International Journal of Instruction *January 2023 ● Vol.16, No.1*
e-ISSN: 1308-1470 ● www.e-iji.net *p-ISSN: 1694-609X*
pp. 589-604

Article submission code: 20220107142041
Received: 07/01/2022 Revision: 02/08/2022
Accepted: 25/08/2022 OnlineFirst: 03/11/2022

Effectiveness of Flipped Classroom on Students' Learning Outcome in Vocational High School: A Meta-Analysis

Christina Ismaniati
Dr., Faculty of Education, Universitas Negeri Yogyakarta, Indonesia, *christina_ismaniati@uny.ac.id*

Ali Muhtadi
Dr. Faculty of Education, Universitas Negeri Yogyakarta, Indonesia, *alimuhtadi@uny.ac.id*

Desy Yanty Cobena
Faculty of Education, Universitas Negeri Yogyakarta, Indonesia, *desyyanty.2020@student.uny.ac.id*

Pranata Lulus Soeparno
Faculty of Education, Universitas Negeri Yogyakarta, Indonesia, *pranatalulus.2020@student.uny.ac.id*

Vocational High School (VHS) has an essential role in preparing graduates for work and reducing unemployment. Therefore, designing suitable instruction is needed to prepare students to master competencies. Determining the learning model is a strategy in instructional design to improve learning outcomes. Through several empirical studies, Flipped Classroom is one of the effective models in vocational high school today. However, no meta-analysis has been published that specifically examines the effect of flipped classroom on VHS students' learning outcomes. This study aimed to summarize the overall effects of Flipped Classroom model at VHS in various majors with a meta-analysis approach. Nineteen studies from seventeen articles were selected based on established criteria. The results show that Flipped Classroom had a significant effect with ES = 1.678 and SE = 0.282. In addition, this study proved to be varied by using heterogeneity test ($Q = 289.669$, $df = 18$, $p < .001$) and free from publication bias by using fail-safe N approaches (fail-safe N value= 2476, $p < 0.001$).

Keywords: vocational school, flipped classroom, meta-analysis, learning outcome, effectiveness

INTRODUCTION

The growth of business and industrial sector in Indonesia increases the demand for skilled graduates from Vocational High School (VHS) (Sajidan et al., 2018). VHS plays

Citation: Ismaniati, C., Muhtadi, A., Cobena, D. Y., & Soeparno, P. L. (2023). Effectiveness of flipped classroom on students' learning outcome in vocational high school: A meta-analysis. *International Journal of Instruction*, *16*(1), 589-604. https://doi.org/10.29333/iji.2023.16133a

a vital role in developing countries, especially in Asia, because it can reduce unemployment by creating employment in the fields of pre-vocational specialization and self-employment (Tilak, 2018). Skilled graduates have been prepared with the appropriate knowledge, skills, and attitude before entering the labour market and can be characterized by mastering the competencies in specific fields (Nuryanto & Eryandi, 2020; Samani, 2018; Wagiran et al., 2017). However, instruction in vocational schools hasn't linked the three domains well, which are the cognitive aspect for their knowledge, psychomotor aspect for their skill, and affective aspect for their attitude (Sudira, 2018). Moreover, there is a discrepancy between the skills learned in VHS and the needs of the world of work. The revitalization of vocational education is needed and formulating a vocational learning model is one of the recommended ways of revitalization (Wagiran et al., 2017).

Learning outcomes can be increased by implementing the right learning model (Prasetya et al., 2018). According to Kurniawan et al. (2019), flipped classroom, as a learning model, is suitable for education in developing countries. Recently, research on this topic has increased significantly (Jwaifell et al., 2018). Brown (2016) defines flipped classroom as a learning delivery model that shifts material delivery activities that should be in class meetings into activities at home, and shifts homework, which initially is an activity at home, into a series of critical thinking activities that take place in the classroom. Flipped classroom encourage personalized learning based on students' individual needs (Bergmann & Sams, 2012; Hamdan et al., 2013). Moreover, flipped classroom in vocational education facilitates students to apply theories into real-life tasks. It supports students' learning process in implementing knowledge and acquiring skills and competencies (Betihavas et al., 2016).

Several studies have investigated the merit of flipped classroom on students' learning outcomes. Previous studies point out the need for further studies with a more rigorous research design together with a more complete and accurate report (Låg & Sæle, 2019), measuring not only cognitive outcomes (Shi et al., 2020) and investigating the influence of other factors in instruction such as learning methods and media (Hew & Lo, 2018; Tan et al., 2017). Furthermore, the studies would be more valuable if they had included a broad conclusion about the effect of the flipped classroom model on learning outcome of VHS students. However, it cannot be investigated only using primary research. Therefore it is necessary to do research with a meta-analysis approach (Borenstein et al., 2009). The characteristic of meta-analysis is combining samples from several studies to be broad so that the results will be more accurate. Meta-analysis is an appropriate research model to synthesize existing evidence to produce answers or conclusions that can later become the basis for designing new studies and guidelines for institutional policies and educational curricula (Borenstein et al., 2009).

