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The Effect of Teacher Scaffolding on EFL Learners' Reading Proficiency: A Meta-analysis

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Abstract

In this research, we carried out a meta-analysis of the effects of teacher scaffolding on EFL learners' reading proficiency in which 28 experimental and quasi-experimental studies published from 2008 to 2022 and 39 effect sizes were reviewed and synthesized. Three questions guide this analysis: What is the overall effect of teacher scaffolding on EFL learners' reading proficiency? To what extent moderator variables such as learners' educational levels and proficiency levels modify the effect of the teacher scaffolding? What is the magnitude of publication bias in this analysis? The overall effect size was found to be 0.89, which represents a large effect size based on Cohen, Manion and Morrison' (2007) scale. The effect sizes of moderator variables were calculated and it was reported that the scaffolding has the most effect in elementary learners and elementary school level. The symmetrical funnel plot together with the fail-safe N test indicates that publication bias does not have any significant effect on the effect size reported in this study. The findings of this meta-analysis have implications for EFL teachers, researchers, policy makers and curriculum developers.

Keywords: Scaffolding, Reading proficiency, Research synthesis, Meta-analysis, Effect size

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1. Introduction

Reading proficiency is a vital aspect of literacy and significantly influences academic success. The primary aim of reading is to enhance comprehension and understanding of the material. To achieve this, teachers must implement effective reading strategies. Research indicates that children who cultivate strong reading skills in their early years tend to maintain high levels of reading comprehension throughout their education and beyond (Oxford, 1997).

There are various methods for teaching reading that come from various schools of thought or ideologies, from behaviorism to cognitivism to social constructivism. In behaviorism, the classroom teacher carried out the majority of the reading instruction, not the students (Philips, 1995; Williams, 1984). The behaviorist perspective was criticized for emphasizing reciting and being mechanistic. For example, behaviorism was challenged by Vygotsky (1962) as being isolated, specialized, excessively restricted, and intrapersonal from a psychological standpoint. Contrarily, cognitivism places more emphasis on memory, methods of information processing, attention, and noticing. Both theories received harsh criticism for omitting the social environment of learning. According to social constructivism, learning is not an individualistic process; hence, it must be learnt in a social setting with the assistance of competent peers, parents, or knowledgeable teachers (Vygotsky, 1978).

Constructivists assume that students learn subjects and reading comprehension more efficiently with the help of capable adults, parents, teachers or peers. In this theory, therefore scaffolding is a prerequisite for reading development to take place appropriately (Lantolf & Thorne, 2006). Scaffolding can be linked to Vygotsky's (1978) idea of "the zone of proximal development" (ZPD), which is the difference between the learner's actual developmental level and the degree of prospective development that could occur with direction or collaboration from a more competent individual. Besides, it is the central concept in socio-cultural theory (Clark & Graves, 2005), which elaborates the important role of teachers as mediators.

We need to use new quantitative techniques for addressing the complexities of reading comprehension, clarifying the state of current knowledge, and guiding future research and educational practices. These techniques produce more exact results, in light of the shortcomings of empirical investigations and conventional reviews (Glass et al., 1981; cook et al., 1992; Petticrew & Robert, 2008). Thus, Glass (1976) is credited with coining the term "meta-analysis," which is now used as a substitute for the narrative review. Weighted and unweighted overall probability are used to get the meta-analysis, which eliminates subjectivity

(Cooper & Rosenthal, 1980). The term meta-analysis refers to a quantitative approach that statistically combines the results of primary empirical studies on the same subject and "provides a precise estimate of the population effect of a certain construct" (Ellis, 2015, p. 2). It uses multiple regression and analysis of variance techniques, with effect sizes as the dependent variable, to resolve discrepancies in the literature on a particular topic (Cooper & Hedges, 2009). In a meta-analysis, the data that have been processed from earlier analyses or research are used. Alternatively said, it is an analysis of analyses (Glass, 1976). An interesting aspect of a meta-analysis is that it also calculates the effect of moderator variables (Glass, 1982), which has been neglected to examine in an original empirical study.

This study aims to clarify previous experimental research by synthesizing their effect sizes to reach a conclusive understanding of the scaffolding strategy's overall impact. Additionally, it explores how moderate variables influence the impact of scaffolding on overall reading proficiency.

2. Literature Review

Reading and comprehension go hand in hand because without comprehension and understanding, pupils are unable to recognize and interpret the written material. For this reason, teachers' top priorities are to aid pupils in understanding the texts more easily. Good students employ a variety of comprehension strategies at once and often intentionally select specific reading strategies to enhance their understanding, especially when reading tough texts. However, as Bassiri (2012) points out, the employment of reading comprehension strategies might be deemed beneficial if students are given the right support so they can complete a work or engage in a practice that is out of their league. This help is referred to as scaffolding, a Vygotskian metaphor for a teacher supporting a student through conversation, questioning, dialogue, and nonverbal modeling in which the learner undertakes literacy tasks that could not be done without that assistance. When the students requested to organize the paragraph from the passage, they did not know how to start. Therefore, to solve these problems, the use of the scaffolding method in teaching and learning is essential to be used as an alternative method. Scaffolding for reading instruction can be examined under three headings: pre-reading, during reading and post-reading activities.

Scaffolding as a teaching and learning approach involves the teacher and students working together to solve problems while the teacher provides assistance and direction. Scaffolding is a strategy employed by teachers to facilitate learners' transition from supported

to independent performance. In order to enhance students' reading comprehension, teachers must gain a more profound grasp of scaffolding and incorporate it into their classrooms more often. (Clark & Graves, 2005).

The idea of scaffolding was inspired by Vygotsky, but not directly drawn from, Vygotsky's ideas. However, Vygotsky did not use the scaffolding metaphor. Kaye (1970) said that a child's problem-solving is frequently assisted and supported by people who are more skilled, which laid the foundation for the idea of scaffolding. The term scaffolding was initially used to elaborate on the impact of tutoring on problem-solving behavior by Wood, Bruner, and Ross in 1976. (Wood et al., 1976, P. 90) define scaffolding as ‘‘A process that enables a child or a novice to solve a problem, carry out a task, or achieve a goal which would be beyond his unassisted efforts.’’ They use the metaphor of "scaffolding" to explain the process that works when an adult, a peer, or another competent individual helps a child complete a task that is above his or her current capacity. Scaffolding creates opportunities for the individual to actively learn from others, receive assistance in reciprocal interactions, and construct new knowledge (Hosseini, 2008).

