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Implementation of Flipped Classroom Learning Model to Increase Student's Critical Thinking Ability

Yuliana Putri✉, Edy Cahyono, Dyah Rini Indriyanti

Pascasarjana, Universitas Negeri Semarang, Indonesia

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Abstract

Students must have critical thinking ability and utilize ICT in the learning process to face the challenges of 21st century learning. Likewise, in biology learning accompanied by contextual learning related to everyday life such as the concept of environmental change. Technological developments also need to be maximally utilized in the learning process by flipped classroom learning. This study aims to know the increase in students' critical thinking ability towards flipped classroom learning model. This research method used a quasi-experimental design with a non-equivalent pretest posttest control group design. The subjects of this study included students of class XMIPA 1 and XMIPA 2 at SMAN 1 Palimanan. The results showed that there is a difference in the increase in critical thinking ability between the experimental class and the control class. The experimental class has a higher N-gain than the control class. The independent sample T test hypothesis test shows that the N-Gain significance value is less than the alpha value, which means that there is a significant difference in critical thinking skills between the experimental class and the control class. Based on the research conducted, it can be concluded that flipped classroom learning can increase students' critical thinking ability in environmental change material.

✉ correspondence :
Pascasarjana, Universitas Negeri Semarang, Indonesia
Jalan Kelud Utara III No.37, Semarang, Jawa Tengah, Indonesia
50237
E-mail: yulianaputri044@gmail.com

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INTRODUCTION

Life in the 21st century requires a variety of abilities that must be mastered by someone, it is hoped that education can prepare students to master these various abilities so that they become successful individuals in life. Zubaidah (2017) states that important abilities in the 21st century are still relevant to the four pillars of life which include learning to know, learning to do, learning to be and learning to live together. The four principles each contain specific skills that need to be empowered in learning activities, such as critical thinking skills, problem solving, metacognition, communication, collaboration, innovation and creation, information literacy, and various other abilities. This achievement is emphasized on the learning process, including biology learning.

Biological concepts in order to be maximally conveyed and associated with every day or contextual life which requires students to have critical thinking ability, of course, it is necessary to apply a learning model. The current recommended learning model is a learning model that requires students to actively compile their own knowledge (student centered). One learning model that requires students to be active in the learning process is the flipped classroom learning model. The flipped classroom learning model is very much in line with 21st century education in line with the rapid development of ICT.

Flipped classroom is a learning model that provides time outside the classroom, while at home student's find and study the material to be learnt in class first. The allocation of learning time in class is maximally used by students to collaborate with peers, practice, and receive feedback on their learning progress. Students will find it easier to build their own knowledge when participating in classroom learning.

The flipped classroom learning model aims to reform ordinary teaching methods that are inefficient and often fail to engage students in the classroom with a concept where school task is done at home and homework is done at school. This model is also known as an "inverted classroom" (Bergmann & Sams, 2012). The flipped classroom learning model can be used by teachers to improve students' critical thinking ability. One indication that problem-solving ability that train students' critical thinking ability through TIMSS (Trends in International Mathematics and Science Study) and PISA (Program for International Student Assessment) that the quality of education in Indonesia is still low. The latest TIMSS results, namely in 2015 which measured abilities in the fields of mathematics and science, Indonesia was ranked 44th out of 49 countries (Nizam, 2016). PISA 2018 assesses Indonesian students' reading literacy skills at 371, math abilities at 379, and science skills at 396. Indonesia is in the bottom 10 rankings (OECD, 2018).

According to those things students' critical thinking ability need to be improved again, the application of the flipped classroom learning model requires tools in the form of social network media that carry learning content. One of the learning social networks that can be easily used is edmodo. Edmodo is a software or website of learning social network that students can use on mobile phones, tab, laptop, or PC. Edmodo has educational features that support learning. Learning elements such as assignments, material presentation, and evaluation are all facilitated by educational features in edmodo virtual class (Hadi et al., 2017).