Many studies on flipped classrooms have been carried out using meta-analysis. For example, Gillette et al. (2018) found no significant difference between flipped classroom and lecture-based instruction. On the other hand, a study conducted in various disciplines reported Flipped Classroom have a small effect (Låg & Sæle, 2019). In contrast to earlier findings, studies in nursing education and health profession education

show a significant effect of flipped classroom in improving students' performance (Hew & Lo, 2018; Tan et al., 2017). It is similar to Lencastre et al. (2020), who state that flipped classrooms increase students' specific skills, knowledge, and extrinsic motivation. In addition, Flipped classroom receives positive feedback from primary to secondary school students (Unal & Unal, 2017). However, Cheng et al. (2019) find that flipped classroom has little effect on middle school and college students and negatively affect graduate students.

A specific study on vocational education has been carried out by Mubai et al. (2020). Flipped classroom were found very effective and appropriate to use in vocational education, both high school and college. Since students have different characteristics, no such reviews have been reported in vocational high school. Mubai et al. (2020) makes no attempt to examine the effect of other factors such as the sample size, research design, and major. Thus, the researcher considers it necessary to conduct meta-analysis research to answer the following questions: Does using the flipped classroom model in vocational high school really improve learning outcomes, whether their knowledge, skill, and attitude? How does the flipped classroom influence learning outcome in terms of publication, subject, research design, sample size, and learning media? Therefore, the researcher uses meta-analysis to answer the gaps in the results of previous studies by analyzing and investigating the effectiveness of flipped classroom, specifically on student learning outcomes at vocational high school, and examining factors that influence it.

METHOD

Research Design

This study used a meta-analysis method by reviewing several published articles. The purpose of this study was to statistically evaluate the findings of primary studies that measured the effectiveness of flipped classroom learning model on students learning outcomes at vocational education level in Indonesia. Meta-analysis provides an overall evaluation with statistical analysis of the quantitative data collected and obtained in independent studies on a specific subject (Cleophas & Zwinderman, 2017). In general, the steps of meta-analysis in this study based on Borenstein et al. (2009), namely; 1) Determine the inclusion criteria for the research being analyzed, 2) Define the procedure for collecting empirical data and coding the research variables, 3) Apply statistical analysis.

Criteria of Inclusion

All studies in the initial review were examined and graded for further analysis. The inclusion criteria used to refine publications of research, and results were:

1. The publication year ranges from January 2017 to October 2021. It started in 2017 because the earlier year found no publication flipped classroom in vocational high school
2. Type of publication is articles and proceedings considered for sufficient quality.
3. Written in Indonesian or English

4. Related to flipped classroom and learning achievement or outcome of VHS students
5. A full-length article is accessible for obtaining the data
6. The article reports mean, standard deviation, and number of samples (N) for both experimental and control groups. If these conditions are not met, then use the t-value or F-value or p-value accompanied by the number of samples (N) for both experimental and control groups.

Data Collection and Coding

Empirical research on flipped classroom, specifically vocational education and learning outcomes topics, were collected as the primary data for this study. Data were obtained by entering keywords in online databases such as Google Scholar, national journals, international journals. The keywords applied in collecting research studies such as "the effect of flipped classroom on student achievement in VHS" and other equivalent words in Indonesian and English. In addition, to increase the number of articles or proceedings that met the requirements, another technique was operated by using hand searching technique, manually searching page by page of the entire contents of the article to identify any relevant study which met the inclusion requirements (Armstrong et al., 2005; Richards, 2008). Based on the specified inclusion criteria, 17 articles met the requirements, with one article examining three aspects of learning outcomes at once, so 19 effect sizes in total were analyzed. Furthermore, a coding phasewas needed to facilitate the author in conducting data analysis. The components in the coding were information on year of research, author, type of publication, sample size, research design, measured learning outcomes, majors (areas of expertise), subjects, and learning media

Statistical Analysis

The statistical procedures in this study are based on Borenstein et al. (2009), which are to calculate the size of the effect of each primary study, conduct heterogeneity tests and estimation model selection, check publication biases, and calculate p-values to test research hypotheses. The OpenMee Application was used to get the size effect and test the data's heterogeneity. Referring to Cohen (Sullivan & Feinn, 2012), the effect size for experimental studies are classified as large if ≥ 0.80, medium if $= 0.50$, and small if ≤ 0.20. Furthermore, the data is categorized heterogeneous when the p-value < 0.001. If the data proves heterogeneous, an analysis of the moderator variables is performed.

At the step of examination of publication bias, a study is said to be resistant to bias when the spread of the size of the effect shows a symmetrical distribution around vertical lines (Borenstein et al., 2009). In this step, the data is analyzed using the help of JASP software to make the calculation process more accurate. However, if the size of the effect is not fully distributed symmetrically, then the File-Safe N (FSN) approach is carried out. If the File-Safe N value $> (5K + 10)$ is met, where K is the number of studies included in the meta-analysis, then the study is said to be resistant to publication bias and can be scientifically accounted for (Mullen et al., 2001).

