Hybrid Learning for Conceptual Understanding Skills in Mathematics: A Meta-Analysis

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***Abstract*—The previous studies regarding hybrid learning and mathematics concept showed that there is an inconsistent effect of hybrid learning on students' conceptual understanding skills in mathematics. The purpose of this study is to approximate and examine the effect of hybrid learning on students' mathematical conceptual understanding skills and some moderating factors predicted in affecting students' heterogeneous mathematics concept. Meta-analysis was employed to conduct this study by selecting random effect model. The process of literature search and selection established 39 documents published in 2011 – 2021. Hedges' equation was used to measure the effect size. Data analysis employed Z test and Q Cochrane test supported by the Comprehensive Meta-Analysis (CMA) software. The results showed that hybrid learning had a moderate positive effect ($g = 0.867$; $p < 0.05$) on students' conceptual understanding skills in mathematics. This study indicates that hybrid learning is effective in enhancing students' mathematical conceptual understanding skills. Furthermore, educational level, geographical location and group size of intervention were not the significant moderating factors. It means that students' heterogeneous mathematics concept in hybrid learning process were not affected by the moderating factors. This study suggests mathematics teacher and lecturer to implement hybrid learning as an alternative mathematics learning in enhancing students' mathematics concept.**

***Index Terms*—Conceptual understanding, hybrid learning, mathematics, meta-analysis.**

I. Introduction

One of the mathematical capabilities that students need to acquire is conceptual understanding [1]. Conceptual understanding is the main foundation in learning mathematics in which it is closely connected to the students' ability to solve problems [2, 3]. Students will not be able to solve mathematical problems if they do not understand the mathematical concepts in the problem. Lack of understanding of mathematical concepts will hinder the improvement of other mathematical abilities of students.

A learning model that can enhance students' mathematical conceptual understanding, especially during this Coronavirus Disease 2019 (COVID-19) pandemic, is a hybrid learning model [4]. Some literatures stated that hybrid learning is a learning model that combine offline instruction and online instruction [5, 6]. The offline instruction in this study represents a learning using some platforms but these platforms do not create interactive learning while the online instruction understood in this study is a learning utilizing some online platforms and the platforms can appear the interactive learning. The combination of the two learning systems aims to maximize the benefits of both learning systems so that students are capable to reach the expected learning objectives [7, 8]. In hybrid learning, both offline instruction and online instruction, the processes of communication among educators and students still run smoothly [5, 7]. When the learning is conducted in offline, students are required to construct their understanding independently. Meanwhile when the learning is conducted in online, the concept can be further emphasized by educators. So, by applying hybrid learning, students' mathematical conceptual understanding can be enhanced.

Research on the implementation of the hybrid learning has been widely conducted by researchers in the past. The results exposed that the students' mathematical conceptual understanding obtain a positive impact significantly when used hybrid learning [9–12]. Arifin and Herman [13], stated that internet-based learning can enhance students' mathematical conceptual understanding and learning independence. Meanwhile, several other studies have shown that hybrid learning has no significant impact and even has a negative impact on students' mathematical conceptual understanding skills [14–16]. The studies on the effect of hybrid learning on students' mathematical conceptual understanding have not shown consistent results.

Several studies connected to use of the mathematics learning used hybrid learning discovered that hybrid learning had a moderate effect on students' mathematical conceptual understanding skills [17, 18]. Several other studies even reported that hybrid learning had a strong effect on students' mathematical conceptual understanding skills [19–22]. However, several studies stated that hybrid learning had a modest effect on students' mathematical conceptual understanding skills [23–25]. Hybrid learning was even found to have a weak effect on students' mathematical conceptual understanding skills [26]. These findings indicate that there has been heterogeneity of the effect of hybrid learning on students' mathematical conceptual understanding skills. It means that there has been a gap in the level of students' conceptual understanding in mathematics in the implementation of hybrid learning. Therefore, several potential factors, such as geographical location, educational level, and group size of intervention, need to be explored and examined to determine whether or not they are significant in affecting the heterogeneity of the effect of hybrid learning on students' mathematical conceptual understanding skills. Educational level, geographical location, and group size of intervention are selected as the moderating factors to be

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investigated and examined because they are substantial factors and the data related to the moderating factors is easy to get from each document or primary study.

