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META-ANALYSIS: THE EFFECT OF THE FLIPPED CLASSROOM MODEL ON STUDENTS' HIGHER-ORDER THINKING ABILITY

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ABSTRACT

This study aimed to determine the effect of the Flipped Classroom model on higher-order thinking skills as a whole and parts in terms of education level and year of publication. The method used in this study is a quantitative method with a meta-analytic research design. Data collection was carried out by searching for relevant or related publication articles on the topic to be studied on internet network sites in the form of Google Scholar, Google Scholar, Researchgate, OneSearch, Microsoft Academia, Academia, and Repository. The sampling technique used purposive sampling technique. The instrument used is a data code sheet that summarizes data and data information. Data were analyzed by calculating the effect size value using the standardized means difference formula. Based on the analysis carried out, it was obtained: 1) The Flipped Classroom model as a whole was effective in improving students' high-level thinking skills, found seven published articles with a mean effect size of 2.225 and classified as very large; 2) The Flipped Classroom model based on educational level is effective in improving students' high-level thinking skills; 3) The Flipped Classroom model based on the year of publication is effective in improving students' high-level thinking skills.

Keywords: Flipped classroom; higher-order thinking ability

1. INTRODUCTION

Education must create a golden generation ready to compete in a global society according to the demands of the times, making society productive and more competitive (Farisi, 2016). 21st-century National Education aims to realize the ideals of a nation. The Indonesian nation is happy and lives in prosperity, has a respectable and equal position with other nations in the global world

through the formation of a society consisting of quality human resources, namely individuals who are willing, independent, and capable of realizing the ideals of the nation by Permendikbud No. 21 of 2016 (Permendiknas No. 21 Tahun 2006, 2006).

Capabilities that can be expected in 21st-century learning are higher-order thinking skills that need habituation, trained gradually and continuously (El-Shaer & Gaber, 2014). Higher-order thinking skills are based on the ability to analyze, evaluate, and create. Higher-order thinking skills are an important aspect of teaching and learning. A person's thinking ability can affect learning ability, speed, and effectiveness of learning (Nurhayati & Angraeni, 2017).

Higher education is one of the institutions that plays a role in determining the success of development in Indonesia, it is expected to be able to prepare human resources who are competent and able to compete in the world of work, especially in the era of the industrial revolution 4.0. The practice of learning in the 4.0 revolution era in tertiary institutions is e-learning (Fajriah et al., 2020). The rapid development of information technology requires teachers, teachers, and lecturers to adapt and innovate in using various digital-based learning methods (Ishak et al., 2019).

The Flipped Classroom learning model provides teaching that is generally done in class and teaching that is generally done as homework and then reversed. Flipped classroom combines face-to-face learning with online learning (Ramadhani & Fitri, 2020) so that students can prepare themselves before class begins (Lin & Hwang, 2018; Sams & Bergmann, 2013). Previously, students who came to class listened to the teacher's explanation and went home to do the practice questions. After being turned over, students read the material and view the learning videos before they come to class and they start discussing, exchanging knowledge, and solving problems, with the help of other students as well as the teacher, training students to develop procedural fluency when needed, inspiring and helping them with projects that are challenging by providing greater control over learning (Suriaman & Dewi, 2019) thereby maximizing the time to use that knowledge (Jdaitawi, 2019).

The Flipped Classroom principle is that work that is usually done as homework such as problem-solving and essay writing, is more done in class with guidance from the teacher or other students. Flipped classroom learning allows students to listen to teacher explanations or watch videos made at home (Herreid & Schiller, 2013; Wei et al., 2020) thereby supporting interactive

learning (Cabı, 2018; Cevikbas & Kaiser, 2020), which can make students' abilities to be better (Zheng et al., 2020). Flipped Classroom is an effective strategy for maximizing student responsibility to explore learning materials online to support student interest and motivation to produce maximum projects (Rindaningsih, 2018). Flipped Classroom is effective for improving reasoning abilities.

Gillani and O'Guinn (2014) conclude that the reverse class mostly uses a constructivist learning approach, which includes: perceiving learning as an active approach that requires the active participation of students. Thus, learning previously only done in the classroom can now be done outside the classroom. There are four conditions in triggering Higher Order Thinking Skills or commonly called Higher Order Thinking Skills (HOTS): (a) Requires specific learning strategies and cannot be used in other learning situations in certain learning situations; (b) Does not see intelligence as an ability that cannot be changed, but a unity of knowledge that is influenced by several factors consisting of awareness, strategy and learning environment; (c) Views of understanding that have shifted from unidimensional, spiral, hierarchical, or linear towards understanding to be multidimensional and interactive; (d) More specific higher order thinking skills such as critical thinking skills, reasoning, analytical and creative skills, problem-solving (Ariyana et al., 2018). For this reason, this research was conducted to see the effect of the Flipped Classroom Model on Students' higher-order thinking abilities.