FINDINGS

Characteristics of Research Samples

Based on the established criteria, 19 study samples from 17 primary data studies were obtained that met all the specified criteria. The studies selected between 2017 and 2021 because there has been no publication that specifically examines the effectiveness of using flipped classroom learning models on vocational students' learning outcomes before 2017. Table 1 summarises the characteristic of study samples that became the object of the meta-analysis consisting of the author and year of publication, research design, and learning outcomes.

Table 1
Summary of studies included in the meta-analysis (part 1)

No.	Author	Year	Research Design	Learning Outcome
1	Shohib & Anistyasari	2017	Pre-Post Control Group	Cognitive
2	Sucipto et al	2017	Pre-Post Control Group	Cognitive
3	Sucipto et al	2017	Pre-Post Control Group	Psychomotor
4	Sucipto et al	2017	Pre-Post Control Group	Affective
5	Harmaini	2018	Non-Equivalent Control Group	Cognitive
6	Sukayanti et al	2018	One Group Pre-Post	Cognitive
7	Mas'ud & Surjono	2018	Non-Equivalent Control Group	Cognitive
8	Hamid & Effendi	2019	Pre-Post Control Group	Psychomotor
9	Hidayah	2019	One Group Pre-Post	Cognitive
10	Taufik & Urbani	2019	Non-Equivalent Control Group	Psychomotor
11	Yanti	2019	Pre-Post Control Group	Cognitive
12	Darmawan	2020	Pre-Post Control Group	Cognitive
13	Kausar et al	2020	Non-Equivalent Control Group	Cognitive
14	Rusnawati	2020	Post Test Only Control Group	Cognitive
15	Sinatrya & Aji	2020	One Group Pre-Post	Cognitive
16	Oktarina	2021	Pre-Post Control Group	Psychomotor
17	Putra et al	2021	Post Test Only Control Group	Cognitive
18	Sakti	2021	One Group Pre-Post	Cognitive
19	Zakhia & Dermawan	2021	One Group Pre-Post	Cognitive

Due to the wide variety of majors in VHS, the majors in this study were classified based on their area of expertise. Four categories were created, namely ICT (Information and Communication Technology), TE (Technology and Engineering), BM (Business and Management), and Other categories for studies that did not mention majors or areas of expertise being studied. Likewise for the subjects studied, these subjects are grouped based on the types of subjects in VHS, namely normative, adaptive, and productive. Furthermore, it was found that the media formats used today are more varied. The use of e-learning, Edmodo, and Moodle makes it possible to share files in the format of audio, video, images, text, and links systematically, which in this study are grouped into LMS categories. Therefore, the media category consists of video, LMS, social media, and other categories for media that do not belong to the three categories above and for studies that do not mention the media used. The results of the classification can be seen in Table 2.

Table 2
Summary of studies included in the meta-analysis (part 2)

No	Author	Publication	Field of Expertise	Subject	Media
1	Shohib & Anistyasari	Journal	ICT	Productive	Other
2	Sucipto et al	Journal	ICT	Productive	LMS
3	Sucipto et al	Journal	ICT	Productive	LMS
4	Sucipto et al	Journal	ICT	Productive	LMS
5	Harmaini	Proceedings	BM	Productive	Video
6	Sukayanti et al	Journal	ICT	Normative	LMS
7	Mas'ud & Surjono	Journal	ICT	Adaptive	LMS
8	Hamid & Effendi	Journal	TE	Productive	Video
9	Hidayah	Journal	ICT	Productive	LMS
10	Taufik & Urbani	Proceedings	Other	Normative	Social Media
11	Yanti	Journal	TE	Normative	Video
12	Darmawan	Journal	Other	Adaptive	Other
13	Kausar et al	Journal	BM	Adaptive	Video
14	Rusnawati	Journal	ICT	Productive	Video
15	Sinatrya & Aji	Journal	Other	Normative	Social Media
16	Oktarina	Journal	ICT	Productive	Other
17	Putra et al	Journal	ICT	Adaptive	LMS
18	Sakti	Journal	ICT	Productive	LMS
19	Zakhia & Dermawan	Journal	ICT	Productive	LMS

Effect Size of Each Study

Some research studies only report t and F values, so they must be converted first using OpenMee. Furthermore, the calculation is carried out where the effect sizes of each study are presented in Table 3.