Based on these descriptions, innovation in learning is needed to support the optimization of the biology learning process in environmental change material and help students achieve the learning goals. Media in learning activities has an important role, namely to deliver subject matter to students. Learning social networks such as Edmodo on environmental change materials in high school are used to become an alternative learning through flipped classrooms. Students are expected to increase critical thinking ability after implementation flipped classroom learning. Students who have great critical thinking ability will be able to analyze well, develop critical insight, and think from different points of view. Students can also solve problems by making good choices in dealing with daily life.

METHOD

The experimental research method used in this research is quasi-experimental. Quasi-experimental is used because in reality it is difficult to get the control group used for research (Sugiono, 2016). The research design used was a non-

equivalent control group design. This research was conducted at SMA Negeri 1 Palimanan in the even semester of the 2019/2020 academic year. This research was conducted in April-May 2020. The research was conducted online due to the global Covid-19 pandemic through several software including edmodo, whatsapp, and zoom meeting for experiment class/flipped classroom learning. Experiment class used edmodo outside classroom than WhatsApp and zoom meeting are used to replace face-to-face learning inside classroom. Control class just used one software that is edmodo to replace face-to-face learning inside classroom.

The data in this study included a pretest-posttest with a description test totaling 14 questions to measure the critical thinking skills of students tested on 30 students of class X MIPA 1 as an experimental class and 30 students of class X MIPA 2 as a control class. The research data were analyzed by using N-Gain test, prerequisite test (normality and homogenity test), and hypothesis test. Indicators of students' critical thinking ability used in this study according to Greenstein (2012) are thinking critically, analyzing information, using data to develop critical insights, and synthesizing several points of view.

RESULT AND DISCUSSION

Critical Thinking Ability of Experiment and Control Class

Learning about environmental change and waste recycling using the flipped classroom learning model shows different results at the pretest and posttest between the experimental and the control class. The pretest-posttest mean between the experimental class and the control class can be seen in Figure 1 below.

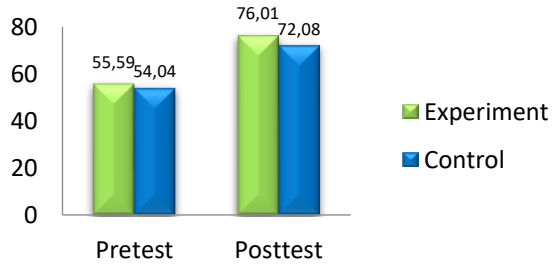

Figure 1. The average pretest-posttest score of students' critical thinking skills between the experimental class and the control class

Figure 1 shows the average acquisition of the pretest and posttest scores of students' critical thinking abilities between the experimental class and the control class. The pretest mean score of the experimental class and the control class showed a difference. The data above can be said that the average pretest score of the experimental class is greater than the average pretest score of the control class. The average posttest score of students' critical thinking ability in the experimental and control classes has increased. These data indicate that the average posttest score of the experimental class is greater than the average posttest score of the control class.

The data on the average N-gain score of students' critical thinking skills in the experimental class and control class can be seen in Figure 2 below.

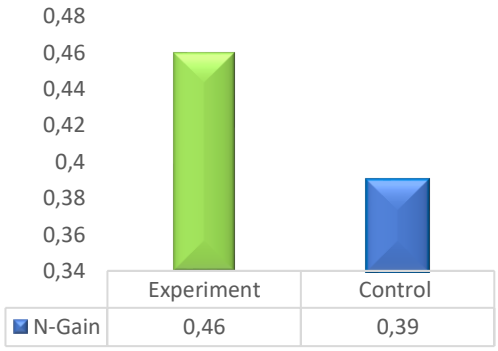

Figure 2. Graph of the average N-Gain score of critical thinking ability (CTA) students in the experimental class and the control class

Figure 2 shows the average N-Gain score of students' critical thinking abilities in the experimental class and the control class. Both the average N-Gain score of the experimental class and control class were included in the medium category. The average N-Gain score of the experimental class was greater than the average N-Gain score of the control class.

