning achievement.

The implementation of POE strategy with GI model showed that there was a correlation between students' learning achievement and critical thinking skills. According to Triwiyono as quoted by Ningsih (2012) learning with experiments is more effective in improving students' critical thinking skills. Basically students have the potential for critical thinking skills. The potential is better trained from an early age through learning that requires students to be active and is very unfortunate if it can not be developed properly (Setyorini, 2011). A person with high critical thinking skills also has the ability to hypothesis, to assume, to classify, to observe, to measure, to analyze, to draw conclusions, and to evaluate according to the criterion of critical thinking stated by Carind and Sund as quoted in Setyowati (2011). The better the students' critical thinking skills, the better learning achievement they will get. This is in line with Marzano's theory (in Gunawan, et al. 2008) which explained that critical thinking skills are required in learning activities because they can have a positive effect on student's achievement. The result of Ragasa's study (2007) also showed that critical thinking influenced learning achievement. Wu (2013) who examined the relationship of critical thinking skills with the achievement of primary and secondary school students showed that there was a relationship between critical thinking skills and learning achievement.

The implementation of POE strategy with GI model is expected to be useful theoretically and practically for students, teachers, and schools. Theoretically, this implementation can help students to build their own knowledge; to cultivate a sense of responsibility, confidence, and openness of students in group; and to improve critical thinking skills that are useful for children's brain development. Practically, this implementation can train students' critical thinking, cultivate ideas and creativity, and improve the ability to communicate with teachers and friends. By providing syllabus, lesson plans, learning resources, and learning media based on POE strategy with GI model teachers can use them to improve the quality of learning and

student activities, as well as to improve the quality of schools with teachers who are more professional, innovative, and creative in learning activities and students who are smart, active, creative, in accordance with educational goals to be achieved.

CONCLUSION

Based on the discussion of research results, it can be concluded that the implementation of POE strategy with cooperative learning GI model has positive effect on students' learning achievement and critical thinking skills. Improvement in learning achievement and the profiles of students' critical thinking skills that were achieved optimally i.e answering questions of teachers or friends related material, searching for various sources as a reference of its findings, summarizing and evaluating its findings, active and taking a role in groups, predicting the problems, predicting problem solving solutions, conducting observation to collect data and proving the predictions, writing observation reports, and explaining their new knowledge. The ability to think critically also correlates significantly to students' learning achievement.

Suggestion in this research is the implementation of POE strategy with GI model will have positive effect in learning if it's done at least in a whole themes. The use of interesting media will also help students to focus more on learning. Teachers can begin to practice the critical thinking skills of elementary students by adapting the learning to the thinking level of elementary school children.

REFERENCES

- Adebayo, F. & Olufunke, B. T. (2015). Generative and predict observe explain instructional strategies: towards enhancing basic science practical skills of lower primary school pupils. *International Journal of Elementary Education*, 4(4), 86-92. Retrieved from <http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=192&doi=10.11648/j.ijeedu.20150404.12>