Conceptual understanding is one of the five "intertwining strands" of mathematical proficiency [27]. Students need to understand mathematical concepts in order to develop other mathematical skills. Therefore, a meta-analysis related to the hybrid learning impact on students' mathematical conceptual understanding skills needs to be carried out to discover whether or not the hybrid learning can be an effective solution to enhance students' mathematical conceptual understanding. Furthermore, education officials, educators, and teaching staff also need accurate information regarding the effectiveness of hybrid learning in enhancing students' mathematical conceptual understanding, especially during this pandemic.

Meta-analysis of hybrid learning has been carried out by many researchers in the field of medical education [28–32]. There were also several meta-analyses that examined the hybrid learning effect on students' achievement and learning outcomes [33–36]. However, there has been no meta-analysis study on hybrid learning that specifically examines the hybrid learning impact on students' mathematical conceptual understanding skills. As a consequence, this study may be able to reveal the hybrid learning effect on students' conceptual understanding skills in mathematics.

This current meta-analysis study aims to approximate and examine the impact of hybrid learning on students' conceptual understanding skills in mathematics. In addition, this study examines some moderating factors such as educational level, geographical location, and group size of intervention predicted in affecting the heterogeneity of students' mathematical conceptual understanding skills. The following research questions are directed to this study:

1) What is the effect size of hybrid learning implementation on students' mathematical conceptual understanding skills? Is hybrid learning effective for students' mathematical conceptual understanding skills?
2) Do educational level, geographical location, and group size of intervention affect students' heterogeneous mathematical conceptual understanding skills?

II. METHODS

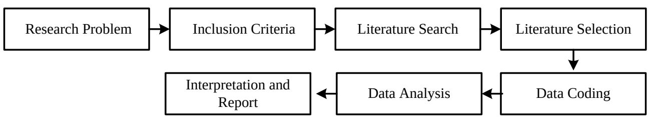

Fig. 1. Meta-analysis steps.

A meta-analysis was employed to conduct this research [37, 38]. The random effect model was selected as an estimation model in analyzing effect size data because this research assessed the effect of hybrid learning on conceptual understanding skills in mathematics in different populations such as populations with different educational level and geographical location. Borenstein *et al.* [38] stated that the random effect model is an estimation model of meta-analysis accommodating the heterogeneous study in which the true effect can vary from study to study. Some literatures stated that to carry out meta-analysis, there were seven steps [39], [40]. The steps of meta-analysis are presented in Fig. 1.

A. Inclusion Criteria

Some inclusion criteria were established to limit the problems of this research. Liberati *et al.* [41] suggested PICOS (Population, Intervention, Comparator, Outcome, Study design) to be referred in establishing the inclusion criteria. The inclusion criteria were: 1) the document was published in the period of 2011 – 2021; 2) the document was only written in English; 3) the published document is such as journal article or conference paper and the unpublished document is such as script, thesis, or dissertation; 4) the document was indexed by Scopus, Web of Science, or Google Scholar; 5) the document reported the sufficient statistics to compute the effect size such as mean, standard deviation (SD), sample size (N), *p*-value, or *t*-value; 6) study design in the document was a quasi-experiment research; 7) comparator in the document was traditional learning with face to face; 8) intervention in the document was hybrid learning; 9) outcome in the document was mathematical conceptual understanding skills; and 10) population in the document was primary, secondary, and university/college students in Asia, America, Europa, Africa, and Australia. These were expected to focus in searching and selecting literature.