A great body of studies has been conducted to test the effect of different types of scaffolding on learners' reading comprehension presentations both in EFL and ESL contexts. For instance, some studies have worked on the effectiveness of the teacher scaffolding on reading proficiency. They have found that teacher scaffolding has a significant effect on learners' reading proficiency (AbiyYigzaw, 2015; Abdul-Majeed & Muhammad, 2015; Buli, Basizew, & Abdisa, 2017; Demissie, 2018). AbiyYigzaw (2015) conducted a study on 'Effects of Teacher Scaffolding on Students' Reading Comprehension' with a focus on grade four students. Their finding revealed that scaffolding reading strategy instruction is effective in improving students' passage reading comprehension. The impact of applying scaffolding tactics on the reading comprehension abilities of EFL students was examined by Abdul-Majeed and Muhammad in 2015 and they found that scaffolding helped the participants' reading comprehension skills. Buli et al. (2017) conducted a study at Sire Secondary School to determine the impact of instructors' scaffolding on ninth-grade students' reading comprehension. The results showed that students who were taught reading comprehension using scaffolding techniques did better than the students in the control group. Demissie (2018) aimed to investigate scaffoldings' effects on students' reading comprehension. The findings of the study revealed that the scaffolders and scaffoldees showed greater pre-to-post intervention improvement in reading comprehension and rated the intervention as socially valid.

Another group of studies worked on the effectiveness of the other types of scaffolding on learners' reading comprehension. For example, the impact of symmetrical scaffolding on advanced students' reading comprehension was examined by Khosravi (2017). The outcomes showed that symmetrical scaffolding significantly improved participants' reading comprehension abilities. Moreover, Mojarrabi Tabrizi et al. (2019) study's goal was to determine how employing hard scaffolding (it created to help pupils with a challenging activity, and this help should be arranged in advance) and soft scaffolding (it occurs when a teacher moves around the classroom and engages in conversation with the kids) in symmetrical and asymmetrical experimental settings affected the reading comprehension skills of Iranian EFL learners. The results showed that scaffolding improved the reading comprehension skills of EFL students. In asymmetrical conditions, soft scaffolding was seen to be beneficial; in symmetrical conditions, the effectiveness was not seen. Furthermore, it was discovered that hard scaffolding worked well in both symmetrical and asymmetrical situations.

A third group of studies used technology and media as scaffolding along with other types of scaffolding. For instance, Ter Beek et al. (2019) created a digital learning environment to scaffold students' expository text reading in seventh-grade history classrooms. Students in the experimental group could employ hints composed of cognitive and metacognitive reading strategy instruction, whereas students in the control group obtained no additional support. They discovered no differences between situations regarding students' self-regulated learning or motivation, but students' cognition of problem-solving reading strategies significantly improved in the experimental group. Eventually, a comparison of students with different reading levels revealed that below- average readers were satisfied the most from digital reading practice. Piriyasurawong (2020) designed Scaffolding Augmented Reality Model (SC-AR Model) as a scaffolding tool to make an immersive learning environment to improve DR (Deep Reading) skill for new learners. The researcher implemented SC-AR Model to the sample group. The outcome indicates that the gain scores of learners are incredibly higher and higher than the group that read only the text, without SC-AR. The conclusion, thus, is that SC-AR Model enhances learner's DR skill effectively. In another study Uçak and Kartal (2022) examined the effects of reading strategy training provided online through an experimental scaffolding tool in comparison to similar training provided by a teacher, and a control condition. The instructional design of the tool followed scaffolding design guidelines, reciprocal teaching model, and principles of multimedia design. At last, they found that both experimental groups significantly improved their reading comprehension and metacognitive

strategy awareness, while the control group's reading and engagement scores decreased. The in-class experimental group also improved on the engagement scale. No significant difference in reading comprehension was observed between the experimental groups or compared to the control group.

The issue at hand is that numerous studies have been conducted on various forms of scaffolding, including teacher scaffolding and its impact on learners' reading comprehension; however, the findings remain inconclusive. This ambiguity may arise from a multitude of factors, including variations in language proficiency, educational background, age, gender, and other contextual conditions. Furthermore, accurately determining the overall effect of teacher scaffolding on reading proficiency is complicated by the presence of multiple intervening variables.To accurately evaluate the population effect, a meta-analysis research is therefore required to combine the findings of earlier, related investigations. Meta-analysis is a sort of systematic review and it differs from standard narrative reviews in a number of respects. A meta-analysis is used to summarize the direction and magnitude of the effects obtained from the prior empirical studies that investigated the same subject or phenomenon. While a meta-analysis is inclusive rather than selective, they are essentially descriptive and selective (Ellis, 2015). Therefore, this study aims to address this gap by synthesizing the results of previous experimental studies and examining how moderating variables influence the effectiveness of this educational intervention.

3. Method

3.1. Sampling Procedure and Materials

Participants in a meta-analysis are those who took part in the original studies on the same topic (Little et al., 2008). As a result, rather than selecting participants, the sampling technique in meta-analysis selects pertinent studies and papers with the same topic that have been published in valid scientific journals and that provide the statistical data required in meta-analysis.

Based on the inclusion and exclusion criteria, prior studies were chosen as our sample of study. To be included in the sample, the studies should:

1) be experimental or quasi-experimental studies in which L2 learners received teacher scaffolding for improving their reading proficiency; 2) be published between the years 2000 and 2022; 3) be published in English; 4) contain enough statistical information to calculate the effect size, such as means and standard deviations for pre- and post-test

scores for intervention and comparison group means, t-test values and group sizes, one-way ANOVA for the groups, F-values and sample sizes, etc.; 5) Should give the sample size of the studied groups.