The difference between posttest and pretest scores is higher in the experimental class because it has been treated in the form of flipped classroom learning with a combination of online learning at home (edmodo) and face-to-face learning at school which is replaced through Zoom Meetings and WhatsApp. While the control class only did face-to-face learning which was replaced by learning using edmodo. There are more learning activities in the

experimental class, especially in the experimental class. Students can discuss the discussion sheets provided through zoom meetings so that students understand better. this is because the problems in the student discussion sheets, some of which are used as pretest-posttest questions.

The flipped classroom learning process with whatsapp module is divided into two parts, namely learning outside and inside the classroom. Learning outside the classroom starts with students returning from school. Students learn independently outside school hours by studying the material in the module that have been shared or from other relevant sources, such as books, power points, or learning videos (Farid et al., 2019). Previously, teachers had formed heterogeneous groups. The teacher instructs that each group can discuss together both outside and classroom learning. When learning in the classroom students can discuss with their respective groups, but when learning outside the classroom students cannot discuss. Most students in that class have private tutoring schedules. So it's difficult to discuss or study together. Students can only discuss the material being studied through whatsapp. With the use of these media, teachers can also monitor and assist students in learning outside the classroom. Zainuddin (2016) said that This learning process initially experienced obstacles because students were not familiar with the learning applied by researchers. There are some students who have not fully followed the teacher's instructions and the class becomes crowded, but at the next meeting students begin to adapt to the learning.

After students go home begin learning outside the classroom. Initially the teacher (researcher) reminded that learning outside the classroom had begun. Students respond well. Students ask about what tasks are learned. To ask about difficulties in learning, students are still shy or afraid. There are some students who ask personally not in the group. Flipped classroom learning is based on revised taxonomic theory from Bloom's cognitive domain. In applying flipped classroom learning, remembering and understanding as the lowest level of cognitive domains are practiced or studied with a longer time outside class hours. This is meant for students before learning in the classroom already have preparation regarding the material being studied. While in the classroom, students in groups can use knowledge that has been learned before and also focus on higher forms of cognitive work, including applying, analyzing, evaluating, and creating with the help of students and teachers (Sun et al., 2017).

The critical thinking ability can be sharpened through learning science. Science is a scientific group that has special characteristics, namely the study of factual natural phenomena, either in the form of reality or equity and causality. It takes a higher power of reason to learn these things. Science education has a huge role in training and sharpening the power of reason to look for causal links, concluding, elaborating, exploring values, and thinking ability.

Individuals with ideal critical thinking tend to try to understand a problem clearly, to "fix it," to find the truth if it is to be found, and to present a problem honestly and clearly; the ideal critical thinker has the ability to clarify, to properly seek and assess the basis for a view, to conclude wisely from the basis, to think and integrate imaginatively, and to do these things with sensitivity and skill (Ennis, 2015).

Thinking ability or trained thinking are not only important in the world of work, education, and training or research. Everyone is important to have thinking ability. A person's good thinking skills will have the capital to be able to solve problems that occur in his life. Someone who has the skills to think, will be able to solve the problem alone or in groups. It also relates to a person's mindset. The mindset is classified as a productive thinking pattern (productive thinking). Both lateral and parallel thought patterns are forms or tools that help someone to produce creative ideas (Sudarma, 2013).

The mindset needs to be developed continuously in every lesson, including in this study which applies the flipped classroom learning model, which results in differences in critical thinking ability between control classes. According to Song and Kapur (2017) regarding the comparison of ordinary learning and learning using flipped classroom learning for middle students in learning mathematics about polynomials, it shows a quite visible difference where students who are taught using traditional learning in studying polynomials still experience errors which on average are still the same when the pre-test was held and when the post-test was held after taking ordinary class, while

students who took flipped classroom learning experienced an increase in solving polynomial questions, this can be seen from the pre-test results, which initially had quite a lot of errors in solving polynomial questions but after following the flipped classroom the students were able to answer the post-test about polynomials correctly.

Analysis of Differences in Critical Thinking Ability of Experiment Class and Control Class

The difference in students' critical thinking abilities in the experimental class and the control class can be seen by doing statistical tests. The statistical test used in this study was carried out in two stages, namely the prerequisite test and the difference test. The prerequisite test consists of the normality test carried out with the Shapiro Wilk test and the homogeneity test, both tests are carried out to determine whether the data obtained from the research results are normally distributed and homogeneous or not. The prerequisite test results determine the next step in the statistical test, namely the difference test. If the data is normally distributed, then the independent sample T test parametric test is carried out if not using the Mann Whitney-U test.