B. Literature Search and Selection

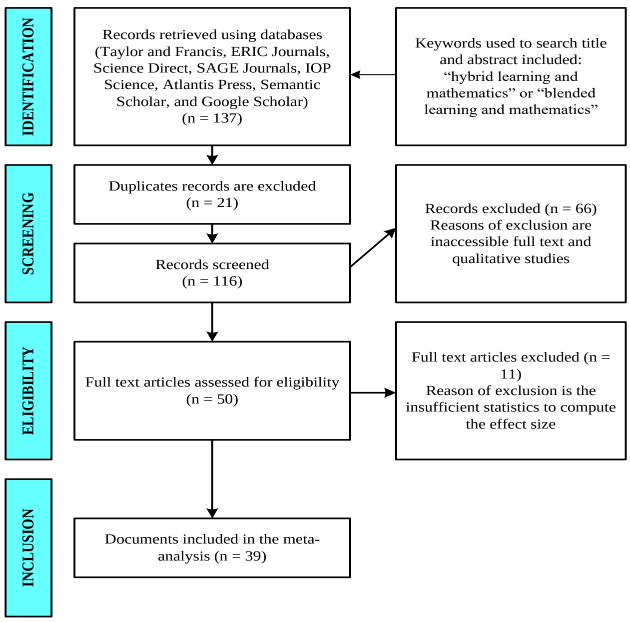

Fig. 2. The selection process of document.

Some databases such as Taylor and Francis, Science Direct, Eric Journals, SAGE Journals, IOP Science, Atlantis Press, Semantic Scholar, and Google Scholar were used to search literature. Some combinational keywords such as "hybrid learning and mathematics" or "blended learning and mathematics" were also used to ease in finding literature. 137 documents were found by using the databases and the combinational keywords. Furthermore, these documents were selected to establish the eligible documents. Moher *et al.* [42], mentioned that there were four steps to select document that were: 1) identification, 2) screening, 3) eligibility, and 4) inclusion. The selection process of document is presented in Fig. 2.

C. Data Coding

Some information such as author, statistical data, educational level, geographical location, group size of intervention, publication year, document type, indexer, and database were coded to a coding sheet. The information is shown in Table I.

TABLE I: THE FREQUENCY DISTRIBUTION OF DOCUMENT

Variables	Groups	Frequency	Percentage
Educational Level	Primary school	6	15.38
	Secondary school	14	35.90
	University or college	19	48.72
Geographical Location	Asia	19	48.72
	America	15	38.46
	Europa	1	2.56
	Africa	3	7.69
	Australia	1	2.56
Group Size of Intervention	n ≤ 30 (small size)	9	23.08
	n > 30 (large size)	30	76.92
Publication Year	2011	1	2.56
	2012	3	7.69
	2013	2	5.13
	2014	2	5.13
	2015	3	7.69
	2016	6	15.38
	2017	4	10.26
	2018	3	7.69
	2019	5	12.82
	2020	5	12.82
	2021	5	12.82
Document Type	Journal article	37	94.87
	Dissertation	2	5.13
Database	Google scholar	13	33.33
	Semantic scholar	7	17.95
	ERIC	9	23.08
	DOAJ	5	12.82
	Science direct	5	12.82
Indexer	Scopus	25	64.10
	Web of science	10	25.64
	Google scholar	4	10.26

Two coders were involved to justify that coding data was credible and valid [43]. The two coders are lecturers with expertise in statistics. The measuring of consistency of these coders in coding data used Cohen's kappa coefficient because the process of data coding only involved two coders [40]. McHugh [44], mentioned that the formula for Cohen's Kappa is as bellow:

$$\mathrm{K} = \frac{\mathrm{Pr(a)\text{-}Pr(e)}}{\mathrm{1\text{-}Pr(e)}} \tag{1}$$

where Pr(a) is the agreement of actual observed and Pr(e) is chance agreement. The results of Cohen's Kappa test are shown in Table II.

TABLE II: THE RESULTS OF COHEN'S KAPPA

Items	Kappa Value	Agreement Level	Sig. Value
Educational level	0.923	Strong	0.000
Geographical location	0.918	Strong	0.000
Group size of intervention	0.843	Strong	0.000
Publication year	0.813	Strong	0.019
Document type	0.847	Strong	0.000
Indexer	0.964	Strong	0.000
Database	0.965	Strong	0.000
Mean of intervention	0.813	Strong	0.003
Standard deviation of intervention	0.903	Strong	0.005
Mean of comparator	0.852	Strong	0.003
Standard deviation of comparator	0.843	Strong	0.006
Group size of comparator	0.802	Strong	0.030

Table II shows that agreement level of those coders in extracting data in every item was categorized as strong [44]. The significance value of every item extracted was also less than 0.05. These findings indicate that coding data verified by those coders is valid and credible [40, 45, 46].