Table 3
Effect size and standard error of each study

No	Author	Sample (N)	Effect Size	Standar Error	Lower Limit	Upper Limit
1	Shohib & Anistyasari	68	0.629	0.249	0.141	1.170
2	Sucipto et al	58	0.961	0.277	0.417	1.505
3	Sucipto et al	58	0.516	0.267	-0.006	1.038
4	Sucipto et al	58	0.239	0.264	-0.280	0.758
5	Harmaini	70	0.696	0.239	0.228	1.164
6	Sukayanti et al	27	5.920	0.628	4.690	7.150
7	Mas'ud & Surjono	34	0.770	0.355	0.074	1.466
8	Hamid & Effendi	35	0.924	0.356	0.226	1.622
9	Hidayah	30	0.489	0.263	-0.029	1.001
10	Taufik & Urbani	38	0.252	0.326	-0.039	0.890
11	Yanti	64	7.876	0.736	6.434	9.318
12	Darmawan	40	1.213	0.344	0.540	1.886
13	Kausar et al	72	0.950	0.249	0.462	1.438
14	Rusnawati	92	1.602	0.239	1.134	2.070
15	Sinatrya & Aji	31	2.335	0.329	1.691	2.979
16	Oktarina	43	0.464	0.31	-0.143	1.071
17	Putra et al	64	0.624	0.25	0.132	1.116
18	Sakti	30	5.874	0.592	4.714	7.034
19	Zakhia & Dermawan	36	2.438	0.311	1.828	3.048

Table 3 shows the lowest effect size is 0.239 (Sucipto et al., 2017, the 3rd study), and the highest is 7.876 (Yanti et al., 2019). In general, most of the analyzed studies have high and significant effect sizes (e.g., Darmawan et al., 2020; Hamid & Effendi, 2019; Rusnawati, 2020). These studies indicate that the flipped classroom learning model in VHS is more effective than traditional learning. However, several studies also have insignificant effect sizes (e.g., Hidayah & Sumbawati, 2019; Oktarina et al., 2021; Taufik & Purbani, 2019) indicating that the flipped classroom learning model in VHS is not significantly different from traditional learning.

Heterogeneity Test

The following step is measuring the heterogeneity. The results show that the effect sizes of the 19 independent samples are heterogeneous ($Q = 289.669$, $df = 18$, $p < .001$). These results indicate that the variance between the effect sizes used in this study is highly variable. This has implications for moderating variable analysis to determine the contribution of each moderator variable to the difference in variance between the effect sizes.

Summary of Effect Size

The results of the analysis in this study used a random effect model. Table 4 shows that the mean effect size of the 19 studies is 1.678 ($p < .001$), with a 95% confidence interval ranging from 1.125 to 2.230. These results reveal a significant impact of the flipped classroom learning model on learning in VHS compared to traditional learning and is in a large category.

Table 4
Main analysis results

Variabel	Number of studies (k)	Estimate	Standar Error (SE)	95% CI	Q	df
Overall	19	1.678	0.282	[1.125;2.230]	289.669*	18

Moderator Analysis

Table 5 describes the moderator variables in this study before being analyzed by each moderator.

Table 5
Descriptive statistics of included studies

Moderator Variable	Identified Categories	Frequency	Percentage
Publication	Journal	17	89%
	Proceedings	2	11%
Field of Expertise	Other	3	16%
	Technology and Engineering	2	11%
	Business and Management	2	11%
	Information and Communication Technology	12	63%
Subject	Normative	4	21%
	Adaptive	4	21%
	Productive	11	58%
Research Design	Pretest-posttest control group	8	42%
	Non-equivalent control group	4	21%
	One group pre-post	5	26%
	Post-test only control group	2	11%
Learning Outcome	Cognitive	14	74%
	Psychomotor	4	21%
	Affective	1	5%
Media	Video	5	26%
	LMS	9	47%
	Social Media	2	11%
	Other	3	16%
Sample Size	Big	16	84%
	Small	3	16%

Publication

The results of the analysis (Table 6) reveal that the average effect size based on the type of publication is significantly different (Qb = 12.598; p < 0,001). This indicates that the variable type of publication affects the effectiveness of using the flipped classroom learning model in VHS. The average effect size of the journal category is bigger (ES = 1.838; p < 0,001) compared to the proceedings category (ES = 0.529; p < 0,05) and the difference in mean effect size was both confirmed to be significant.

Area of Expertise

The results of the analysis (Table 6) revealed that the average effect size of each major variable was significantly different (Qb = 17.006; p < 0.001). This shows that majors affect the effectiveness of using the flipped classroom learning model in VHS. Of the four major categories, only the Technology and Engineering category (ES = 4.370; p = 0.209) was insignificant. However, this finding does not represent all areas of expertise. It is still difficult to find studies in other areas such as Agribusiness and Agrotechnology, Maritime Affairs, Arts and Creative Industries, and Tourism.

Subject

The average effect sizes of the three categories of maps based on Table 6 were found to be significantly different (Qb = 38.587; $p < 0.001$). This indicates that subjects affect the effectiveness of using the flipped classroom learning model in VHS. Of the three categories of subjects, the use of the flipped classroom learning model was most effectively used in the normative subject (ES = 4.034; $p < 0.05$).

Research Design

The results of the analysis (Table 6) revealed that the average effect size of each category on the research design variables was significantly different (Qb = 62.671, $p < 0.001$). These results indicate that the research design affects the effectiveness of using the flipped classroom learning model in VHS, where One Group Pre-test And Post-test (ES = 3.341; $p < 0.001$) has the largest effect size.