To search the studies that meet the inclusion criteria, an in-depth search was done in Google Scholar and the Scopus and in several online databases (ending in September 2022) including ProQuest, ERIC, and Science Direct. Additionally, we manually searched TESOL, Wiley, and Oxford peer-reviewed journals. We obtained different experimental studies including articles published in open-access or subscription-based journals, MA theses, and PhD dissertations to prevent publication bias which may not get published due to the lack or weak correlation with published research. We used a list of different combinations of keywords including the scaffolding, scaffolding strategy, zone of proximal development, ZPD, reading comprehension, reading proficiency, the effect of scaffolding, the impact of scaffolding, and the effect of scaffolding on reading. We retrieved a comprehensive list of abstracts, so studies appearing to meet inclusion criteria were then obtained and reviewed in full, and those not meeting the inclusion criteria would be excluded. If the item looked promising according to its abstract or title, we read the whole text to check other criteria such as the necessary statistical data. Once a document was obtained, the reference list was investigated to identify the other published studies. All in all, From 54 documents collected, 28 studies on the effect of scaffolding on reading comprehension met the inclusion criteria. Descriptive statistics of those 28 final selected studies are presented in Table 1.

Table 1. *Features of the studies included in the Meta-Analysis*

Characteristics								**Total**
Publication year of research		2008	2009	2010	2012	2014	2015	N=28
	N	1	1	1	1	3	2	
	%	3.6	3.6	3.6	3.6	10.7	7.1	
		2016	2018	2019	2020	2021	2022	
	N	1	4	3	3	6	2	
	%	3.6	14.3	10.7	10.7	21.4	7.1	
Type of Research		Article		Master Thesis		PhD Dissertation		N=28
	N	22		5		1		
	%	78.6		17.9		3.6		
Country		China		Ecuador	Ethiopia	Indonesia		N=28
	N	2		1	1	5		
	%	7.1		3.6	3.6	17.9		

	Iran	Iraq	Jordan	Netherlands
N	7	1	1	1
%	25.0	3.6	3.6	3.6
	Philippines	Singapore	South Korea	Spain
N	2	1	1	1
%	7.1	3.6	3.6	3.6
	Taiwan	Thailand	Turkey	USA
N	1	1	1	1
%	3.6	3.6	3.6	3.6

3.2. Data collection

The material for this meta-analysis was transformed into coded form through a coding process after all studies were retrieved for analysis. The results, as well as the content and methodological aspects of the investigations, were assessed and coded in this step. In order to ensure the reliability of study selection, more than one research assistant was used to screen and choose papers to establish inter-rater reliability. Based on what was suggested by Plonsky and Oswald (2012), the coding reliability was assessed through measuring the inter-rater reliability. To do so, two coders independently coded all studies. The coders were MA students of Teaching English as a Foreign Language (TEFL) in the Department of Applied Linguistics at an International University. They were trained in one session to become familiar with the process of coding. Then, Cohen's kappa reliability coefficient between the coders was calculated using SPSS software (version 22, IBM SPSS Statistics, USA). It was found to be 0.94, which means that a good consistency exists between the raters. Finally, disagreements were discussed and settled. Coding sheets were reviewed and adjusted based on the raters' agreement.

The coding process has been successfully completed with the assistance of computer technology, significantly expediting the procedure. A Microsoft Excel file was used to import the statistical data. The data were integrated directly into the analysis software to determine the effect size, which streamlines the analysis process. Comprehensive Mete-Analysis (CMA) is a software that was used as an analytical tool in this research. It reduces the amount of time needed for analysis. Additionally, it helps organize and classify information. In the coding procedure the specific driven data from retrieved studies were categorized as (1) name of the study; (2) name of author; (3) year of publication; (4) country of study; (5) type of the study (article, master thesis, PhD dissertation); (6) sample size; (7) study design; (8) age of participants; (9) gender of participants; (10) language level of participants; (11) educational

level of participants; (12) contact hour (Duration); (13) number of participants in experimental group and control group; (14) experimental group pretest mean score and standard deviation; (15) control group pretest mean score and standard deviation; (16) experimental group posttest mean score and standard deviation; (17) control group posttest mean score and standard deviation (Little et al. (2008).

3.3. Data analysis

Effect sizes are used in meta-analysis to combine statistically different results from previous primary studies. Different types of effect sizes, such as Cohen's d or Hedges' g, require researchers to choose the right type of effect size, which is determined by the characteristics of the primary studies considered. As with the primary analysis, collecting a large sample size of is an important issue for the meta-analysis (Park & Hong, 2016). Analysis involved calculating each study's effect size based on the statistical data that was gathered. Hedges' g is one of the several methods for calculating the effect size, it produces a more accurate result and is preferred to Cohen's d when the sample size is under 20 because it uses pooled standard deviations from both groups (Control and Experimental group). We used Hedges' g since it provides us with a more accurate estimate of the population standard deviation (Borenstein et al. 2009). Taking the advantages of Hedges' g over other indices, in this study we use it to calculate effect size using Equation (1).

$$\text{Hedges' g} = \frac{\bar{M}_1 - \bar{M}_2}{SD^*_{pooled}} \qquad \text{Equation (1)}$$

In this formula M_1 is the mean of the experimental group, M_2 is the mean of the control group, and SD is pooled and weighted standard deviation. Hedges' g (like Cohen's d) is biased upwards for small samples (under 50). The effect sizes have also been weighted and corrected for small sample sizes using Equation (2).

$$g = \frac{\bar{M}_1 - \bar{M}_2}{SD^*_{pooled}} \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}} \qquad \text{Equation (2)}$$

More than one effect size was calculated for studies where the effect of the scaffolding on reading proficiency was examined on different groups and reported along with the relevant data. In order to combine the effect sizes of the studies to determine the efficacy of the scaffolding and its direction of effect, the average effect size was calculated in the end. We determined the effect sizes associated with each study and synthesized them to create an overall effect size before interpreting its significance. Various scales have been proposed for the

interpretation of the overall effect size. For instance, Cohen, Manion and Morrison (2007) interpret the effect size as follows:

- 0 ≤ Effect size value (Cohen's d or Hedge's g) ≤ 0.20 insignificant effect;
- 0.21 ≤ Effect size value (Cohen's d or Hedge's g) ≤ 0.50 small effect;
- 0.51 ≤ Effect size value (Cohen's d or Hedge's g) ≤ 0.8 medium effect;
- 0.81 ≤ Effect size value (Cohen's d or Hedge's g), strong effect

Comprehensive Meta-Analysis (CMA) software (Ver. 3.3, Biostat, Inc, USA) was used in this study for data analysis and graphs preparation. This software provides the opportunity to calculate forest plot, funnel plot of both the observed study and imputed study, individual effect size, and main effect size.