D. Data Analysis

The effect size was measured using the Hedges' g because it could accommodate a relatively small sample size [47]. Borenstein *et al*. [38], mentioned that Hedges' g is calculated as follows:

$$g = \frac{\bar{x}_1-\bar{x}_2}{\sqrt{\frac{(n_1-1)s_1^2+(n_1-1)s_2^2}{n_1+n_2-2}}} \times \left(1-\frac{3}{4df-1}\right) \tag{2}$$

In which $\overline{x_1}$, S_1^2, and n_1 in a row represented the average, standard deviation, and sample size of the intervention group while $\overline{x_2}$, S_2^2, and n_2 in a row represented the average, standard deviation, and sample size of the control group.

The effect size obtained was classified into some categories. Cohen *et al*. [48], classified it into four categories that were: g = 0.00 – 0.20 (weak effect), g = 0.21 – 0.50 (modest effect), g = 0.51 – 1.00 (moderate effect), and g > 1.00 (strong effect).

The Z test was employed to examine the significance of hybrid learning effect on students' mathematical conceptual understanding skills [38]. In addition, Cochran's Q test was used to examine the significance of some moderating factors such as educational level, geographical location, and group size of intervention in affecting the heterogeneity of students' conceptual understanding skills in mathematics [49]. The categorization of every potential factor is grouped in Table I.

Published studies statistically tended to have reported the results that were significant and were used in meta-analysis studies so that the bias of publication was able to occur [50], [51]. As a consequence, publication bias analysis had to be carried out. The publication bias was analyzed using the funnel plot and the test of Egger's regression [52]. Rothstein *et al*. [52] argued that the funnel plot shows the distribution of the collection of effect size data that subjectively researchers can conclude it symmetrical or unsymmetrical based on the line in the center of plot. Therefore, to justify the symmetry of the distribution of effect size data collection, the test of Egger's regression was performed. The funnel plot analysis is presented in Fig. 3.

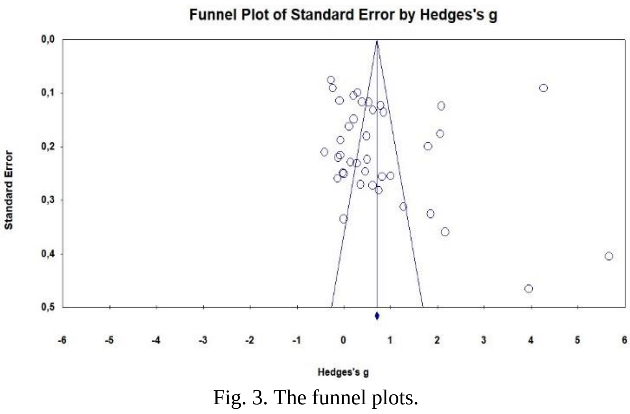

Fig. 3. The funnel plots.

The funnel plot in the Fig. 3 shows that the distribution of effect size data was symmetrical. It was also supported by Egger's regression test showing that intercept = 0.961; t-value = 0.309; and p-value = 0.759. The significance value of the t-statistic was more than 0.05. It indicates that the effect size data distributed in the funnel plot is symmetrical. It means that the collection of effect size data does not indicate publication bias.

III. Results and Discussion

A. Results

1) Overall effect size of each document

The effect size of the overall implementation of hybrid learning to enhance students' understanding of mathematical concepts from each document is presented in Table III.