This prerequisite test consists of a normality test and a homogeneity test. The results of the prerequisite test for the difference in students' critical thinking ability in the experimental class and the control class. The results of the normality test for the N-Gain data in general. Based on the results of the N-Gain data normality test, the experimental class showed that the data were normally distributed because the significance value was greater than 0.05, both in the control class and in the experimental class. The normality test of the control class N-Gain data resulted in a sig. 0.078 and the experiment yields a sig value. 0.108 so that the N-Gain data for the control class were normally distributed. The results of the general homogeneity of the N-Gain data. The results of the N-Gain data homogeneity test showed that the data were homogeneous because of the sig. 0.935> 0.05. Based on the results of the prerequisite test, it is known that the N-Gain data is normally distributed and homogeneous.

The result of the prerequisite test for the N-Gain data shows that the data is normally distributed and homogeneous, so the difference test performed on the N-Gain data is the Parametric Independent Sample T Test. The results of the N-Gain difference of hypothesis testing from the general N-Gain data. The significance value of N-Gain based on the results of the T test is 0.032, which means that Ho is rejected and Ha is accepted. Based on these data it can be concluded that there are significant differences in students' critical thinking skills between the experimental class and the control class.

The difference in students' critical thinking skills in the experimental and control classes for each indicator can be seen by performing statistical tests on the N-Gain data. The statistical test carried out is the same as the difference in students' critical thinking skills in general. Tthe results of the prerequisite test for N-Gain data for each indicator of critical thinking ability (CTA). CTA 1 is think critically, CTA 2 is analyzing information, CTA 3 is analyzing data to develop critical insight, and CTA 4 is synthesizing several points of view. The N-Gain data from the normality test results have a significance value greater than 0.05 on the indicators of critical thinking ability (CTA) 1-3 so that the N-Gain CTA 1-3 data is normally distributed while for indicator 4 the normality test shows the value is less than 0.05, so it can be said that the N-Gain data is not normally distributed. The results of the N-Gain homogeneity test showed that the data were homogeneously distributed on each indicator of critical thinking ability (CTA) 1, 2, 3, and 4 because the resulting significance value was greater than 0.05.

Hypothesis testing is carried out on the N-Gain data for each CTA indicator. CTA indicators 1, 2, and 3 show data that is normally distributed and homogeneous so that the hypothesis test that is carried out is the parametric test of the Independent Sample T Test or what is called the T test. The CTA 4 indicator shows data that is not normally distributed and data is homogeneous. So that indicator 4 hypothesis testing is carried out by using the non-parametric Mann-Whitney U test. The results of the N-Gain data hypothesis test on each indicator are described in table 1 below.

Tabel 1. Result of Hypothesis testing data N-Gain to each indicator of critical thinking ability (CTA)

Data	Hypothesis testing	Sig. (2-tailed)	Asymp. Sig. (2-tailed)	Notes
CTA 1	Independent sampel T Test	0.264	-	Not different Significant
CTA 2	Independent sampel T Test	0.261	-	Not different Significant
CTA 3	Independent sampel T Test	0.013	-	Significantly different Significan
CTA 4	Mann-Whitney U	-	0.281	Not different Significant

Table 1 shows the results of the N-Gain data hypothesis test for each CTA indicator. Based on Table 1, it can be concluded that there is a significant difference in the improvement of creative thinking ability between the experimental class and the control class for the CTA 3 indicator.

Based on the test results, it can be seen that the flipped classroom learning model can be applied well in learning activities. Flipped classroom learning model is effective in improving critical thinking skills and science learning outcomes through the increased of student motivation, and there is positive influence between motivation to learn about critical thinking skills and learning outcomes (Kurnianto *et al*, 2020). It is in line with the study conducted by Alanda *et al*, (2019) that the mathematical critical thinking ability of experimental class students through the flipped classroom model with Edmodo media is better than the control class through conventional models on flat-sided space building material. The students' mathematical problem-solving and critical thinking abilities use the flipped classroom model with edmodo media for class VIII students.

