

## Analysis of Quantum Learning Model with Peer Assessment on Achievement Student's Critical Thinking Skill in Mathematics

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### Abstract

This research aims to analyze mathematics critical thinking of students on Quantum Learning model with Peer Assessment. This mixed method with sequential explanatory took fifth graders of whole Mayong district, Jepara municipal, in academic year 2018/2019 as the population. The sample consisted of chosen classes: VA and VB. The subjects were six VA students chosen based on three critical thinking groups: high, moderate, and poor. The techniques of collecting data used mathematics critical thinking skill test, peer assessment observation, and interview. The findings showed that Quantum Learning model learning with Peer Assessment was effective to improve mathematics critical thinking skill. On high group category students, they could meet all indicators well. The moderate group students had not been able to meet an indicator, the evaluation. The poor group category students had two unfulfilled indicators, namely evaluation and explanation. Based on the data obtained, it can be concluded that the quantum learning model with peer assessment is effective in improving student's critical thinking skill in mathematics.

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## INTRODUCTION

Based on Trends International Mathematics and Science Study (TIMSS) in 2015, it was reported that Indonesia was on 44<sup>th</sup> rank out of 49 countries with score 397 (IEA, 2016). It proved that mathematics skill in Indonesia was low. It indicated that there were several things in education to improve.

The problems became reflection for Indonesian education word, especially primary level to create active, creative, and innovative as well to have roles in fostering students' intelligence (Widiana & Jampel, 2018:247). Students with higher motivation to learn would get better learning achievement. It is influenced by good learning process. Good learning process should be adjusted to characteristics of students so that they could better understand the materials.

The 21<sup>st</sup> century mathematics learning has 4C purposes: Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation (Arifin, 2017:93). Those characteristics are included in critical thinking skill. Mite (2017) stated that critical thinking is an important asset for human since it is a part of self-matureness. The components consisting in critical thinking skill can train their thinking skill and obtain understanding of a fact and concept which could improve learning achievement.

Mathematics critical thinking skill is reliability of thinking effectively to facilitate an individual creating, evaluating, and making decision upon what is believed and done (Jumaisyaroh, 2015:88). So, critical thinking is cognitive thinking process with various skills in identifying, analyzing, and evaluating argument and claiming the truth, seeking elements in concluding, and explaining thought in certain situation.

Teaching and learning activities cannot only just focus on cognitive aspect but also it should be emphasized on other skills. One of cognitive aspects is critical thinking skill (Wicaksono, 2014:90). Critical thinking skill could be developed or strengthened through

learning process. It could develop cognitive skill of a certain lesson and critical thinking skill.

Based on the explanations and supports from observation and interview with teachers SDN 1 Sengonbugel, Mayong district, Jepara municipal, it was found that learning mathematics had not been done innovatively so learning process was not optimal. There were many influential factors, such as teachers, students, and learning facilities.

Teacher is the important factor in learning process. In the school, during mathematics lesson, the teacher only explained the material from the used learning sources. It seemed monotonous with same stages done. Teacher had not used innovative learning model during teaching. The media were not varied so learning was considered boring by some students.

Students' difficulties in mathematics learning were they thought mathematics was difficult. They thought there were many calculations to do. They seemed to apply their memorization rather than understanding to solve each learning. It was not effective in learning. The students rarely shared opinions in learning so their thinking ability to criticize a problem is very low.

Mathematics learning model selection is an influential factor affecting learning achievement. Teachers are motivated to be able to choose appropriate model to mediate mathematics abstractive unique feature and its other complex features to low critical thinking skill level of students.

A learning model contributing greatly in creating joyful and transparent situations is Quantum Learning. Santoso (2016) showed there were several positive influences in using the learning model toward mathematics critical thinking skill of students. It could be seen from the final score of the learning model utilization. It was better than direct learning toward critical thinking.

Quantum Learning is innovative learning since its design or realization techniques are not conservatives. It means the model does not only focus on teacher and is constructive for students (Martini, 2014). In this case, the learning is more

student centered. Students are not only information recipients but also active in learning. Quantum Learning also provides awareness for students about importance of learning. It is in line with Ahsin (2016:161) stating that Quantum Learning is a joyful strategy of method to motivate students in learning. DePorter in Siswoyo (2016:35) stated that Quantum Learning really emphasized on meaningful and qualified learning process. Such learning is surely done by well-arranged plan.