Study name	Statistics for each study						
	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Naidoo et al, 2016	0,388	0,116	0,014	0,160	0,616	3,340	0,001
Vernadakis et al, 2021	0,749	0,281	0,079	0,198	1,301	2,663	0,008
Hua et al, 2013	0,213	0,149	0,022	-0,079	0,504	1,428	0,153
Apawu, 2014	0,851	0,136	0,018	0,584	1,117	6,258	0,000
Aslam, 2015	0,114	0,163	0,026	-0,205	0,432	0,699	0,485
Hendriks, 2012	0,497	0,224	0,050	0,058	0,935	2,221	0,026
Zein, 2019a	0,460	0,247	0,061	-0,024	0,943	1,864	0,062
Brashear, 2020	0,785	0,123	0,015	0,544	1,026	6,389	0,000
Ayub & Gul, 2021	2,083	0,124	0,015	1,840	2,326	16,792	0,000
Powers et al 2016	-0,274	0,076	0,006	-0,423	-0,125	-3,614	0,000
Chingos et al, 2017	4,265	0,091	0,008	4,088	4,443	47,117	0,000
Rodrigo-Peiris et al, 2018	-0,088	0,115	0,013	-0,313	0,136	-0,771	0,440
Zhang & Jiao, 2013	-0,119	0,220	0,049	-0,551	0,313	-0,541	0,589
Sciarappa et al, 2016	0,278	0,231	0,053	-0,175	0,731	1,203	0,229
Yusoff et al, 2017	0,816	0,256	0,065	0,315	1,317	3,193	0,001
Fulfillment & Ann, 2020	5,663	0,405	0,164	4,869	6,456	13,988	0,000
Alsalhi et al, 2021	2,058	0,176	0,031	1,713	2,404	11,679	0,000
Fazal & Bryant, 2019	0,298	0,099	0,010	0,104	0,491	3,013	0,003
Mlotshwa et al, 2020	0,146	0,229	0,052	-0,303	0,594	0,635	0,525
Ristanto et al, 2021	0,999	0,255	0,065	0,500	1,498	3,925	0,000
Zein, 2019b	0,001	0,251	0,063	-0,490	0,493	0,005	0,996
Botts & Crockett, 2017	0,531	0,117	0,014	0,302	0,761	4,533	0,000
Ghilay, 2021	1,799	0,200	0,040	1,408	2,190	9,016	0,000
Mese & Dursun, 2019	-0,018	0,249	0,062	-0,506	0,470	-0,072	0,943
Kazua & Demirkol, 2014	3,951	0,465	0,216	3,039	4,863	8,492	0,000
Smith & Suzuki, 2015	0,616	0,273	0,074	0,082	1,150	2,260	0,024
Aksu & Goksu, 2020	0,001	0,335	0,112	-0,656	0,657	0,002	0,999
Maseket al, 2017	0,488	0,181	0,033	0,134	0,842	2,702	0,007
Ludwig, 2021	0,203	0,105	0,011	-0,002	0,409	1,938	0,053
Shechtman et al, 2019	-0,233	0,091	0,008	-0,410	-0,055	-2,569	0,010
Bowens & Warren, 2016	0,623	0,132	0,017	0,365	0,881	4,735	0,000
Martin et al, 2015	2,162	0,360	0,129	1,457	2,867	6,013	0,000
Putra et al, 2018	1,273	0,312	0,098	0,661	1,885	4,077	0,000
Lin et al, 2016	0,356	0,270	0,073	-0,174	0,886	1,317	0,188
Ramadhani & Aisyah, 2020	1,854	0,325	0,106	1,216	2,492	5,696	0,000
Gerlich & Sollosy, 2011	0,076	0,216	0,047	-0,348	0,500	0,352	0,725
Krishnan, 2016	0,073	0,188	0,035	-0,295	0,440	0,386	0,699
Kakish, 2012	0,413	0,210	0,044	0,001	0,825	1,966	0,049
Sujanem et al, 2018	0,133	0,259	0,067	-0,376	0,641	0,511	0,609
	0,867	0,207	0,043	0,462	1,272	4,195	0,000