The next logical step in meta-analysis is to select an analysis model for the calculation of mean effect size. For meta-analysis, there are two statistical models: fixed-effect model and random effect model (Borenstein et al., 2009). The analysis model is determined by the degree of heterogeneity, and a random-effects model is typically advised when statistical heterogeneity is identified. Q test and I^2 test are used to determine the degree of heterogeneity. If Q value and degree of freedom are equal, there is no heterogeneity (dispersion in observed effect). The significant Q statistic result (Q (39) = 293.05, p 0.05) demonstrates the heterogeneity of effect sizes within studies. In addition, the fact that the I^2 (87.03) value is greater than 75% indicating the extreme heterogeneity of the distribution of the effect sizes of studies on the scaffolding. In order to conduct subsequent analysis, the random effect model was employed. In the current study, moderator analysis was conducted to analyze the direction of the differences between subgroups and between the average effect sizes of the variables (Karadag˘ et al. 2015). The moderator variables are analyzed as a source of heterogeneity is needed to explain observed variance in the effect size. For explaining this variance we conducted moderator analyses within five categories of study characteristics including Age, Language level, Educational level, Gender, and Study type to examine the impact of key study variables on effect sizes.

Publication bias is one potential risk to systematic reviews that researchers should take into account. According to the basic definition of publication bias, studies are published or not published depending on the direction and statistical significance of the results (Rothstein et al., 2005). As a result, a portion of the literature on the issue will be overlooked, and primary study material will not be representative of the population of completed studies. Losing some parts

of the literature leads to inflation in the estimation of the effect because meta-analysis is based on earlier empirical investigations and seeks to synthesize their findings. There are various statistical methods for determining the existence of publication bias in meta-analysis and assessing its effect on the analysis. Funnel Scatter plot and Classic Fail-Safe N were used to evaluate publication bias in this study.

4. Results

4.1. Overall effect size

In order to verify the effect of the teacher scaffolding on EFL learners' reading proficiency, the overall effect size was measured. The Hedges' g was calculated for 39 independent samples from 28 studies involving 2209 subjects exposed to teacher scaffolding (Figure 1). In line with the random model, the mean effect size, the result of the homogeneity test, P-value, and some other statistics are depicted in Table 2. Because a high heterogeneity was found ($I^2 = 87.03$, $p < 0.001$) a random-effects model was used to pool the data. The estimated overall effect sizes for the random model is 0.89 with 95% confidence interval, which is considered as significant or incredibly effective according to Cohen et al. (1987) interpretation.

Table 2. *Fixed and Random effect model statistics*

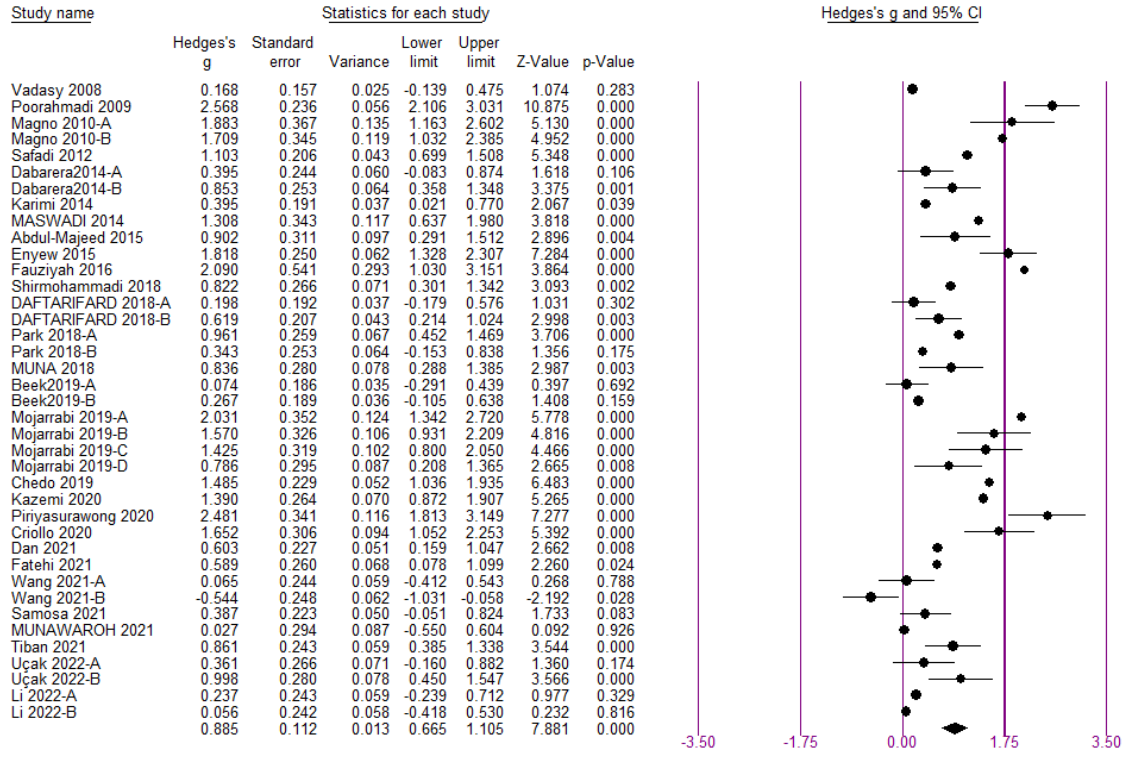
Model	Effect size and 95% confidence interval						Test of null (2-Tail)		Heterogeneity			
Model	Number Studies	Point estimate	Standard error	Variance	Lower limit	Upper limit	Z value	P value	Q value	df	p value	I squared
Fixed	39	0.74	0.04	0.00	0.66	0.82	18.57	0.00	293.05	38	0.000	87.03
Random	39	0.89	0.11	0.01	0.66	1.11	7.88	0.00				

Knowing the size of the P-value is necessary before examining the mean effect size. P-value for this situation is $p=0.00<0.001$. Therefore, we reject the null hypothesis (teacher scaffolding has no significant effect on the reading proficiency of EFL learners) because the test is statistically significant. Additionally, the heterogeneity values are shown in the right side of the table (Q and I^2 Values). The significant Q statistic result (Q (39) = 293.05, p 0.05) demonstrates the heterogeneity of effect sizes within studies. In addition, the fact that the I^2 value is greater than 75% indicating the extreme heterogeneity of the distribution of the effect

sizes of studies on the scaffolding. In order to conduct subsequent analysis, the random effect model was employed.