The use of the internet network in this reverse classroom model helps students to optimize learning. As well as improving higher order thinking skills in students and also providing them with access to material anywhere and anytime (B. Stone, 2012). Students can also carry out their assignments at home or other comfortable places. Students can also consult with researchers without having to meet in person, and researchers can help students online. This makes the learning process fast and not limited by time.

In general, Maolidah et al. (2017) stated that the application of the Flipped Classroom learning model is effectively used to improve students' critical thinking skills in Natural Science (IPA) class VIII subjects with motion material in plants at the Junior High School Pilot Laboratory of UPI Bandung. This is indicated by the significant increase in the results of critical thinking skills tests between before and after the application of the Flipped Classroom learning model which is based on the use of the internet as online learning at home.

Flip learning can be applied to improve students' higher order thinking skills through activities outside and inside the classroom. Outside the classroom, students can explore various learning resources outside the classroom such as videos, power points, e-books, scientific articles and others. In the classroom, students follow the learning process to deepen their understanding of the material through small or large group discussions and problem solving so that they can improve their critical, logical, reflective, metacognitive, and creative thinking skills (Sofya, 2018).

Indicators of critical thinking ability in using data to develop critical insight (CTA 3) have a significant difference, meaning that most students can answer questions that are included in the CTA 3 indicator correctly. Material on environmental change and waste recycling delivered to the experimental class through flipped classroom learning does not directly provide material directly. Learning begins with the provision of modules and videos through online learning (before face-to-face), so students must first identify data on environmental changes that occur in general. Then the change data is evaluated with a scientific approach. Environmental change data is also displayed on student discussion sheets (LDS) at each face-to-face learning (replaced through WA and Zoom). Derived from these activities, students are able to use data to develop critical insights. Environmental change data discussed during learning is contained in test questions so that most students can answer questions correctly.

The CTA-3 indicator (using data to develop critical insights) on different test results shows a significantly different value. This indicates that students have good abilities in using data to develop

critical insights. This ability is obtained because researchers make learning tools according to the basic competencies (KD) of environmental change and waste recycling. KD 3.10 regarding analyzing data on environmental changes and the impact of these changes on life, the result is that students are expected to be able to analyze data on environmental changes that have occurred globally and locally in the area where the student lives.

Environmental change data is included in the LDS (student discussion sheet) as material for students to freely discuss with their friends in the WhatsApp group. Then the questions related to measuring critical thinking indicators are also accompanied by data on environmental changes in the Regency-City of Cirebon. Only indicators use data to develop critical insights which indicate a significant difference which indicates that there is a difference in the thinking ability of each individual.

Everyone certainly has different thinking abilities. So, to find out any critical thinking ability a person has, we can use the aspects or indicators put forward by the experts as a reference. Students are not only knowledgeable, they must be equipped with the ability to think critically, creatively, have strong character, which is supported by the ability to use information and communicate. Critical thinking ability of students in Indonesia must be developed, because critical thinking ability are very important in this 21st century, one of which is to determine success in learning activities.

Critical thinking can be defined as a process as well as an ability. These processes and capabilities are used to understand concepts, apply, synthesize and evaluate the information obtained or the information generated. Not all information received can be used as knowledge that is believed to be true to serve as a guide in action. Likewise, the information generated is not always correct information. This information needs to be assessed through various criteria such as clarity, accuracy, accuracy, reliability, applicability, other supporting evidence, arguments used in drawing up conclusions, depth, breadth, and consideration of reasonableness (Zubaidah, 2017).

The implementation of the flipped classroom learning model is learning that combines online and offline learning. Learning begins with the provision of a video and an online module on environmental change and waste recycling before class. Students in groups are asked to analyze environmental change data that are studied scientifically, after which students must be able to describe the results of their clarification from various points of view. For example, if there is a bad environmental change (a lot of waste), can it be used to become something that has positive value, such as recycling waste.