Quantum Learning model is a teaching which changes learning situation into joyful and it could improve skill and natural talent of students to be more useful for them and other people (Wahyuni, 2014). It is concluded that Quantum Learning is a learning which can create joyful learning and motivate students in learning. It also can promote effective learning because the learning stages in the model uses existential elements of students and their surrounding environments to put long-term effects on students.

Quantum Learning model is done through several appropriate stages. According to De Porter in Sudarman (2016:276) stated that several stages in Quantum Learning existed. There are 6 stages known as TANDUR: develop, experience, name, demonstrate, repeat, and celebrate so that learning can go smoothly.

Heretofore, many assessment system focuses on teachers. It means teachers assessing students. Thus, students cannot judge their weakness and strength in learning. Innovative assessment has not been fully implemented in higher educational level although it actually has broader applications (Zevenbergen, 2001). Therefore, an assessment system is needed that can make students more active, that is peer assessment.

According to White (2009:30), the response survey showed that students' perspective taught by using peer assessment generally was positive and could promote students' learning. Peer assessment, according to Wilfried (2014), it must promote student learning. Peer assessment according to him should: 1) be simple and understandable for

students; 2) be efficient to be executed (no need to have longer time), and 3) not ask assessor to not assess more than one task of other students.

The assessment cannot only rely on test but also assessment to monitor whole process. This assessment done by students when they demonstrate during quantum learning model. According to Nurhadini (2017:74) that peer assessment would facilitate students in critically thinking. They will be habitualized to evaluate and analyze a problem found in his friends.

Students' participation in the activity makes them could cooperate and criticize both their learning process and their friends. It is supported Harsono (2014) whom stated that peer assessment involved students directly to assess.

Based on the explanations, it is important to find out effectiveness of Quantum Learning model with Peer Assessment and analyze comprehensively mathematics critical thinking skill of the students on the learning model.

## METHODS

This reseach used mixed method with sequential explanatory design. The design is a combination design that combines quantitative and qualitative research methods in sequence. The first phase of this method is done with quantitative research, the next stage is qualitative research to strengthen the results of quantitative research.

The population consisted of fifth graders of whole public primary schools in Mayong district, Jepara municipal, in academic year 2018 – 2019. The sample consisted of VA class students from SDN 1 Segonbugel as experimental group and VB class students from the school as control group selected by simple random sampling. The subjects were based on mathematics critical thinking skill with three categorizations: high, moderate, and poor. Two participants were selected for each group randomly.

The used data in this research were student mathematics critical thinking skill, student observation data, and interview result data. The result of mathematics critical thinking skill was analyzed to find out Quantum Learning model

with Peer Assessment effectiveness. Techniques of analyzing quantitative data was done by normality, homogeneity, and effectiveness test consisted of individual passing grade, classical passing grade, and comparative test. The qualitative data was analyzed by using data reduction, presentation, and conclusion.

## RESULTS AND DISCUSSION

This quantitative research was used to test effectiveness of the Quantum Learning and Peer Assessment toward mathematics critical thinking skill of the students. After being researched, the obtained data was analyzed and was tested by normality test as shown on Table 1.

**Table 1.** Result of Data Normality Test

	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Experimental	,150	32	,064
Control	,142	32	,103

The table shows that the significant score of experimental group's normality test was  $0.070 > 0.05$ . It meant the data was normally distributed. Then, homogeneity test showed that the significant score was  $0.070 > 0.05$ , meaning the data was homogeneous.

Besides normality and homogeneity tests, hypothesis test was also used. It was done on individual passing grade, classical passing grade, and comparative tests. The result of hypothesis test is shown on Table. 2.

**Table 2.** Hypothesis Test of Mathematics Critical Thinking Skill of The Students

Hypothesis test	Results	Information
Individual passing grade	$9.21 \geq 1.69$	H <sub>0</sub> denied
Classical passing grade	$2.05 \geq 1.65$	H <sub>0</sub> denied
Comparative test	$1.92 \geq 1.69$	H <sub>0</sub> denied

Table 2 shows that the individual passing grade test result showed the average of mathematics critical thinking skill of students taught by Quantum Learning model and Peer Assessment passed the minimum passing grade that is 60.