The forest plot that displays the distribution of the 39 effect sizes studies together with the overall effect size is shown in Figure 1. Within the forest plot, effect sizes for each individual study were calculated. Each individual effect size is visually represented by a square; the squares and confidence bars show the estimated precision of each study. In addition, the mean effect size for the entire sample is visually represented by the diamond.

As seen in Figure 1, almost all confidence intervals are entirely on the right side of the line. This clearly supports the notion that teacher scaffolding significantly improves the reading comprehension of EFL learners. Four confidence intervals overlap the line of no effect. These studies found that scaffolding does not have any significant effect on learners' reading proficiency. What is evident is that only one confidence interval is on the left side of the line of no effect. In other words, only one study found that scaffolding has a significant negative effect. The diamond at the bottom row combines the individual effects of scaffolding depicted in the forest plot into one cohesive overall effect and converts the plot into a meta-analysis. In short, the center of the diamond shown in the bottom row visualizes the overall effect of scaffolding. Since it is clearly visible to the right from the line of no effect, it clearly shows that teacher scaffolding has a significant positive effect on EFL learners' reading proficiency.



Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Vadasy 2008	0.168	0.157	0.025	-0.139	0.475	1.074	0.283
Poorahmadi 2009	2.568	0.236	0.056	2.106	3.031	10.875	0.000
Magno 2010-A	1.883	0.367	0.135	1.163	2.602	5.130	0.000
Magno 2010-B	1.709	0.345	0.119	1.032	2.385	4.952	0.000
Safadi 2012	1.103	0.206	0.043	0.699	1.508	5.348	0.000
Dabarera2014-A	0.395	0.244	0.060	-0.083	0.874	1.618	0.106
Dabarera2014-B	0.853	0.253	0.064	0.358	1.348	3.375	0.001
Karimi 2014	0.395	0.191	0.037	0.021	0.770	2.067	0.039
MASWADI 2014	1.308	0.343	0.117	0.637	1.980	3.818	0.000
Abdul-Majeed 2015	0.902	0.311	0.097	0.291	1.512	2.896	0.004
Enyew 2015	1.818	0.250	0.062	1.328	2.307	7.284	0.000
Fauziyah 2016	2.090	0.541	0.293	1.030	3.151	3.864	0.000
Shirmohammadi 2018	0.822	0.266	0.071	0.301	1.342	3.093	0.002
DAFTARIFARD 2018-A	0.198	0.192	0.037	-0.179	0.576	1.031	0.302
DAFTARIFARD 2018-B	0.619	0.207	0.043	0.214	1.024	2.998	0.003
Park 2018-A	0.961	0.259	0.067	0.452	1.469	3.706	0.000
Park 2018-B	0.343	0.253	0.064	-0.153	0.838	1.356	0.175
MUNA 2018	0.836	0.280	0.078	0.288	1.385	2.987	0.003
Beek2019-A	0.074	0.186	0.035	-0.291	0.439	0.397	0.692
Beek2019-B	0.267	0.189	0.036	-0.105	0.638	1.408	0.159
Mojarrabi 2019-A	2.031	0.352	0.124	1.342	2.720	5.778	0.000
Mojarrabi 2019-B	1.570	0.326	0.106	0.931	2.209	4.816	0.000
Mojarrabi 2019-C	1.425	0.319	0.102	0.800	2.050	4.466	0.000
Mojarrabi 2019-D	0.786	0.295	0.087	0.208	1.365	2.665	0.008
Chedo 2019	1.485	0.229	0.052	1.036	1.935	6.483	0.000
Kazemi 2020	1.390	0.264	0.070	0.872	1.907	5.265	0.000
Piriyasurawong 2020	2.481	0.341	0.116	1.813	3.149	7.277	0.000
Criollo 2020	1.652	0.306	0.094	1.052	2.253	5.392	0.000
Dan 2021	0.603	0.227	0.051	0.159	1.047	2.662	0.008
Fatehi 2021	0.589	0.260	0.068	0.078	1.099	2.260	0.024
Wang 2021-A	0.065	0.244	0.059	-0.412	0.543	0.268	0.788
Wang 2021-B	-0.544	0.248	0.062	-1.031	-0.058	-2.192	0.028
Samosa 2021	0.387	0.223	0.050	-0.051	0.824	1.733	0.083
MUNAWAROH 2021	0.027	0.294	0.087	-0.550	0.604	0.092	0.926
Tiban 2021	0.861	0.243	0.059	0.385	1.338	3.544	0.000
Uçak 2022-A	0.361	0.266	0.071	-0.160	0.882	1.360	0.174
Uçak 2022-B	0.998	0.280	0.078	0.450	1.547	3.566	0.000
Li 2022-A	0.237	0.243	0.059	-0.239	0.712	0.977	0.329
Li 2022-B	0.056	0.242	0.058	-0.418	0.530	0.232	0.816
	0.885	0.112	0.013	0.665	1.105	7.881	0.000

Figure 1. Forest plot of the effect sizes (k= 39)

4.2. Publication bias

The results of the Funnel Plot (Figure2) and the Trim and Fill test presented in Table 3 show little evidence of a possible publication bias on the effect of teacher scaffolding on reading proficiency. If Funnel Plot is symmetric it shows there is no publication bias and our meta-analysis had taken all relevant studies. And if it is asymmetric, it shows the existence publication bias. In other words, if the density of distribution around the main effect size is high and it is almost symmetric, we conclude there is no publication bias in studies and there is no lost study. As shown in Figure 2, the funnel plot is almost asymmetric, and there is significant variation in the effect sizes, with a greater spread in the middle of the Figure.