In addition to analyzing data to develop critical insights, indicators such as think critically, analyzing information, and synthesizing several points of view, there are no significant differences. It can be concluded that the three indicators of critical thinking are still low. The factors that cause students' low critical thinking ability are students who are not trained and are not familiar with the form of questions that present phenomena.

Point of view is a way of seeing or interpreting this world, which will determine the construction of meaning. Someone who thinks critically will see a phenomenon from many different points of view. Based on this understanding, it is quite difficult for students to synthesize several points of view. In this case students tend to get into problems and overcome them by reducing the existence of problems without thinking about dealing with these problems in different ways.

Anggareni et al. (2013) stated that developing students' critical thinking ability can be done by always asking and questioning the phenomena being studied. Teachers must be able to create learning that can involve students actively in learning activities. This is important in order to create intensive interaction between students, teachers and learning materials as well as to provide opportunities to involve students' thinking abilities, thereby increasing their critical thinking ability.

Critical thinking ability need to be developed through learning in schools so that students can reflect on their own thinking and apply previous knowledge with the knowledge they have acquired. Students as the golden generation in the future must be equipped with critical thinking skills, because someone who has the ability to think critically will be able to solve problems in different ways, namely asking questions, gathering relevant information, conducting investigations, and being able to communicate well (Greenstein, 2012). Vliet's *et al* (2015) study found that repeated use of the collaborative learning strategy -Learning had

improved the critical thinking component and it was enduring.

A study conducted by Nurpianti et al (2018) with a PPB-based flipped classroom model, the results were quite effective in improving critical thinking skills, especially in the analysis aspect. Besides

Critical thinking skills, from the results of studies that have been carried out by the flipped classroom model can improve learning achievement. So that further researchers can use flipped classrooms to improve student learning outcomes.

Critical thinking ability are fundamental skills in solving problems. This ability is important for students to find the source of the problem and how find the right solution to the problem at hand. Critical thinking ability can be instilled in various disciplines. Teachers play an important role in designing and developing learning programs that are more focused on empowering these ability (Zubaidah, 2019). Students who have critical thinking ability tend to produce better cognitive, affective and psychomotor learning achievement (Anggraeni, 2018). Higher-order thinking makes students able to interpret, analyze and provide alternative solutions to problems. One of the higher order thinking skills is critical thinking. Critical thinking is a key competency that must be possessed to solve the problems needed for individuals to live successfully and live responsibly and for society to face present and future challenges (Juang *et al*, 2017).

CONCLUSION

Based on the research conducted, it can be concluded that flipped classroom learning can increase students' critical thinking ability in environmental change material. There is a significant difference increse in students' critical thinking ability between the experimental class that is applied flipped classroom learning and the control class that does not apply flipped classroom learning on material changes to the environment and waste recycling with an average N-Gain of the experimental class of 0.46 and an average N-Gain control class is 0.39. Indicators of critical thinking that have increased differences are using data to develop critical insights. This indicates that the material for environmental change and waste recycling requires environmental change data to increase students' critical thinking ability.

REFERENCES

Alanda Yogi, Mustangin, & Nurul Hasana Siti. (2019). Kemampuan Pemecahan Masalah dan Berpikir Kritis Matematis Melalui Model *Flipped Classroom* dengan Media Edmodo pada Materi Bangun Ruang Sisi Datar. *JP3*. 14 (6): 24-32.

Anggraeni, H., Rahayu, S., Rusdi, & Jazuli, I. (2018). The Effect of Reciprocal Teaching and Problem Based Learning to The Critical Thinking of Senior High School Students in Reproduction System Matery. *Biota*. 11 (1): 77-95.

Anggareni, N. W., Ristiati, dan Widiyanti. (2013). "Implementasi Strategi Pembelajaran Inkuiri Terhadap Kemampuan Berpikir Kritis danPemahaman Konsep IPA SiswaSMP". *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha*. 3 (1): 39-48.

Bergmann, J & Sams, A. (2012). *Flip your Classroom: Reach Every Student in Every Class Every Day*. Eugene, OR : International Society For Tecnology in Education.