2) METHODS

The type of research used is a type of meta-analysis research which is carried out by analyzing quantitative data from the results of previous studies to accept or reject the hypotheses proposed in these studies (Retnawati et al., 2018). This research, a meta-analysis, was conducted to determine the effect of using the Flipped Classroom learning model on students' high-level thinking skills. The population in this study are scientific publication articles in the form of journals about the use of the Flipped Classroom learning model in 2014-2020. Sampling uses a purposive sampling technique because the data is determined based on its suitability with the topic raised. The samples taken are scientific publication articles about the Flipped Classroom model with research types categories, namely (1) Scientific articles created by general researchers and students, (2) Articles using experimental research methods, (3) Articles are quantitative research and fulfill statistical effect data sizes; (4) Articles published in the last nine years, namely from 2014-2022, (5) Articles with the theme of Flipped Classroom learning on students' high-level thinking skills, (6) The sample

education level in the article is at the Junior High School (SLTP) level, Senior High School (SLTA) and Higher Education, (7) Articles are research that has been published in the coverage area in Indonesia, and (8) Scientific articles include the year of publication and level of education. The studies that have been obtained are then analyzed using prism flow. The instrument used in this research is coding data or coding sheets.

3) RESULTS AND DISCUSSION

Based on the results of data navigation, 96 articles were obtained related to the effect of the flipped classroom model on students' higher-order thinking skills. Data navigation was carried out on data search bases: google scholar, research, researchgate, Microsoft academic, open knowledge map, eric, and IPI search. The research articles are filtered based on their suitability with the predetermined sample criteria. From the results of data screening, seven research articles were found that met the sample criteria. Articles that met the sample criteria were then further analyzed to determine the effect size value and the average effect size. The effect size values obtained from each research article are presented in the following.

Table 1. Overall effect size data

Numb	Study Code	Sub-Units		Effect Size value	Information
		Year	Educational stage		
1	Study 1	2017	Senior High School	0.582	Large
2	Study 2	2018	Senior High School	2.487	Very large
3	Study 3	2019	Junior high school	0.568	Large
4	Study 4	2020	Senior High School	2.035	Very large
5	Study 5	2020	Junior high school	1.403	Very large
6	Study 6	2020	Senior High School	2.210	Very large
7	Study 7	2021	Junior high school	6.690	Very large
Summary effect				2.225	Very large

Based on table 1, it was found that of the 7 research articles, there were 29% of the studies had an effect size value in the large category and 71% of the studies had an effect size in the very large category.

The data effect size of Flipped Classroom scientific publication articles based on categories consists of four, namely minor effects ($0<ES\leq0.2$), moderate effects (0and.5), significant effects ($0.5<ES\leq0.8$), and ($0.8<ES\leq 2$). The data above shows that overall the average score of the 7 scientific publication articles has a very large effect size with a value of 2.225, meaning that the

average score of students' higher-order thinking skills in the experimental class is higher than the control class.

In each summary effect calculation table, a significant value (p) in the coefficients table indicates whether the relationship or influence between variables is significant or not. If the p-value<0.05, the relationship between the independent variables and the dependent variable or the impact of the independent variables on the dependent variable is significant. The Estimate value in the Coefficients table states the average effect size of the studies analyzed.

Based on the results of the analysis using the Restricted ML model, the weighted average effect (M) is 2.225. This value indicates that the average effect size of all published articles used as research samples is 2.225 in the very large category with a standard error. Furthermore, to test whether the difference in value is significant or not, it can be seen from the Z test. The calculation results show that $Z = 2.966$, with a p-value of 0.003. With a 95% confidence interval ranging from 0.755 to 3.696, the confidence interval does not contain 0 (zero), in this case, the true effect size is not equal to 0, then H0 is rejected. Thus it can be concluded that the Flipped Classroom Learning Model is effective (significant) on students' high-level thinking skills.

The results of this study are consistent with the theory of constructivism and previous studies. Constructivism theory states that knowledge is always the result of a cognitive construction of reality that occurs through one's activities. Intellectual development depends on sign systems referring to symbols created by culture to help people think, communicate and solve problems (Bariah, et al., 2019). According to constructivism, learning is a process of forming knowledge. This formation must be carried out by individuals who learn. He must actively carry out activities, actively think, develop concepts and give meaning to the things he learns (Saguni, 2019).

Like the constructivism theory, the Flipped Classroom model also requires students to be actively involved in learning (Chabibie, 2020). This model also facilitates student learning experiences and supports the active construction of knowledge (Paynter, 2019). So the Flipped Classroom model requires students to manage their study time at home and school, set assignment completion targets, and compile lots of questions to discuss in class. According to Fernández-Martín et al. (2020) flipped classroom also allows students to evaluate themselves through feedback from the teacher.

The findings obtained from this meta-analysis are also supported by previous studies, such as research conducted by Widyasari et al. (2021), Simamora et al. (2021), Batubara et al. (2022), which revealed that the application of Flipped Classroom capital can improve students' high-level thinking skills. Research conducted by Bariah, et. al. (2019) regarding the application of Flipped Classroom in learning also reveals that the application of the Flipped Classroom model can increase students' independence by reading, asking questions, discussing, and solving their problems.

