

Meta-Analysis of Technology-Based Islamic Religious Education Learning: Analysis of Its Effectiveness and Heterogeneity

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Abstract: Meta-Analysis of Technology-Based Islamic Religious Education Learning: Analysis of Its Effectiveness and Heterogeneity. Objective: This research aims to further examine the effectiveness of technology-based Islamic Religious Education (PAI) learning on student learning achievement, as well as investigate what factors can influence its effectiveness. **Method:** The design used in this research was a meta-analysis of 18 primary studies that met the inclusion criteria. **Results:** The results of the analysis obtained a combined effect size of 1.498 (very large effect). It can be concluded that technology-based PAI learning has a very big influence on student learning achievement compared to conventional learning. Furthermore, heterogeneity analysis reveals that the variables of education level, sample size, and type of technology used can influence the effectiveness of technology-based Islamic religious education learning on student learning achievement. **Conclusion:** This meta-analysis can provide more objective results regarding various effect size variations regarding the effectiveness of technology-based PAI learning.

Keywords: Islamic Religious Education, technology-based learning, meta-analysis.

Abstrak: Meta-Analisis Pembelajaran Pendidikan Agama Islam Berbasis Teknologi: Analisis Efektivitas dan Heterogenitasnya. Tujuan: Penelitian ini bertujuan untuk mengkaji lebih lanjut efektivitas pembelajaran Pendidikan Agama Islam (PAI) berbasis teknologi terhadap prestasi belajar siswa, serta menyelidiki faktor-faktor apa saja yang dapat mempengaruhi efektivitasnya. **Metode:** Desain yang digunakan dalam penelitian ini adalah meta-analisis terhadap 18 penelitian primer yang memenuhi kriteria inklusi. **Hasil:** Hasil analisis diperoleh effect size gabungan sebesar 1,498 (efek sangat besar). Dapat disimpulkan bahwa pembelajaran PAI berbasis teknologi mempunyai pengaruh yang sangat besar terhadap prestasi belajar siswa dibandingkan dengan pembelajaran konvensional. Lebih lanjut, analisis heterogenitas mengungkapkan bahwa variabel tingkat pendidikan, jumlah sampel, dan jenis teknologi yang digunakan dapat mempengaruhi efektivitas pembelajaran pendidikan agama islam berbasis teknologi terhadap prestasi belajar siswa. **Kesimpulan:** Meta-analisis ini dapat memberikan hasil yang lebih objektif mengenai variasi effect size yang beragam tentang efektivitas pembelajaran PAI berbasis teknologi.

Kata kunci: Pendidikan Agama Islam, pembelajaran berbasis teknologi, meta-analisis.

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■ INTRODUCTION

Islamic Religious Education (PAI) has an important role in the formation of the character and morals of students. Azhari et al. (2022) states that if Islamic religious education is carried out properly, then it can form and create religious and religious characters. Through PAI learning, students gain a deep understanding of Islamic teachings, such as monotheism, worship, noble character, and social ethics. PAI is not only about understanding religious teachings, but also guiding students in developing concern for others, upholding tolerance, and cultivating mutual respect. Islamic Religious Education also teaches the values of justice, honesty, and the spirit of business, so that students become individuals who contribute positively to society and the nation. By combining scientific and spiritual aspects, PAI is a solid foundation for building superior character, enabling students to face the challenges of the times with integrity and courage.

PAI has a fundamental role in shaping student character, going beyond the cognitive aspect by being rooted in moral, ethical, and spiritual values (Tabroni & Romdhon, 2022). Apart from providing an in-depth understanding of religious teachings, this education is a guide in developing social awareness and concern for others, strengthening relationships with God, and guiding in facing various challenges in life (Adiyono et al., 2022; Rahmawati et al., 2022; Susilawati et al., 2022; Tabroni & Rahmania, 2022; Taufik, 2020). Thus, Islamic Religious Education not only forms dignified individuals, but also supports the formation of a society based on the principles of justice, tolerance and love, which are the pillars of social harmony and stability. Thus, PAI is not only about understanding religious teachings, but also serves as an important pillar in the formation of characters with integrity, empathy and a positive contribution to the world.