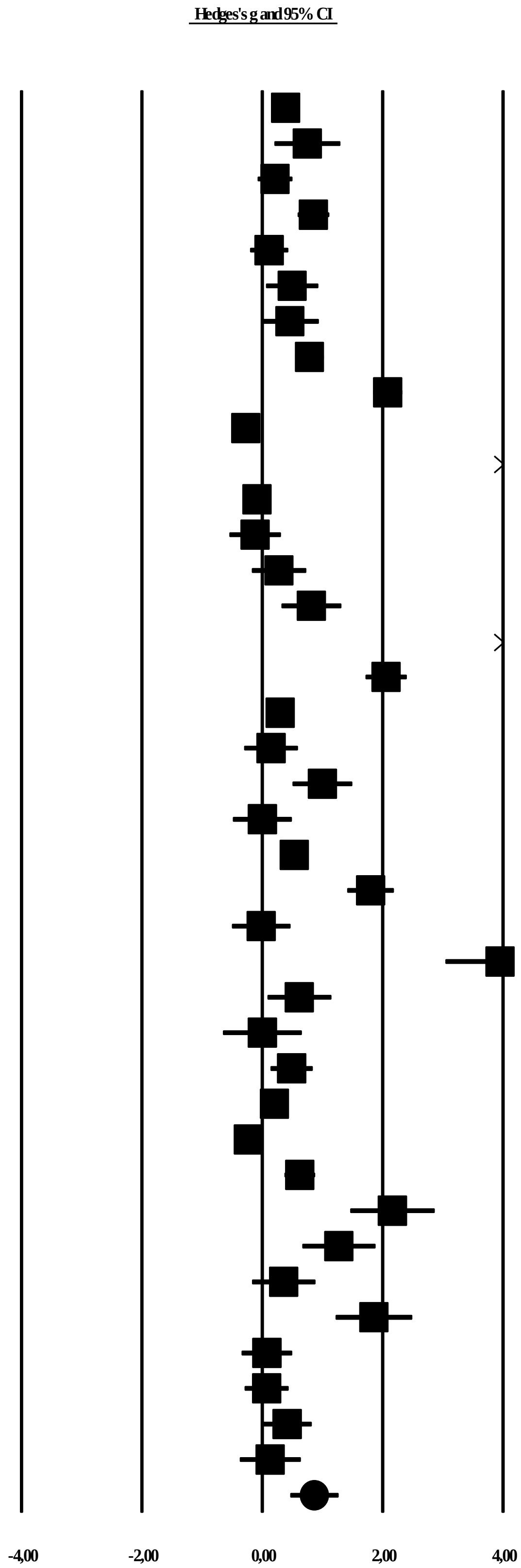

Fig. 4. The forest plot of 39 effect sizes from 39 documents.

TABLE III: SUMMARY OF EFFECT SIZES FROM 39 DOCUMENTS

Study Name	Statistics for Each Study				
	Hedges's *g*	Lower Limit	Upper Limit	*z*-Value	*p*-Value
Naidoo *et al.*, 2016	0.388	0.160	0.616	3.340	0.001
Vernadakis *et al.*, 2021	0.749	0.198	1.301	2.663	0.008
Hua *et al.*, 2013	0.213	-0.079	0.504	1.428	0.153
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Brashear, 2020	0.785	0.544	1.026	6.389	0.000
Ayub & Gul, 2021	2.083	1.840	2.326	16.792	0.000
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Ghilay, 2021	1.799	1.408	2.190	9.016	0.000
Mese & Dursum, 2019	-0.018	-0.506	0.470	-0.072	0.943
Kazua & Demirkol, 2014	3.951	3.039	4.863	8.492	0.000
Smith & Suzuki, 2015	0.616	0.082	1.150	2.260	0.024
Aksu & Goksu, 2020	0.001	-0.656	0.657	0.002	0.999
Masek *et al.*, 2017	0.488	0.134	0.842	2.702	0.007
Ludwig, 2021	0.203	-0.002	0.409	1.938	0.053
Shechtman *et al.*, 2019	-0.233	-0.410	-0.055	-2.569	0.010
Bowens & Warren, 2016	0.623	0.365	0.881	4.735	0.000
Martin *et al.*, 2015	2.162	1.457	2.867	6.013	0.000
Putra *et al.*, 2018	1.273	0.661	1.885	4.077	0.000
Lin *et al.*, 2016	0.356	-0.174	0.886	1.317	0.188
Ramadhani & Aisyah, 2020	1.854	1.216	2.492	5.696	0.000
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Krishan, 2016	0.073	-0.295	0.440	0.386	0.699
Kakish, 2012	0.413	0.001	0.825	1.966	0.049
Sujanem *et al.*, 2018	0.133	-0.376	0.641	0.511	0.609
Overall	0.867	0.462	1.272	4.195	0.000

Based on the effect size classified by Cohen *et al*. [48], of all the documents on the hybrid learning effect on students' understanding of mathematics concepts, 9 documents had strong effect, 8 documents had moderate effect, 9 documents had modest effect, 8 documents had weak effect, and the other 5 documents had negative effect. The frequency distribution of document based on effect size is presented in Fig. 5.