B. Stone. (2012). "Flip Your Classroom to Increase Learning and Student Engagement," in 28. th annual Conference on Distance Teaching & Learning, Madiseon: University of Wisconsin-Madison Division of Continuing Study.

Ennis, R., H. (2015). The Extent to which Critical Thinking is Subject-Specific: Further Clarification. *Educational Researcher*. 19 (1):13-16.

Farid, F R H., Sukestyarno, Mariani, S. (2019). Mathematical Literacy on Student's Self-Regulated Learning by Flipped Classroom with Whatsapp Modul. *Unnes Journal of Mathematics Education Researh*. 8 (2): 125-132.

Greenstein, L. (2012). *Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authenthic Learning*. California: Corwin A Sage Company.

Hadi, K., F, Punandji S, & Saida U. (2017). Sistem Pembelajaran Berbasis Flipped Classroom Menggunakan Media LSN (*Learning Social Network*) Siswa SMAN 1 Plosoklaten. *JINOTEP*. 3 (2): 130-136.

Juang, N A., Suyitno, H., Susilaningsih., E. (2017). Analisis Kemampuan Berpikir Kritis Ditinjau dari Keterampilan Proses Sains dan Motivasi Belajar melalui Model PBL. Journal Of Primary Education. 6(1): 35-43.

Kurnianto, B., Wiyanto, Haryani, S. (2020). Critical thinking skills and learning outcomes by improving motivation in the model of flipped

classroom. *Journal of Primary Education*. 9 (3): 282-291.

Nizam. 2016. Ringkasan Hasil-hasil Asesmen Belajar Dari Hasil UN, PISA, TIMSS, INAP. Puspendik

Nurpianti, S., Suwarna, I. R., Jauhari, A. (2018). *Kajian Implementasi Pendekatan Flipped Classroom pada Pembelajaran Fisika.* Prosiding Seminar Nasional Fisika (SINAFI). Bandung.

OECD, PISA. 2017. *How Does PISA for Development measure mathematical literacy*. Paris: OECD Publisher.

Maolidah, I. S., Ruhimat, T., & Dewi, L.(2017). Efektivitas penerapan model pembelajaran flipped classroom pada peningkatan kemampuan berpikir kritis siswa. *Educational Technologia*. 3(2): 160-170.

Sofya, Rani. (2018). Implementasi *Flip Learning* Strategi Meningkatkan
Higher Order Thinking Mahasiswa. *JIPE* (*Jurnal Ilmu Pendidikan Ekonomi*).

Song, Yanjie dan Manu Kapur. 2017. How to Flip the Classroom - "Productive Failure or Traditional Flipped Classroom" Pedagogical Design?. *Journal of Educational Technology & Society*. 20 (1): 292-305.

Sudarma, Momon. 2013. *Mengembangkan Keterampilan Berpikir Kreatif.* Jakarta: Raja Grafindo Persada.

Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: PT Alfabet.

Sun, Z., Xie, K., & Anderman, L. 2017. The Role of Self-Regulated Learning in Students' Succes in Flipped Undergraduate Math Courses. The Internet and Higher Education. Doi:10.1016/j.iheduc. 2017.09.003.

Vliet, E.A., J. C. Winnips, and N. Brouwer. (2015). Flipped-Class Pedagogy Enhances Student Metacognition and Collaborative-Learning Strategies in Higher Education But Effect Does Not Persist. CBE—Life Sciences Education. Vol. 14: 1–10.

Zainuddin, Z. & Halili, S, H. 2016. Flipped Classroom Research and Trends from Different Fields of Study. International Review of Research in Open and Distributed Learning. 17 (3): 313-340.

Zubaidah, S. (2017). "Mengenal 4c: Learning and Innovation Skills untuk Menghadapi Era Revolusi Industri 4.0 1". Conference: 2nd Science Education National Conference. https://www.researchgate.net/publication/318013627.

Zubaidah, S. (2019). "Keterampilan abad ke-21: keterampilan yang diajarkan melalui pembelajaran. Researchgate". Conference: 2nd Science Education National Conference. https://www.researchgate.net/publication/332469989