Quantum Learning and Peer Assessment passed the minimum passing grade, 60. The analysis result of classical passing grade test

showed that passing grade proportion taught by Quantum Learning and Peer Assessment was higher than 75%. Meanwhile, on comparative test, the result showed that average of mathematics critical thinking skill taught by Quantum Learning and Peer Assessment was higher than average score of students taught by Quantum Learning and Peer Assessment with Direct Instruction.

There are 6 stages in the quantum learning model, which are: develop, experience, name, demonstrate, repeat, and celebrate. Develop, at the beginning of learning activities teachers must try to develop students' interest in learning. Naturally, the learning process by involving students directly in the material with props that support. Name, discuss student worksheets and write data that has been found. Demonstration, present the results of the discussion in front of the class.

Next stages are repeat, students and teachers ask questions and summarize the material that has been learned. Celebrate, the group that gets the highest score will get a rewards from the teacher. Peer assessment is carried out during the student group discussion and final assessment. Each student assesses the activity of his friends in groups and assesses the results of tests that have been done by their friends.

Qualitatively, the research was done to analyze mathematics critical thinking skill of students based on the categorization. The analysis could be seen from the indicators: interpreting, analyzing, evaluating, inferring, explaining, and self-regulating. As explained by Facione (2013:5), the six indicators of critical thinking skills are interpreting, analyzing, evaluating, inferring, explaining, and self-regulating which are connected to critical thinking.

VA class students at SDN 1 Sungonbugle consisted of 32 students. The subjects were 6 students categorized into high, moderate, and poor student categories. Each category consisted of two students. Each subject was analyzed his mathematics critical thinking skill based on the determined indicators as seen on Table 3.

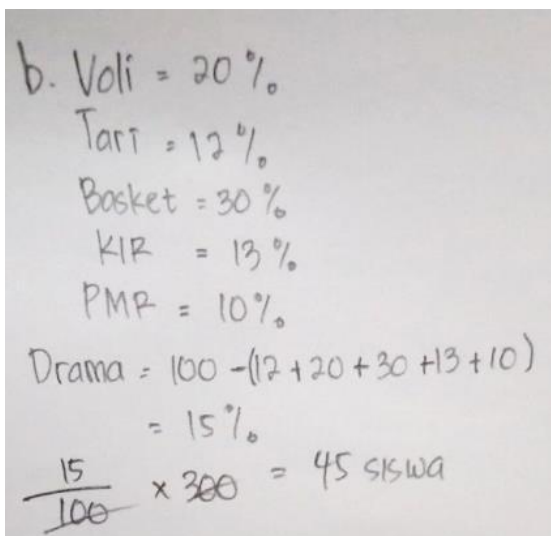
**Table 3.** Analysis of Mathematics Critical Thinking Skill of The Students

Indicators	Subjects		
	High	Moderate	Poor
Interpreting	Capable	Capable	Capable
Analyzing	Capable	Capable	Capable
Evaluating	Capable	Incapable	Incapable
Inferring	Capable	Capable	Capable
Explaining	Capable	Capable	Incapable
Self-regulating	Capable	Capable	Capable

From the table, high category students could do all six indicators well. They could understand, explain, explain the relationship among data, and explain problem and appropriate strategy, and writing completely.

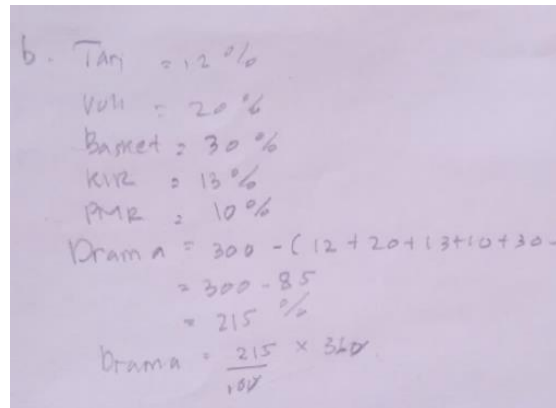
The moderate category students were incapable to accomplish an indicator, evaluation. The students had not been able to solve problems by using appropriate and correct strategies. Meanwhile, the poor category students had two unaccomplished indicators: evaluation and explanation.