Learning Outcome

The results of the analysis (Table 6) reveal that the average effect sizes of the three categories on the measured learning outcomes are significantly different (Qb = 31.767, $p < 0.001$). This indicates that the difference in the categories of learning outcomes measured affects the effectiveness of using the flipped classroom learning model in VHS. The cognitive aspect was found to be the most effective (ES = 2.153; $p < 0.001$) followed by the psychomotor aspect (ES = 0.520; $p < 0.001$) and the affective aspect (ES = 0.239; $p < 0.001$).

Media

The results of the analysis (Table 6) reveal that the average effect size of the media moderator variable is significantly different (Qb = 7.817; $p<0.05$). These results indicate that media differences affect the effectiveness of using the flipped classroom learning model in VHS. Interestingly, the social media category was not proven to be effective in the flipped classroom learning model (ES = 1.293; $p = 0.214$).

Sample Size

In this study, the moderating variable of sample size consisted of two groups, namely studies with small sample sizes <= 30 and studies with large sizes > 30. The results of the analysis (Table 6) revealed that the average effect size of the two categories on the sample size variable was significantly different (Qb = 20,663; $p < 0.001$). This indicates that sample size affects the effectiveness of using the flipped classroom learning model in VHS. Although the overall average effect size proved to have a significant effect, the average effect size category of studies with small sample sizes was found to have no significant effect on the effectiveness of using the flipped classroom model (ES = 4.066; $p = 0.055$). Meanwhile, the mean effect size for the large sample size categories was confirmed to be significant (ES = 1.263; $p < 0.001$).

Table 6
Summary of moderator variable analysis results

Moderator Random Effects Model	k	ES		SE	95% CI (Lower;Upper)	Q	df	Qw	Qb	
Publication							1	277.071	12.598	*
Journal	17	1.838	*	0.315	(1.222;2.455)	275.862	16			
Proceedings	2	0.529	**	0.215	(0.108;0.951)	1.209	1			
Area of Expertise							3	272.663	17.006	*
Other	3	1.266	**	0.612	(0.067;2.465)	20.202	2			
TE	2	4.370		3.476	(-2.442;11.183)	71.429	1			
BM	2	0.818	*	0.172	(0.480;1.155)	1.000	1			
ICT	12	1.586	*	0.349	(0.902;2.270)	180.033	11			
Subject							2	251.082	38.587	*
Normative	4	4.034	**	1.477	(1.139;6.928)	130.435	3			
Adaptive	4	0.860	*	0.144	(0.578;1.141)	3.000	3			
Productive	11	1.251	*	0.296	(0.671;1.831)	117.647	10			
Research Design							3	226.998	62.671	*
Pretest-posttest Control Group	8	1.399	*	0.421	(0.574;2.225)	101.744	7			
Non-equivalent Control Group	4	0.706	*	0.140	(0.431;0.980)	3.000	3			
One Group Pre-post	5	3.341	*	0.907	(1.565;5.118)	114.286	4			
Post Test Only Control Group	2	1.116	**	0.489	(0.158;2.074)	7.968	1			
Learning Outcome							2	257.902	31.767	*
Cognitive	14	2.153	*	0.366	(1.435;2.869)	254.902	13			
Psychomotor	4	0.520	*	0.155	(0.217;0.823)	3.000	3			
Afective	1	0.239		0.265	(-0.280;0.758)		0			
Media							3	281.852	7.817	**
Video	5	2.195	*	0.643	(0.935;3.454)	90.909	4			
LMS	9	1.866	*	0.480	(0.924;2.808)	168.067	8			
Social Media	2	1.293		1.041	(-0.748;3.334)	20.000	1			
Other	3	0.743	*	0.206	(0.332;1.137)	2.876	2			
Sample							1	269.006	20.663	*
Big	16	1.263	*	0.239	(0.794;1.732)	157.895	15			
Small	3	4.066		2.116	(-0.081;8.212)	111.111	2			

Note. *p < .001; **p < .05; k = the number of studies; CI = Confidence Interval; Qw = Q within; Qb = Q between

Publication Bias

Last step is to check for publication bias. Based on Figure 1, it appears that the spread of effect sizes is not completely symmetrical around the vertical line. Therefore, an analysis was carried out with the value of the fail-safe N statistic. According to Mullen

(2001), when the fail-safe N value is more than 5K + 10 (K=number of individual studies), it can be concluded that there is no publication bias in the meta-analysis. In this study K=19, so 5(19) + 10 = 105. The fail-safe N value obtained in this study was 2476, with a target significance of 0.05 and $p < 0.001$. These results also confirm that there is no publication bias problem in the meta-analysis study, so there is no need to add data to the analysis.