Since the Funnel Plot's results are subjective, Fail-Safe N (Table 4) was also used to evaluate and adjust for the quantity of unidentified or missing studies (with insignificant effect sizes) needed to nullify the observed effect size (Cooper, 1979). Furthermore, as shown in the graph created by Duval and Tweedie (Figure 3), it will have a symmetrical structure and be unbiased if 11 studies are added to the left side of the graph (the studies' effect size value decreases from 0.89 to 0.50). The result is regarded as valid when the difference between the observed and adjusted values is minimal. The likelihood of publication bias is reduced as the number of required studies increases. A total of 4089 studies would need to have null results in order to nullify the effect size, according to the Fail-Safe N test (Table 4). This number exceeds the criterion number (i.e. e., where k = 39 studies, and 5k + 10 = 205) (Rosenthal, 1991). According to the result of the test, publication bias cannot account for the significant positive effects seen in all studies. This study's findings are therefore unaffected by the impact of unpublished studies that were not included in this study.

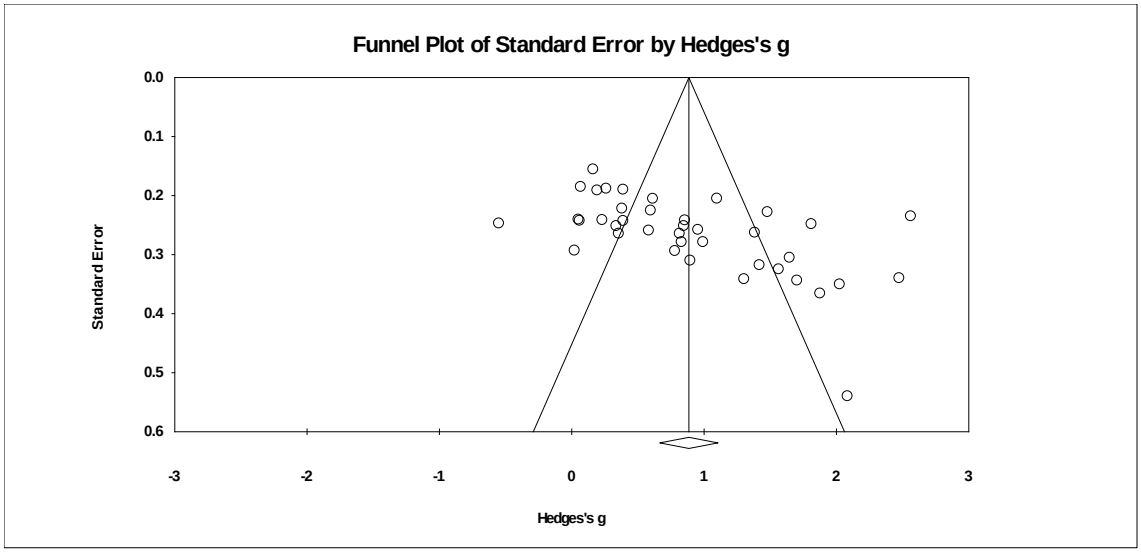


Figure 2. Funnel plot of observed studies

Table 3. The result of Trim and Fill analysis

		Fixed Effects			Random Effects			
	Studies Trimmed	Point Estimate	**Lower limit**	**Upper limit**	**Point Estimate**	**Lower limit**	**Upper limit**	**Q Value**
Observed values		0.74	0.66	0.81	0.89	0.66	1.10	293.05
Adjusted values	11	0.47	0.40	0.54	0.50	0.25	0.76	589.48

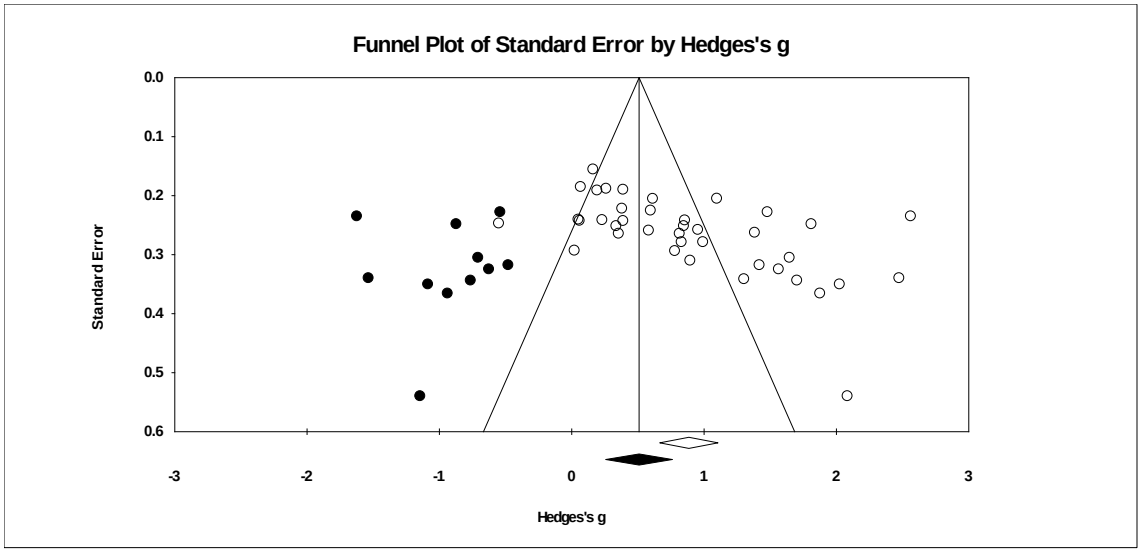


Figure 3. Funnel plot on observed and imputed studies

Table 4. *Results of the classic fail-safe N*

Z-value for observed studies	20.16
P-value for observed studies	0.00
Alpha	0.05
Tails	2
Z for alpha	1.96
Number of observed studies	39
Number of missing studies that would bring p-value to >alpha	4089

4.3. Moderator analysis

The distribution of effect sizes was heterogeneous, as shown by Q = 293.05 and I^2 = 87.03. Therefore, the moderator variables were analyzed as a source of variation which is needed to explain observed variance in the effect size within studies. For explaining this variance we conducted moderator analyses within five categories of study characteristics including Age, Language level, Educational level, Gender, and Study type to examine the impact of key study variables on effect sizes. Table 5 shows how the distribution of moderator variables and their corresponding effect size (g) of teacher scaffolding on learners' reading proficiency.