There are example of student work results in high, moderate, and poor categorized.



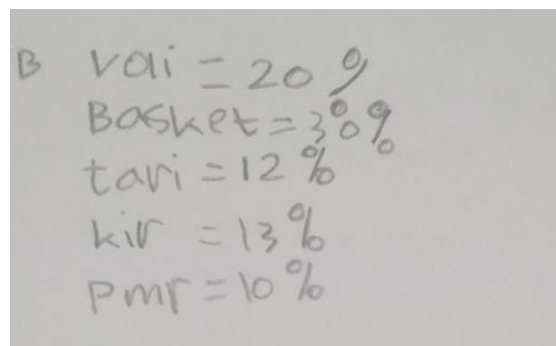
**Figure 1.** Student Work Result in High Category

The answer in Figure 1 shows that students are able to write answers according to the problem, namely explain how to determine the part of Drama extracurricular and determine the many students who take extracurricular drama. This means that the student code can explain the results of the information that already exists with the problem in the problem.



**Figure 2.** Student Work Result in Moderate Category

The answer in Figure 2 shows that student have not been able to write answers according to the problem, it is evident that students do not understand if the percent in a circle is 100%. So when students determine the number of percentages of drama extracurricular get 215% with a total percentage of 300. This means that students have not been able to explain the results of information that already exists with the problems in the problem.



**Figure 3.** Student Work Result in Poor Category

The answer in Figure 3 shows that student have not been able to write answers according to the problem. Students have not explained how to determine the part of Drama extracurricular and determine the many students who take extracurricular drama. On the results of student work, students only write data that is known in question number 4. This means that students cannot explain the results of information that already exists with the problems in the problem.

The implementation of Quantum Learning and Peer Assessment was used to improve mathematics critical thinking skill of the students. Kirom (2017:71) stated that teacher should be able to create good learning condition and involve students so that teacher should have various strategies, methods, and effective model to develop quality and potency of students in improving critical thinking skill in mathematics. It is in line with the opinion, Ridho (2019:11) stated that critical thinking skill would be difficult to be owned by students if the learning process did not implement learning model which trained students' critical thinking.

According to Saputro (2018:31), quantum learning requires students to draw conclusion by themselves upon their already learnt materials. If they could make their own conclusion, then it could train their thinking skills in solving problem. In line with the opinion, Quantum Learning model could be used as interaction of learning combination which the activities had been proved in education (Altin, 2019: 1085). Result of reasech from Saputro (2018:36), Quantum Learning influenced high order thinking skill of students.

Quantum Learning model is also a learning model to habitualize students comfortably and joyfully learn in the class. It has benefits such as fostering positive attitude, motivating, providing long – term learning skill, fostering confidence, and fostering students' successes (Kusumawardani, 2016). Due to the model, students would be more confident in sharing opinion, happier in learning, and motivated in thinking.

Mathematics critical thinking skill is a thinking skill owned by each individual. This skill deals with mathematics learning. Critical thinking and mathematics cannot be separated. Mathematics critical thinking involves cognitive process, analysis, rationale, logic, and reflective thinking of a problem (Ningsih, 2012:45).

Main habit which can develop critical thinking skill is posting question (Mendelovici, 2012:384). It showed that critical thinking skill was useful to check the correctness of information so students would decide a piece of information

was worth to accept or deny (Kalelioglu, 2013:249). Therefore, mathematics critical thinking skill is needed to solve problems in mathematics learning.

In this research, an analysis of mathematics critical thinking skill of the students was done. The analysis was done based on mathematics critical thinking skill test result and the interview done with the subjects analyzed as respondents. The analysis was done by describing mathematics critical thinking skill of the students.

Not all of the students could solve the questions well. The students should have high order thinking skill to solve the problems. According to Hidayati (2016:120) stating that when students had critical thinking skill then they could develop themselves to create, assess, and solve problems.

On high category students, all indicators could be done well. The moderate typed students could not accomplish on an indicator, evaluation, since they could not master the ways or strategies to solve problems on the questions. Meanwhile, the poor category students had two unaccomplished indicators: evaluation and explanation. In evaluation indicators, students failed to determine the ways to solve the problems. Meanwhile, in explanation, students did not understand the problems on the questions.