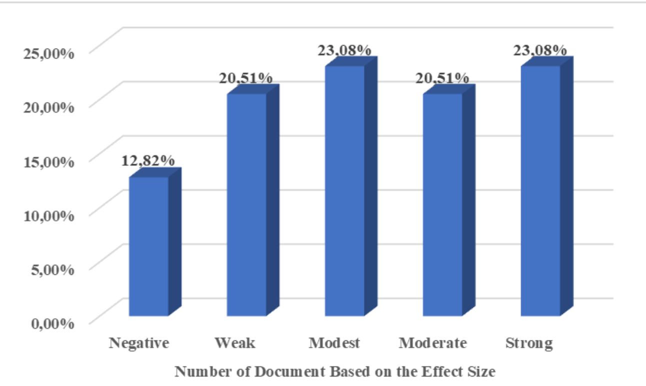

Fig. 5. The percentage of documents based on the effect size.

Furthermore, Fig. 4 shows that overall, the effect size of hybrid learning on students' conceptual understanding skills in mathematics was $g = 0.867$ in which Cohen *et al*. [48], categorized it as a moderate effect. In addition, the significance value of the Z test was less than 0.05. It means that the implementation of hybrid learning is significantly effective for students' conceptual understanding skills in mathematics. It indicates that hybrid learning is an effective learning in enhancing students' understanding of mathematics concepts.

2) Analysis of moderating factors

Moderating factors analyzed in this meta-analysis were educational level, geographical location, and group size of intervention. These factors can be potential to affect the heterogeneity of effect size. As a consequence, the analysis of these potential factors should be conducted. The analysis results of moderating factors are shown in Table IV.

TABLE IV: RESULTS OF THE Q COCHRANE' TEST

Moderating Factors	n	Hedges g	Heterogeneity		
			Qcount	df((Q)	Sig.
Educational Level					
Primary School	6	0.792			
Secondary School	14	1.149	0.964	2	0.618
University or College	19	0.690			
Geographical Location					
Africa	3	2.214			
America	15	0.635			
Asia	19	0.871	3.453	4	0.485
Australia	1	0.488			
Europa	1	0.749			
Group Size of Intervention					
$n \leq 30$ (Small Size)	9	1.134	0.477	1	0.490
$n > 30$ (Large Size)	30	0.790			

Table IV shows that all significant values of the Q Cochrane test for each moderating factor were more than 0.05. It means that educational level, geographical location, and group size of intervention are not significant moderating factors. It indicates that these moderating factors do not affect students' heterogeneous conceptual understanding skills in mathematics in the hybrid learning process.

B. Discussion

1) The effectiveness of hybrid learning on students' understanding of mathematics concepts

Overall, hybrid learning had a moderate positive effect on students' understanding of mathematical concepts. In addition, the imlementation of hybrid learning was significantly effective for students' conceptual understanding skills in mathematics. A relevant study conducted by Li and Ma [53], which synthesized 46 documents, showed that there are increasing of students' accomplishment in mathematics learning because of using computer technology. Higgins *et al*. [54], in their meta-analysis study which synthesized 24 documents, found that the use of technology has a significant impact on students' achievement, motivation, and attitudes in learning mathematics. This is in accordance with hybrid learning which requires the integration of technology in the learning process. Several studies in mathematics learning also showed that hybrid learning can improve learning achievement and outcomes and students' mathematical problem solving abilities [19, 22, 55]. In addition, Sukma and Priatna [56], revealed a result study that blended or hybrid learning is an effective learning model to increase the skills of students' critical thinking in mathematics learning. These findings further support the notion that hybrid learning can enhance students' understanding of mathematical concepts.

Hybrid learning assists learning with the different blending of places and times, biding some conveniences of full virtual courses without missing face-to-face communication completely [57, 58]. The combination of face-to-face and virtual learning provides its own advantages for students. Students can access learning materials online and frequently [59, 60]. This provides opportunities for students to learn independently and interpret the learning that has been done in order to understand the concepts of the material being studied. Conceptual understanding can be promoted the discussion sessions in both virtual and face-to-face within the hybrid learning scope. Hybrid learning has a positive impact on conceptual understanding and concept application in learning [61]. Therefore, these findings indicate that hybrid learning is an alternative learning system that can be applied by teachers in enhancing students' understanding of mathematical concepts.