Table 5. Moderator analysis on the effectiveness of scaffolding on reading comprehension

Moderator variables	**Number of calculated effect sizes**	**Effect size**	**Standard error**	**Variance**	**Lower limit**	**Upper limit**	**Z-Value**	**p-Value**
Age								
Childhood	5	1.26	0.41	0.16	0.46	2.05	3.10	0.00
Adolescence	21	0.70	0.16	0.02	0.39	1.00	4.48	0.00
Youth	7	1.05	0.25	0.06	0.55	1.55	4.15	0.00
Mixed	6	1.06	0.28	0.08	0.52	1.61	3.82	0.00
Language Level								
Elementary	8	1.14	0.27	0.07	0.62	1.67	4.26	0.00
Pre Intermediate	2	0.60	0.17	0.03	0.26	0.93	3.49	0.00
Intermediate	21	0.86	0.17	0.03	0.53	1.18	5.14	0.00

Upper Intermediate	2	0.86	0.20	0.04	0.46	1.25	4.23	0.00
Advanced	1	2.48	0.34	0.12	1.81	3.15	7.28	0.00
Mixed	5	0.42	0.17	0.03	0.09	0.75	2.50	0.01
Educational Level								
Elementary school	3	0.93	0.52	0.27	-0.09	1.94	1.79	0.07
Secondary school	12	0.71	0.16	0.03	0.39	1.02	4.43	0.00
High school	6	0.81	0.25	0.06	0.33	1.29	3.31	0.00
University	14	0.89	0.23	0.05	0.45	1.34	3.93	0.00
Mixed	4	1.43	0.26	0.07	0.92	1.94	5.50	0.00
Gender								
Male	2	0.40	0.21	0.04	-0.01	0.81	1.91	0.06
Female	8	1.47	0.23	0.05	1.03	1.92	6.52	0.00
Both	29	0.76	0.12	0.01	0.52	0.99	6.32	0.00
Study Type								
Article	33	0.86	0.12	0.02	0.62	1.10	6.93	0.00
Master Thesis	5	1.06	0.29	0.08	0.49	1.63	3.65	0.00
PhD Dissertation	1	0.86	0.24	0.06	0.38	1.34	3.54	0.00

4.3.1. Age

The effect sizes of scaffolding for childhood, adolescence, and youth were 1.26, 0.70, and 1.05 respectively. According to Table 5, the findings showed that the implementation of the scaffolding strategy resulted in a significant improvement among the learners during their childhood. (g= 1.26, SE= 0.41, $CI95$= 0.46, 2.05) and adolescents displayed the least amount of progress in their learning. (g= 0.70, SE= 0.16, CI_{95} = 0.39, 1.00).

4.3.2. Language Level

The studies were categorized into five groups including elementary, pre-intermediate, intermediate, upper-intermediate, and advanced. As Table 5 shows, the average effect size of these groups was calculated as 1.14, 0.60, 0.86, 0.86, and 2.48 respectively. The pre-intermediate group demonstrated the lowest level of achievement among learners (g=0.60), and

those in the elementary group achieved the highest mean effect size (g=1.14). Although the advanced group shows the highest impact of the scaffolding (g= 2.48).

4.3.3. Educational Level

Scaffolding had mean effect sizes of 0.93, 0.71, 0.81, and 0.89 at the elementary, secondary, high school, and university levels of reading proficiency, respectively. The findings in Table 5 showed that students who used the scaffolding strategy made significantly higher gains at the elementary level (g= 0.93, SE= 0.52, CI_{95}= -0.09, 1.94) and significantly lower gains at the secondary level (g= 0.71, SE= 0.16, CI_{95}= 0.39, 1.02).

4.3.4. Gender

The effect sizes of scaffolding for male, female, and a combination of both were 0.40, 1.47, and 0.76 respectively. Based on Table 5, the findings demonstrate that the results indicate a significant impact of scaffolding on female learners with an average effect size of 1.47 (SE= 0.23, CI_{95}= 1.03, 1.92), while having the least effect on male learners (g= 0.40, SE= 0.21, CI_{95}= -0.01, 0.81).

4.3.5. Study Type

The studies were divided into three groups according to their type as articles, master theses, and PhD dissertations. According to the result of the analysis presented in Table 5, the average effect size of practices in each of them was calculated as 0.86, 1.06, and 0.86, respectively. According to the result, the largest effect size can be seen in master theses (g= 1.06).

5. Discussion

While teacher scaffolding is a beneficial strategy for improving learners' reading proficiency, the results of the studies that tested the effect of this strategy under controlled conditions were inconclusive. Although some studies claimed that teacher scaffolding had a significant beneficial effect, others claimed that its effect was limited or insignificant. Additionally, individual studies did not demonstrate how moderator factors modified the impact of this reading strategy; therefore, this meta-analysis was carried out to present empirical evidence of how moderator variables modify the effect of the scaffolding as well as to synthesize the effect of the previous empirical findings into an overall combined effect size. To achieve this, 28 primary studies and 39 effect sizes were reviewed and synthesized in which 2209 participants participated in all of them. According to the analysis, which revealed an overall effect size of

0.89, teacher scaffolding is an effective intervention in enhancing the reading proficiency of EFL learners.