The researcher had designed the learning so for experimental group with purpose to habitualize them thinking critically in solving problem. Quantum Learning model and Peer Assessment done for experimental group brought positive effects for them. The students were more active, happier, more confident, and more responsible in utilizing critical thinking through the given problems.

According to Haryani (2012:167), attitudes and ways to think critically could be developed through learning mathematics process based on the concepts, strong structure and relevance to promote critical thinking skill. In line with the notion, Amir (2015) told that critical thinking did not mean the persons should be able in debating by insisting his misleading opinion or assumption. However, he should be able to

provide solution of the problems and it should have strong evidence, rationale, and carefulness.

According to Setyorini (2011:54), basically, students had potency to think critically. The potency could be better when it is trained as early as possible through active learning. It will be unfortunate if they cannot develop the skill well. Therefore, the implementation of Quantum Learning with Peer Assessment could train mathematics critical thinking skill of students. It could be seen on each indicator and result of students' interviews.

## CONCLUSION

Based on the findings, it could be concluded that Quantum Learning with Peer Assessment was effective. The result of mathematics critical thinking skill of the students showed from six students of each group, the high category student could do all indicators well. The moderate type students could not accomplish an indicator, evaluation. The poor category students only could accomplished two indicators: evaluation and explanation.

## CONCLUSION

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## REFERENCES

- Ahsin, M. N. 2016. Peningkatan Keterampilan Menulis Karangan Narasi dengan Menggunakan Media Audiovisual dan Metode Quantum Learning. *Jurnal Refleksi Edukatika*, 6(2), 158–171.
- Altin, M dan Saracaloglu, A.S. 2019. The effect of Quantum learning model on foreign language speaking skills, speaking anxiety and self-efficacy of secondary school students. *Journal of Language and Linguistic Studies*, 15(3), 1083-1104.
- Amir, M.F. 2015. Proses Berpikir Kritis Siswa Sekolah Dasar dalam Memecahkan Masalah Berbentuk Soal Cerita Matematika Berdasarkan Gaya Belajar. *Jurnal Math Educator Nusantara*, 1(2), 159-170.
- Arifin, Z. 2017. Nasional Pendidikan dengan tema “Isu-isu Strategis Pembelajaran MIPA Abad 21. *Jurnal THEOREMS (The Original Research of Mathematics)*, 1(2), 92-100.
- Facione, P.A. 2013. *Critical Thinking: What It Is and Why It Counts*. Measured Reasons and The California Academic Press, Millbrae, CA.
- Harsono, E., Suparmi, dan Cari. 2014. Pembelajaran Fisika Menggunakan Model STAD Dengan Peer Assesment Untuk Meningkatkan Kemampuan Penalaran Analitis dan Prestasi Belajar Siswa Kelas XI IPA. *Jurnal Inkuiri*, 3(3), 107–119.
- Haryani, D. 2011. Pembelajaran Matematika dengan Pemecahan Masalah untuk Menumbuhkembangkan Kemampuan Berpikir Kritis Siswa. *Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan*, 2(1), 121-126.
- Hidayati, N. 2016. Hasil Belajar dan Keterampilan Berpikir Kritis Siswa Madrasah Tsanawiyah dalam Pembelajaran IPA Melalui Kerja Ilmiah. *Proceeding Biology Education Conference*, 13(1), 118-127.
- IEA (2016) TIMSS 2015 International Results in Mathematics, [Online] Tersedia :<http://timss2015.org/timss-2015/mathematics/student-achievement/>, 15 Februari 2018
- Jumaisyaroh T., E.E. Napitupulu, E.E., dan Hasratuddin. 2014. Peningkatan Kemampuan Berpikir Kritis Matematis dan Kemandirian Belajar Siswa SMP melalui Pembelajaran Berbasis Masalah. *Jurnal Kreano*, 5(2), 157-169.
- Kalelioglu, F dan Gilbahar, Y. 2013. The Effect of Instructional Techniques on Critical Thinking and Critical Thinking. *Education Technology & Society*, 17(1), 248-258.
- Kirom, A. 2017. Peran Guru dan Peserta Didik dalam Proses Pembelajaran Berbasis Multikultural. *Jurnal Pendidikan Agama Islam*, 3(1), 69-80.
- Kusumawardani, I. 2016. Penerapan Quantum Learning Untuk Meningkatkan Motivasi Belajar Siswa Pelajaran PKN Kelas VA SDN Punguran. *Jurnal Pendidikan Guru Sekolah Dasar*, 2(1), 923–933.
- Mendelovici, R. dan Zion, M. 2012. Moving from Structured to Open Inquiry Challenges and Limits. *Journal Science Education International*. 23(4). 383—399.
- Mite, Y dan Corobima, A.D. 2017. Education The correlation between critical thinking and the learning results of the senior high school students in biology learning implementing