2) The heterogeneity of students' mathematical conceptual understanding skills in the hybrid learning

This study revealed that educational level was not a moderating factor. It means that educational level does not affect students' heterogeneous mathematical conceptual understanding skills in the hybrid learning. In addition, it shows that there are not different conceptual understanding skills in mathematics between primary, secondary, and college students. This finding is line to the previous study which also stated that the factor of educational level did not significantly moderate the heterogeneous effect size of hybrid learning on students' mathematics achievement [34]. It strengthens the results of this study that educational level does not affect the level of students' mathematical conceptual understanding skills in the hybrid learning.

Furthermore, Table IV shows that the implementation of hybrid learning had strong effect on secondary students' conceptual understanding skills in mathematics and moderate effect on primary and college students' understanding of mathematics concepts. It means that the hybrid learning is more effective to enhance secondary students' mathematical conceptual understanding skills than primary and college students' understanding of mathematics concepts. Be in accordance with this finding, the study results carried out by Kazu and Demirkol [62], discovered that the achievement of secondary students' academic using hybrid learning was higher than the secondary students' academic using traditional learning. Then, the results of the meta-analysis conducted by Bernard *et al*. [63], revealed that hybrid learning can improve students' achievement. Thus, this meta-analysis study provides information that hybrid learning is more suitable to be applied in the secondary schools and universities.

Another finding showed that the factor of geographical location did not cause the heterogeneous effect of hybrid learning implementation on students' conceptual understanding skills in mathematics. It means that there are no different mathematical conceptual understanding skills between Asian, American, African, European, and Australian students. Furthermore, Table IV shows that the application of hybrid learning had strong effect on African students' mathematical conceptual understanding skills, modest effect on Australian students' conceptual understanding skills in mathematics, and moderate effect on Asian, American and European students' understanding of mathematics concepts. It means that the implementation of hybrid learning is more effective in enhancing African students' conceptual understanding skills in mathematics than Asian, American, Australian and European students' mathematical conceptual understanding skills. In addition, Australian mathematics teachers should provide more effort in enhancing students' understanding of mathematics concepts.

Then, the factor of group size of intervention also did not affect the heterogeneity of students' mathematical conceptual understanding skills in the hybrid learning. It shows that there are no different conceptual understanding skills in mathematics between small group and large group. This finding is suitable to the meta-analysis study conducted by Means *et al*. [34], stating that the factor of group size of intervention does not moderate the heterogeneous effect size of hybrid learning implementation on students' mathematics achievement. It provides strong evidence that group size of intervention does not affect students' heterogeneous conceptual understanding skills in mathematics in the hybrid learning process. Furthermore, Table IV show that the implementation of hybrid learning had strong effect on students' mathematical conceptual understanding skills in small group and moderate effect on students' mathematical conceptual understanding skills in large group. It means that the hybrid learning implementation is more effective in enhancing students' mathematical conceptual understanding skills in small group than students' mathematical conceptual understanding skills in large group.

IV. Conclusion and Implication

This meta-analysis study provides information that hybrid learning has moderate effect on students' conceptual understanding skills in mathematics in which it is significantly effective for students' mathematical conceptual understanding skills. It interprets that the hybrid learning is one of the effective solutions in enhancing students' conceptual understanding skills in mathematics. Furthermore, some moderating factors such as educational level, group size of intervention and geographical location, do not cause students' heterogeneous conceptual understanding skills in mathematics in the process of hybrid learning. Therefore, this study provides a basis for lecturers and teachers to organize hybrid learning as an alternative mathematics learning to enhance students' conceptual understanding skills in mathematics. It is expected that hybrid learning can be considered as an effective solution in solving problems regarding students' weak understanding of mathematical concepts.

V. Limitations and Suggestions

There are several limitations of this meta-analysis study. Firstly, other moderating factors such as intervention duration, the implementation quality of intervention, mathematical content and technology used in online learning are not involved. Secondly, number of main studies are still relatively limited. Thus, it is recommended for further relevant meta-analysis studies to involve other moderating factors and add the document of primary study.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Yullys Helsa defined the research problems, established the inclusion criteria, and searched and selected the document. Turmudi coded the data from every document to the coding sheet and examined the validity and reliability of data. Dadang Juandi analyzed the data using CMA software. All authors were involved in finishing the final manuscript.

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