According to Cohen (1987) and Heges (2008), the best way to interpret effect sizes is in relation to other effect sizes. Based on the scales developed by Plonsky and Oswald (2010) and Cohen (1987), the overall effect size calculated for this meta-analysis was 0.89 (95% CI 0.66 to 1.11). In light of this, it is important to compare the significance of this finding with those of Plonsky (2011), who found the overall average effect of 0.49. Besides, in the area of second language instruction, Ahmadnattaj and Ostovar-Namaghi (2020) synthesized the effect sizes of 46 studies, with the end result showing an overall effect size of 1.18. Moreover, Ostovar-Namaghi and Nakhaei (2017) conducted a meta-analysis of CLIL (Content and Language Integrated Learning) efficacy, which produced an overall effect size of 0.81. As we get closer to the subject of this study, it is good to mention Doo, Bonk, and Heo's (2020) meta-analysis of the effects of scaffolding on learning outcomes in an online learning environment in higher education. This meta-analysis included studies with 64 effect sizes and the result indicated an overall effect size of 0.86. The overall effect size found in this study (0.89) is strong when compared to those reported in these studies.

Despite the strength and size of the overall effect size, we should not take it as a basis for decision-making because the studies covered in this meta-analysis showed a high degree of heterogeneity (I^2 = 87.03); hence; As Borenstein et al (2009), suggest subgroup analysis is required to see how moderator variables change the effect on scaffolding. Taking age as a moderator, a significant difference was observed in childhood, adolescence, and youth. The scaffolding had a moderate effect on both the adolescents (0.70) and the youth (1.05), but it had a strong effect on the childhood (1.26). These results clearly show that the effect of teacher scaffolding at lower ages is more significant than its effect at higher ages. According to Vygotsky's Zone of Proximal Development, the intervention of an adult facilitates the learning process of a child, especially in different reading measures. Based on Magno (2010), reading instruction for young children should be scaffolded to help them improve their reading skills. Moreover, he believes that scaffolding is beneficial for children because the teacher who serves as a model, decoder, and feedback provider provides the necessary support to reduce their anxiety in reading. Scaffolding has been found to be particularly effective in the preschool years (Jacobs, 2001). In general, teacher scaffolding is more effective for children than adults, possibly because children and younger learners are less cognitively developed than adults and need more facilitators or strategies such as scaffolding for reading comprehension.

Taking language proficiency as the moderator, subgroup analysis revealed that elementary learners (g=1.14, p=0.00) made a great gain and pre-intermediate (g=0.60, p=0.00), intermediate (g=0.86, p=0.00), and upper-intermediate learners (g=0.86, p=0.00) When considering language proficiency as a moderator, the subgroup analysis indicated that elementary learners showed substantial improvement (g=1.14, p=0.00). In contrast, pre-intermediate (g=0.60, p=0.00), intermediate (g=0.86, p=0.00), and upper-intermediate learners (g=0.86, p=0.00) experienced less significant gains compared to the elementary group. Although the advanced learners gained the highest impact of the scaffolding (g= 2.48), it is better to ignore its result because only one study was conducted at this level. This difference can be partially explained by the fact that the scaffolding strategy has been used better and more effective by teachers at lower levels. On the other hand, the ceiling effect can affect the results. It should also be taken into account that adults have more background knowledge and domain of vocabulary, and they are more mentally developed than children. Therefore, they understand the texts more easily and need less help from others.

Just like other moderators, educational level modified the effect of teacher scaffolding on reading proficiency. Among different levels, it was found that scaffolding had the largest effect on the elementary school level (0.93) compared to other levels, that is, secondary school (0.71), high school (0.81), and university (0.89). Most of the students at the elementary school are novice learners. Therefore, beginner learners need teacher scaffolding to improve their reading comprehension. The teacher and the peers can take role as scaffolders and help the novice students to reduce the zone of proximal development area. The novice students also develop their metacognitive strategies like scaffolding by modeling the behavior of the teachers and also the expert peers, with reciprocal teaching and peer tutoring (Royanto, 2012). As it is said by Byrnes (2001), others' help such as prompts, cues, modeling, describing, asking questions and discussions can become scaffolders for the novice students. As a result, distributed cognition happens through discussions and dialogues in reciprocal teaching (Pea, 1993). Belland et al. (2017) also mentioned that "scaffolding's strongest effects are in populations the furthest from the target learner population in the original scaffolding definition" (pp. 331–332), where expert assistants enable children to extend their problem solving or strategic performance beyond what they can achieve on their own (Wood et al., 1976).

Taking gender as the moderator, subgroup analysis revealed that teacher scaffolding had a positive effect on the reading proficiency of both male and female (0.76) groups. In most of the articles that were analyzed, the sample included both male and female groups, and in all of

them, scaffolding was effective on learners' reading proficiency. But the number of articles that worked exclusively on men or women were not many, so it is better not to consider them.

Funnel scatterplots, Trim and Fill Method, and Fail-Safe N test showed low levels of publication bias, as shown in the results section. In other words, the results of these tests show few unpublished lost studies and thus do not change the calculated overall effect size. Therefore, the effect size reported in this study shows high validity.

The considerable effect size reported in this study is strong evidence for previous theoretical perspectives. For example, it supports Cubukcu's (2008) and Fung's (2003) arguments that scaffolding of reading comprehension helps improve students' reading proficiency. According to Abdul-Majeed (2015), scaffolding techniques empower EFL learners to independently explore and comprehend information, thereby cultivating their active and self-directed learning abilities. Moreover, it improved the reading comprehension of both weak and strong students. Jallivand (2014) stated that the use of teacher scaffolding reading strategy instruction has resulted in an increased reading comprehension skill of the students. When a teacher makes learning environments that facilitate reading engagement to be continuous and conforming to students' level, their reading comprehension improves.

In sum, the overall effect size of our study (0.89) shows that teacher scaffolding has a significantly high effect on EFL learners' reading proficiency. Moreover, the text discusses the implications of a study on teacher scaffolding in English as a Foreign Language (EFL) reading instruction. Teachers can effectively apply scaffolding strategies in classrooms, enhancing the learning environment, especially for young learners. Policymakers are likely to favor scaffolding methods for teaching EFL at elementary levels, given the comprehensive findings of this research compared to individual studies. The results will assist material developers in integrating scaffolding into language education syllabi, particularly benefiting female learners at the elementary proficiency level. The study confirms a significant positive effect (effect size of 0.89) of scaffolding on EFL reading proficiency, allowing researchers to rely on these findings rather than individual studies. It emphasizes the need for precise reporting of statistics in future research to validate teaching strategies like scaffolding.

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