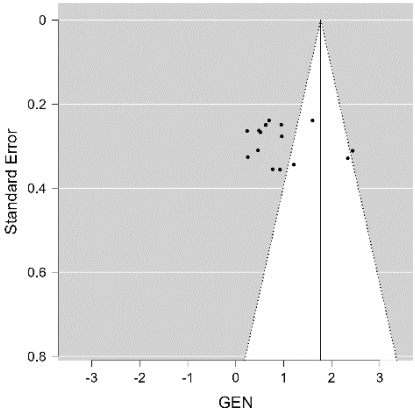

Figure 1
Funnel plot random effect model

DISCUSSION

The study results show that the flipped classroom at the VHS level has conducted several empirical studies to assess its effectiveness in several areas of expertise, subject categories and covers the three aspects of learning outcomes, namely cognitive, psychomotor, and affective. A meta-analysis conducted on 17 empirical studies with 19 study samples that can be studied from 2017 to 2021 shows that the flipped classroom has a significant and positive effect with an effect size value of 1.678. This finding supports the findings that have been previously carried out on secondary education students (Gillette et al., 2018; Hew & Lo, 2018; Tan et al., 2017) and in vocational education (Mubai et al., 2020). These results certainly prove flipped classroom effective in improving the learning outcomes of VHS students both in terms of knowledge, skills and attitudes.

From a number of studies, studies of Sakti & Sukardi (2021), Sukayanti et al. (2018), and Yanti et al. (2019) showed the biggest effect that is 7.876, 5.920, 5.874. The number of studies with large category (ES 0.8) were 10 studies, moderate effect ($0.2 \leq ES \leq 0.8$) were 9 studies, and no studies with low effect were found. However, some studies are not significant, such as the study by Hidayah & Sumbawati (2019), Oktarina et al. (2021), Sucipto et al. (2017) in their second and third studies, and Taufik & Urbani (2019).

The moderators analyzed in this study indicate that the type of publication, area of expertise, subjects, research design, learning outcomes, media, and samples size are significant factors in using the flipped classroom. The flipped classroom is proven to influence learning outcomes at the vocational level, especially in ICT expertise, Business and Management, and Engineering Technology. For future research, it is recommended that studies be conducted in other areas of expertise such as Agribusiness and Agrotechnology, Maritime Affairs, Arts and Creative Industries, and Tourism. In addition, research results show that most of the studies (14 studies) measure cognitive aspects. So based on Sudira's (2018) statement, it is better to measure the effect of the flipped classroom model on other aspects, namely psychomotor and affective aspects. To be streamlined with the rapid development of technology-based learning media, it is recommended to conduct research that uses other learning media. Several other factors, such as the duration of using the flipped classroom model and strategies or learning activities in the flipped classroom learning model, also need to be studied further.

CONCLUSION

This study reviewed 19 empirical studies that met the inclusion criteria. Based on the results, it can be concluded that the flipped classroom learning model is an effective learning model for VHS' learning outcomes, which is 1.678 with a standard error of 0.282. Therefore, this learning model is recommended to be applied in both normative, productive, and adaptive subjects in students' cognitive, psychomotor, and affective aspects. However, there are still limitations in this study, such as the category of majors. It does not represent all vocational majors in Indonesia, and the media used does not represent several other learning media that can be used. In addition, it is still not researched how long the duration of using this learning model is effective for students and what learning activities can affect it. In accordance with current needs, improving the quality of VHS graduates, it is recommended for teachers to use the flipped classroom learning model. The moderator variables that have been studied in this study may be considered in implementing the flipped classroom learning model.

REFERENCES

Armstrong, R., Jackson, N., Doyle, J., Waters, E., & Howes, F. (2005). It's in your hands: The value of handsearching in conducting systematic reviews of public health interventions. *Journal of Public Health*, *27*(4), 388–391. https://doi.org/10.1093/pubmed/fdi056

Bergmann, J., & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*.

Betihavas, V., Bridgman, H., Kornhaber, R., & Cross, M. (2016). The evidence for "flipping out": A systematic review of the flipped classroom in nursing education. *Nurse Education Today*, *38*, 15–21. https://doi.org/10.1016/j.nedt.2015.12.010

Borenstein, M., V. Hedges, L., Higgins, J. P. T., & Rothstein, H. R. (2009). Introduction to Introduction. In *An Introduction to Information Processing*. John Wiley & Sons, Ltd. https://doi.org/10.1016/b978-0-12-209005-9.50005-9

Brown, B. A. (2016). Understanding the Flipped Classroom : Types , Uses and Reactions to a Modern and Evolving Pedagogy. *Culminating Projects in Teacher Development*, *12*, 27.

Cheng, L., Ritzhaupt, A. D., & Antonenko, P. (2019). Effects of the flipped classroom instructional strategy on students' learning outcomes: a meta-analysis. *Education Tech Research And Development*, *67*(4), 793–824. https://doi.org/10.1007/s11423-018-9633-7

Cleophas, T. J., & Zwinderman, A. H. (2017). *Modern Meta-Analysis: Review and Update of Methodologies*. Springer.

Darmawan, W., Kuswandi, D., & Praherdhiono, H. (2020). Pengaruh Blended Learing Berbasis Flipped Classroom pada Mata Pelajaran Prakarya Terhadap Hasil Belajar Siswa Kelas X SMK. *Edcomtech*, *5*(1), 170–179.