- group investigation (gi) learning in Malang. *Journal of Applied and Advanced Research*, 2(2), 56-62
- Ningsih, S.M., Subali, B., dan Sopyan, A. 2012. Implementasi Model Pembelajaran Process Oriented Guided Inquiry Learning (POGIL) untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Physics Education Journal*, 1(2), 44-52.
- Nurhardini, R. 2017. Pengaruh Self dan Peer Assessment pada Materi Ekosistem Terhadap Berpikir Aplikatif dan Kritis Siswa SMA, *Jurnal Pendidikan Matematika dan Sains*, 5(1), 69-76.
- Ridho, S., Ruwiyatun, Subali, B., dan Marwoto, P. 2019. Analisis Kemampuan Berpikir Kritis Siswa Pokok Bahasan Klasifikasi Materi dan Perubahannya. *Jurnal Penelitian Pendidikan IPA*, 6(1), 10-15.
- Santoso, E. 2016. Pengaruh Penggunaan Model Pembelajaran Quantum Terhadap Kemampuan Berpikir Kritis Matematik Peserta Didik. *Jurnal Cakrawala Pendas*, 2(1), 55-69.
- Saputro, T dan Latifah, S. 2018. Efektifitas Metode Pembelajaran *Quantum Learning* Terhadap Kemampuan Berpikir Tingkat Tinggi Peserta Didik Kelas X MA. *Indonesian Journal of Science and Mathematics Education*, 1(2), 29-37.
- Setyorini, U., Sukiswo, S.E., dan Subali. B. 2011. Penerapan Model Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan Fisika Indonesia*, 7(1), 52-56.
- Siswoyo, A.A dan Retno, Y.A. 2016. Pengembangan Perangkat Pembelajaran Tematik Berbasis Quantum Learning Berdasarkan Pendekatan Saintifik. *Jurnal Widyagogik*, 4(1), 33-43.
- Sudarman, S. W. dan I. V. 2016. Efektifitas Penggunaan Metode Pembelajaran Quantum Learning terhadap Kemampuan Pemahaman Konsep Matematis Mahasiswa. *Jurnal Pendiidkan Matematika*, 7(2), 275-282.
- Wahyuni, A.A.I.A., Candiasa, I M., dan Suarni, K. 2014. “Pengaruh Model Pembelajaran Kuantum Berorientasi PMR dan Asesmen Otentik Terhadap Hasil Belajar Matematika Peserta Didik Kelas VIII SMP Negeri 1 Payangan”. *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, 3(4), 86-97.
- White, E. 2009. Student Perspectives of Peer Assessment for Learning in a Public Speaking Course. *Asian EFL Journal - Professional Teaching Articles*, 33(1), 1-55.
- Wicaksono, A.C. 2014. Hubungan Keterampilan Metakognitif dan Berpikir Kritis terhadap Hasil Belajar Kognitif Siswa SMA pada Pembelajaran Biologi dengan Strategi Reciprocal Teaching. *Jurnal Pendidikan Sains*, 2(2), 85-92.
- Widiana, I.W., dan Jampel, I.N. 2018. Improving Students' Creative Thinking and Achievement through The Implementation of Multiple Intelligence Approach with Mind Mapping. *International Journal of Evaluation and Research in Education (IJERE)*, 5(3), 246-255.
- Wilfried, A., Huisman, B., dan Maarten. 2014. Selft and Peer Assessment in Massive Open Online Courses. *International Journal of Higher Education*, 3(3), 119-128.
- Zevenbergen, R. 2001. Peer Assessment of Student Constructed Posters: *Journal of Mathematics Teacher Education*, 4(1), 95-113.