- Adora, N. M. (2014). Group investigation in teaching elementary science. *International Journal of Humanities and Management Sciences (IJHMS)*, 2(3), 146-147. Retrieved from <http://www.isaet.org/images/extraimages/A1114067.pdf>
- Akçay, 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 Turkish Science Education*, 11(4). Retrieved from https://www.researchgate.net/publication/288596343_The_effect_of_different_methods_of_cooperative_learning_model_on_academic_achievement_in_physics
- Arikunto, S. (2010). *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta.
- Djamarah & Zain. (2006). *Strategi belajar mengajar*. Jakarta: Rineka Cipta.
- Duran, M. & Sendag, S. (2012). A preliminary investigation into critical thinking skills of urban high school students: role of an it/stem program. *Scientific Research Creatif Education Journal*, 3(2), 241-250. Retrieved from https://file.scirp.org/pdf/CE20120200011_48908341.pdf
- Gunawan, I., Suraya, S. N., & Tryanasari, D. (2014). Hubungan kemampuan berpikir kreatif dan kritis dengan prestasi belajar mahasiswa pada mata kuliah konsep sains ii prodi pgsd ikip pgri madiun. *Premiere Educandum Journal*, 4(1), 10-40. Retrieved from <http://e-journal.unipma.ac.id/index.php/PE/article/view/304>
- Kalayci, N. (2001). *Problem solving and applications in social studies*. Ankara: Gazi Kitapevi.
- Kearney, M. & Young, K. (2004). Classroom use of multimedia-support predict-observe-explain task in a social constructivist learning environment. *Research Science Education Journal*. 34(4), 427-453. Retrieved from <https://link.springer.com/article/10.1007/s11165-004-8795-y>
- Makhmudah, U. (2011). Efektifitas model pembelajaran group invesigation terhadap hasil belajar fisika materi pokok gerak kelas vii mtsn tanon sragen tahun ajaran 2010/2011. *Undergraduate Thesis*. Semarang: IAIN Walisongo.
- Meilia, M. & Disman. (2016). The effect of group investigation method towards critical thinking ability with students' self study moderator variable. *The Social Sciences of Medwell Journals*, 11(15), 3804-3807. Retrieved from <https://www.medwelljournals.com/abstract/?doi=sscience.2016.3804.3807>
- Mun, F. T., Nghoh, K. G., & Lian, S. C. (2004). Using group investigation for chemistry in teacher education. *Asia-Pacific Forum on Science Learning and Teaching Journal*, 5(1). Retrieved from <https://pdfs.semanticscholar.org/f5e1/f50dea6e0f96e21fe118fdb7500645c10635.pdf>
- Nafi'ah, I & Andreas, P. B. P. (2015). Analisis kebiasaan berpikir kritis siswa saat pembelajaran ipa kurikulum 2013 berpendekatan scientific. *Journal of Biology Education*, 4(1), 53-59. Retrieved from <https://journal.unnes.ac.id/sju/index.php/ujbe/article/view/5234>
- Ningsih, S. M., Subali, B., & Sopyan, A. (2012). Implementasi model pembelajaran process oriented guided inquiry learning (pogil) untuk meningkatkan kemampuan berpikir kritis siswa. *Unnes Physics Education Journal*, 1(2), 44-52. Retrieved from <http://journal.unnes.ac.id/sju/index.php/upej/article/view/1364>
- OECD. (2016). *Country note - programme of international students achievement indonesia result from pisa 2015*. Retrieved from <https://www.oecd.org/pisa/PISA-2015-Indonesia.pdf>
- Pitoyo, A., Waluyo, Herman, J., Suwandi, Sarwiji, Andayani. (2014). The effect of group investigation learning model, accelerated learning team and role playing on elementary school students' writing skills viewed from cognitive style. *Journal of Education and Practice*, 5(1), 21-29. Retrieved from <http://www.iiste.org/Journals/index.php/JEP/article/view/10406>
- Ragasa, C. Y. (2007). *A correlation of critical thinking with achievement in statistics and attitude toward statistic*. Retrieved from <http://www.icmel1.org/node/1375>
- Setyorini, U., Sukiswo, S. E., & Subali, B. (2011). Penerapan model problem based learning untuk meningkatkan kemampuan berpikir kritis siswa smp. *Jurnal Pendidikan Fisika Indonesia*, 7(1), 52-56. Retrieved from <https://journal.unnes.ac.id/nju/index.php/JPI/article/view/1070/0>
- Setyowati, A., Subali, B., & Mosik. (2011). Implementasi pendekatan konflik kognitif dalam pembelajaran fisika untuk menumbuhkan kemampuan berpikir kritis

- siswa smp kelas vii. *Jurnal Pendidikan Fisika Indonesia*, 7(2), 89-96. Retrieved from <http://journal.unnes.ac.id/nju//index.php/J PFI/article/view/1078>
- Sharan, Y. & Sharan, S. (2014). Gi expands cooperative learning. *Educational Leadership*. 47(4), 17-21. Retrieved from http://www.ascd.org/ASCD/pdf/journals/e d_lead/el_198912_sharan.pdf
- Susanto, A. (2011). *Perkembangan anak usia dini*. Jakarta: Kencana. Prenada Media Group.
- Teerasong, S., Wanrawee, C., Pintip, R., & Duangjai, N. (2010). Development of a predict-observe-explain strategy for teaching flow injection at undergraduate chemistry. *The International Journal of Learning*, 17(8), 137-150. Retrieved from <http://www.il.mahidol.ac.th/office/ra/image s/research/pdf/2553/7-2553.pdf>
- Tlala, K. M. (2011). The effect of predict-observe-explain strategy on learner's misconceptions about dissolved salts. *Mini Dissertation*. South Africa: Univesity of Limpopo.
- Ulfi, K., Subali, B., & Hendratto. (2011). Penerapan model pembelajaran group investigation pada siswa kelas viii smp untuk menumbuhkan kemampuan memecahkan masalah. *Undergraduate Thesis*. Semarang: Universitas Negeri Semarang.
- Van D. W, & John. A. (2008). *Matematika sekolah dasar dan menengah*. Jakarta: Erlangga.
- Yupani, N., Garminah, N., & Mahadewi, L. (2013). Pengaruh model pembelajaran poe berbantuan materi bermuatan kearifan lokal terhadap hasil belajar ipa siswa kelas iv. *Undergraduate Thesis*. Singaraja: Universitas Pendidikan Ganesha.
- Wah, L. C. & Treagust, D. (2004). *The effectiveness predict - observe - explain (poe) technique in diagnosing student's understanding of science and identifying their level of achievement*. Australia: Curtin University of Technology.
- White, R. T., & Gunstone, R. F. (2014). *Probing understanding*. Great Britain: Falmer Press.
- Widoyoko, E. P. (2011). *Evaluasi program pembelajaran paduan praktis bagi pendidik dan calon pendidik*. Yogyakarta: Pustaka Pelajar.
- Wu, J. J., & Yeh, Y. C. (2013). *The relationship between critical thinking and academic achievement among elementary and secondary school students*. Retrieved from <http://www.fed.cuhk.edu.hk>