Gillette, C., Rudolph, M., Kimble, C., Rockich-Winston, N., Smith, L., & Broedel-Zaugg, K. (2018). A meta-analysis of outcomes comparing flipped classroom and lecture. *American Journal of Pharmaceutical Education*, *82*(5), 433–440. https://doi.org/10.5688/ajpe6898

Hamdan, N., McKnight, P., McKnight, K., & Arfstrom, K. M. (2013). *A Review of Flipped Learning* (Issue August 2013). https://flippedlearning.org/wp-content/uploads/2016/07/WhitePaper_FlippedLearning.pdf

Hamid, A., & Effendi, H. (2019). Flipped Classroom sebagai Alternatif Pembelajaran pada Mata Pelajaran Dasar Listrik dan Elektronika. *JTEV (Jurnal Teknik Elektro Dan Vokasional)*, *V*(1), 81–86.

Harmaini, L. (2018). The Influence of Flipped Classroom and Learning Independence Models on Student Learning Outcomes of Class X Office Administration Vocational School. *2nd Padang International Conference on Education, Economics, Business, and Accounting.*, *64*, 344–351. https://doi.org/10.2991/piceeba2-18.2019.109

Hew, K. F., & Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Medical Education*, *18*(1), 1–12. https://doi.org/10.1186/s12909-018-1144-z

Hidayah, N., & Sumbawati, M. S. (2019). Efektivitas Model Pembelajaran Flipped Classroom terhadap Self Regulated Learning dan Hasil Belajar Siswa pada Mata Pelajaran Dasar Desain Grafis di SMK N 1 Surabaya. *IT-Edu*, *04*(01), 165–173.

Jwaifell, M., Abu-Omar, R., & Al-Tarawneh, M. (2018). The readiness of Arabic language teachers for integrating flipped classroom: Case of Ma'an. *International Journal of Instruction*, *11*(4), 855–868. https://doi.org/10.12973/iji.2018.11454a

Kausar, A., Maryono, D., & Aristyagama, Y. H. (2020). *The Effectiveness of Implementation Blended Learning Flipped Classroom Type Reviewed from Student Learning Outcomes in Digital Simulation Subjects at Vocational High School*. *3*(3).

Kurniawan, E., Muslim, S., Rahmadyanti, E., Aribowo, W., Kusumawati, N., Ismayati, E., Basuki, I., & Rahim, R. A. (2019). Vocational Students Readiness In The Face of the Industrial Revolution 4.0 and the Demands of Life in the 21st Century Skills. *Celebes Education Review*, *1*(1), 40–52. https://doi.org/10.37541/cer.v1i1.118

Låg, T., & Sæle, R. G. (2019). Does the Flipped Classroom Improve Student Learning and Satisfaction? A Systematic Review and Meta-Analysis. *AERA Open*, *5*(3), 233285841987048. https://doi.org/10.1177/2332858419870489

Lencastre, J. A., Morgado, J. C., Freires, T., & Bento, M. (2020). Curriculum Innovation. *International Journal of Instruction*, *13*(4), 575–592. https://doi.org/10.5005/jp/books/11100_14

Mas'ud, H., & Surjono, H. D. (2018). The Implementation of Flipped Classroom Learning Model Using Moodle To Increase Students' Higher Order Thinking Skills. *Journal of Educational Science and Technology (EST)*, *4*(3), 187. https://doi.org/10.26858/est.v1i1.6521

Mubai, A., Ambiyar, A., Fadhilah, F., & ... (2020). Meta analisis: Efektivitas model pembelajaran flipped classroom di pendidikan kejuruan. *Jurnal Pembangunan …*, *8*(1). https://journal.uny.ac.id/index.php/jppfa/article/view/36542

Nuryanto, A., & Eryandi, K. Y. (2020). The 21st Century Ideal Skills for Vocational High Schools. *International Conference on Educational Research and Innovation (ICERI 2019)*, *Atlantis P*, 142–147. https://doi.org/10.2991/assehr.k.200204.026

Oktarina, R., -, A., -, M. G., -, F., Muskhir, M., & Effendi, H. (2021). The Effect of The Use of Multimedia Flip Book With the Flipped Classroom Approach in Vocational School. *Journal of Education Technology*, *5*(1), 159–166. https://doi.org/10.23887/jet.v5i1.31435

Prasetya, B., Muchtar, H., & Syahrial, Z. (2018). Pengaruh Model Pembelajaran Dan Minat Belajar Terhadap Hasil Belajar Statistik. *Jurnal Teknologi Pendidikan (JTP)*, *20*(2), 221. https://doi.org/10.24114/jtp.v11i2.12591

Putra, I. N. T. A., Sugihartini, N., & Wahyuni, D. S. (2021). Pengaruh Model Pembelajaran Problem Based Learning in Flipped Classroom Berbasis Media Rumah Belajar Terhadap Prestasi Belajar Simulasi Digital Peserta Didik Kelas X Multimedia Di SMK Negeri 3 Singaraja Tahun Ajaran 2019/2020. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *18*(1), 11. https://doi.org/10.23887/jptk-undiksha.v18i1.25568

Richards, D. (2008). Handsearching still a valuable element of the systematic review: Commentary. *Evidence-Based Dentistry*, *9*(3), 85. https://doi.org/10.1038/sj.ebd.6400602

Rusnawati, M. D. (2020). Implementasi Flipped Classroom Terhadap Hasil Dan Motivasi. *Jurnal Ilmiah Pendiidikan Dan Pembelajaran*, *4*(April), 139–150.