Effect Size Data Based on Education Level

Effect size data from the analysis results obtained in 7 publication articles of the Flipped Classroom model, which we then interpret based on the educational level of the article. The effect size results obtained are as follows.

Table 2. Effect size data based on educational level

Educational Level	Statistic		
	N	Summary Effect	Information
Junior High School	3	1.736	Very large
Senior High School	4	2.627	Very large

The results obtained from analyzing research articles on the effect of the Flipped Classroom learning model on students' high-level thinking skills at the junior high school education level with a total of 3 articles in the very large category with a summary effect value of 1.736, and at the senior high school education level with a total as many as 4 articles obtained in the large effect category with a summary effect value of 2.627. So it can be concluded that the Flipped Classroom learning model for students' high-level thinking skills is effective at the senior high school education level.

Based on the results of the analysis using the Restricted ML model, the weighted average effect (M) is 1.736. This value indicates that the average effect size of all published articles at the junior high school level used as the research sample is 1.736 in the large category with a standard error of 0.607. The calculation results show that $Z = 2.859$, with a p-value of 0.004. With a 95% confidence interval ranging from 0.546 to 2.926, the confidence interval does not contain 0 (zero), in this case, the true effect size is not equal to 0, then H0 is rejected. Thus, it can be concluded that at the junior high school level, the Flipped Classroom learning model is effective for students' high-level thinking skills.

In addition, the analysis results using the Restricted ML model obtained a weighted average effect (M) of 2.627. This value indicates that the average effect size of all published articles at the high school level used as the research sample is 2.627 in the vast category with a standard error of 1.340. The calculation results show that $Z = 6.540$, with a p-value < 0.001. With a 95% confidence interval ranging from 0.002 to 5.253, the confidence interval does not contain 0 (zero), in this case, the true effect size is not equal to 0, then H0 is rejected. Thus, it can be concluded that at the senior high school level, the Flipped Classroom learning model is effective for students' high-level thinking skills.

This result is also supported by previous studies, such as research conducted by Nasution et al. (2021), Agustantia (2019), Qory (2022), Ansori and Nafi' (2018) revealed that the application of the Flipped Classroom learning model has effectiveness on high-level thinking skills of high school students. Research conducted by Qory (2022) regarding the application of Flipped Classroom in learning also reveals that using the Flipped Classroom model can create active and effective learning, such as discussion and problem-solving.

Judging from the steps of the Flipped Classroom model, it is known that this learning model directs students to have prior knowledge before class learning begins. This initial knowledge influences the success of students in understanding and solving problems. In connection with this, one of the results of a similar study, namely research conducted by Qory (2022) revealed that during the learning process, students were enthusiastic about discussing with their group mates regarding the topic of the problem given earlier by the teacher. Learners no longer feel boredom that usually only listens to explanations from the teacher. But they can find as much information as possible to solve a topic problem to find a solution, so students are required to first analyze the problem before getting solutions and answers.

Effect Size Data by Year of Publication

Effect size data from the analysis results obtained in 7 published articles of the Flipped Classroom model, which we then interpret in the year of publication. The effect size results obtained are as follows.

Table 3. Effect size data based on the year of article publication

Year of Publication	Statistic		
	N	Summary effect	Information
2017-2019	3	1.191	Very large
2020-2021	4	3.030	Very large

The results obtained from analyzing the published articles on the Flipped Classroom learning model on students' high-level thinking skills based on the year of publication or the year the article was published were divided into two, namely in 2017-2019 with a total of 3 articles obtained in the very large effect category with the summary effect value is 1.191 and in the range of 2020 - 2021 with a total of 4 articles obtained in the very large effect category with a summary effect value of 3.030 so it can be concluded that the Flipped Classroom learning model affects students' high-level thinking skills based on the year of publication the greatest value of the mean effect size is in the 2020-2021 range.

Based on the results of the analysis using the Restricted ML model, the weighted average effect (M) is 1.191. This value indicates that the average effect size of all published articles in the 2017 - 2019 range used as the research sample was 1.191 in the large category with a standard error of 0.627. The calculation results show that $Z = 1.901$, with a p-value of 0.057. With a 95% confidence interval ranging from 0.037 to 2.419, the confidence interval does not contain 0 (zero), in this case, the true effect size is not equal to 0, then H0 is rejected. Thus it can be concluded that in the 2017 – 2019 year of publication, the Flipped Classroom learning model is effective for students' high-level thinking skills.

Based on the analysis results using the Restricted ML model, the weighted average effect (M) is 3.030. This value indicates that the average effect size of all published articles in the 2020 - 2021 range used as the research sample is 3.030 with a vast category and a standard error of 1.179. The calculation results show that $Z = 2.569$, with a p-value < 0.010. With a 95% confidence interval ranging from 0.719 to 5.341, the confidence interval does not contain 0 (zero), in this case, the true effect size is not equal to 0, then H0 is rejected. Thus it can be concluded that in the vulnerable year of publication 2020–2021, the Flipped Classroom learning model is effective for students' high-level thinking skills.

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