Sajidan, Baedhowi, Triyanto, Totalia, S. A., & Masykuri, M. (2018). Peningkatan Proses Pembelajaran dan Penilaian Pembelajaran Abad 21. In *Kemendikbud Jakarta*.

Sakti, R. H., & Sukardi, S. (2021). Empirical Effect: Flipped Classroom-Based E-Learning to Face Learning on Covid-19 Pandemic. *Jurnal Pendidikan Dan Pengajaran*, *54*(1), 1–8. https://doi.org/10.23887/jpp.v54i1.31645

Samani, M. (2018). Vocational Education in the Era of Industry 4.0: An Indonesia Case. *International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018)*, *201*, 45–47. https://doi.org/10.2991/aptekindo-18.2018.10

Shi, Y., Ma, Y., MacLeod, J., & Yang, H. H. (2020). College students' cognitive learning outcomes in flipped classroom instruction: a meta-analysis of the empirical literature. *Journal of Computers in Education*, *7*(1), 79–103. https://doi.org/10.1007/s40692-019-00142-8

Shohib, & Anistyasari, Y. (2017). *Pengaruh Model Pembelajaran Flipped Classroom Terhadap Prestasi Belajar Siswa Pada Mata Pelajaran Rancang Bangun Jaringan Di SMK Negeri 3 Buduran Sidoarjo*. *02*, 26–35.

Sinatrya, P., & Aji, S. U. (2020). Efektivias Model Pembelajaran Flipped Classroom Daring Menggunakan Media Sosial Instagram di Kelas X SMK. *Primatika : Jurnal Pendidikan Matematika*, *9*(2), 81–90. https://doi.org/10.30872/primatika.v9i2.368

Sucipto, T. L. A., Efendi, A., Hanif, H. N., & Budiyanto, C. (2017). The Influence of Learning Management Technology to Student's Learning Outcome. *IJPTE : International Journal of Pedagogy and Teacher Education*, *1*(1), 11–18. https://doi.org/10.20961/ijpte.v1i1.4606

Sudira, P. (2018). Metodologi Pembelajaran Vocational: Inovasi, Teori dan Praksis. In *UNY Press*.

Sukayanti, L. R., Sudarma, I. K., & Jampel, I. N. (2018). Pengembangan Blended Learning Tipe Flipped Classroom Pada Mata Pelajaran Seni Budaya Kelas Xi. *Jurnal EDUTECH Universitas Pedidikan Ganesha*, *6*(1), 134–146. https://ejournal.undiksha.ac.id/index.php/JEU/article/view/20279

Sullivan, G. M., & Feinn, R. (2012). Using Effect Size—or Why the P Value Is Not Enough . *Journal of Graduate Medical Education*, *4*(3), 279–282. https://doi.org/10.4300/jgme-d-12-00156.1

Tan, C., Yue, W.-G., & Fu, Y. (2017). Effectiveness of flipped classrooms in nursing education: Systematic review and meta-analysis. *Chinese Nursing Research*, *4*(4), 192–200. https://doi.org/10.1016/j.cnre.2017.10.006

Taufik, & Purbani, W. (2019). *The Implementation of Flipped Classroom as an Attempt to Improve Indonesian EFL Learners' Speaking Performance*. *401*(Iceri 2019), 153–157. https://doi.org/10.2991/assehr.k.200204.028

Tilak, J. B. G. (2018). Education and development in India: Critical issues in public policy and development. In *Education and Development in India: Critical Issues in Public Policy and Development*. Springer Singapore. https://doi.org/10.1007/978-981-

13-0250-3

Unal, Z., & Unal, A. (2017). Comparison of student performance, student perception, and teacher satisfaction with traditional versus flipped classroom models. *International Journal of Instruction, 10*(4), 145–164. https://doi.org/10.12973/iji.2017.1049a

Wagiran, M., Pardjono, M., Suyanto, W., & Sofyan, H. (2017). *Vocational Education Development Framework in 21st Century*. *102*(Ictvt), 395–398. https://doi.org/10.2991/ictvt-17.2017.68

Yanti, Y. A., Buchori, A., & Nugroho, A. A. (2019). Pengembangan Video Pembelajaran Matematika melalui Model Pembelajaran Flipped Classroom di Sekolah Menengah Kejuruan. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *1*(6), 381–392. https://doi.org/10.26877/imajiner.v1i6.4868

Zakhia, F. Y., & Dermawan, D. A. (2021). Penerapan Flipped Classroom Pada Mata Pelajaran Pemrograman Berorientasi Objek Sebagai Solusi Pembelajaran Daring Dimasa Pandemi di SMKN 2 Surabaya. *Jurnal IT-EDU*, *5*, 678.