Abdurahman Shaleh explained that there are four objectives of Islamic Education. The first is the goal of physical education (*ahdaf al-jismiyah*), which aims to prepare humans as caliphs of developers in the world through the development of physical skills through training and coaching. The second is the goal of spiritual education (*ahdaf al-ruhaniyah*), which focuses on the internalization of values, a strong personality, and the application of Islamic morality. The third is the purpose of reason (*ahdaf al-aqliyah*), which aims to form intellect and intelligence to identify the truth and signs of Allah's power, which ultimately leads to the strengthening of faith and piety. Fourth is social goals (*ahdaf ijtimaiyah*), which involve the formation of characters that can develop into individuals who have intelligence in interacting and communicating socially in everyday life (Arifuddin, 2014). To achieve these goals, teachers are expected to be able to create quality learning, where effective and efficient learning takes place through a structured planning process, generates individual involvement, and stimulates learning enthusiasm.

Along with the rapid development of information and communication technology, technology-based learning approaches are increasingly getting attention in the world of education, including Islamic learning. This method utilizes various technological tools and applications, such as educational software, online platforms, interactive multimedia, and digital learning resources to increase the effectiveness of the learning process. Technology has tremendous potential to enhance Islamic learning by bringing innovation and efficiency (Ediansyah, 2022; Fahmi et al., 2021; Ramadhani & Muhtadi, 2018; Taufik et al., 2020; Tolchan & Mu'ammam, 2019). First, technology allows wider access to scientific sources so as to enrich students' understanding independently (Haryani et al., 2021). Second, with a variety of multimedia

content, technology makes it easier to explain religious concepts that are often abstract, helping students understand better (Winarto et al., 2020). Third, technology enables online group communication and discussion, facilitating collaboration between students and enriching discussions around religious issues (Arslan, 2020; Hinojo Lucena et al., 2020; Miskiah et al., 2019). Fourth, distance and flexible learning, which is supported by technology, allows learning to take place without being limited by geographical and time constraints, expanding access to religious education (Laili et al., 2022; Müller & Mildenerger, 2021; Purnomo et al., 2022; Rafiola et al., 2020; Samritin et al., 2023; Setiawan et al., 2022; Sulistyowati et al., 2023). Therefore, technology can facilitate access to information, present material in an interesting form, and enable more dynamic interactions between teachers and students.

Many previous studies have confirmed that the application of technology-based PAI learning can increase student achievement (Ardiansah, 2019; El Qory et al., 2022; Janah, 2023; Kamaruddin et al., 2022; Maghfiroh et al., 2019; Mariah & Fauziah, 2020; Masripah et al., 2019; Samsiyah & Fajar, 2021; Wahidah & Chotbuddin, 2021; Edison, 2021; Harun et al., 2021; Hidayatulloh et al., 2023; Mafruhah et al., 2019; Panjaitan et al., 2020). However, different results were found by Ansori (2020) and Irwanto (2020) who found that the application of technology-based PAI learning was not effective in student learning achievement. Differences in research results on the same topic can raise doubts in decision making. Therefore, further research approaches are needed so as to provide more accurate conclusions. To achieve this goal, a meta-analysis approach can be used.

Meta-analysis is a statistical analysis technique that combines the results of previous studies on the same topic to find the combined effect of each study used (Cohen, Manion, &

Morrison, 2007). Meta-analytic studies can be used to evaluate the results of previous research to reach in-depth and accurate conclusions (Schmidt & Hunter, 2004; Retnawati et al., 2018; Tamur & Juandi, 2020). This research approach produces more objective conclusions than other review methods because it focuses on the effect size of empirical findings (Schmidt & Hunter, 2004; Retnawati et al., 2018). Effect size is a quantitative index used to summarize study results in meta-analyses. That is, the effect size reflects the magnitude of the relationship between variables in each study (Borenstein et al., 2021).

From the literature search we've conducted up to this point, there haven't been any meta-analysis investigations that have assessed the impact of utilizing technology-based PAI learning on student academic performance. Therefore, this study aims to measure the effectiveness of the application of technology-based PAI learning on student achievement using a meta-analysis approach. In addition, this study also investigated whether the moderator variables of sample size, education level, sample size, year of study, and type of technology could affect the effectiveness of using technology-based learning on student achievement. With a deeper understanding of this relationship, it is hoped that a more effective and targeted learning approach can be developed, which can support students' academic success.

This research has important implications for the world of education, especially Islamic education. This study can produce objective and precise findings regarding the confusing gap in effect sizes between variables related to technology-based PAI learning and students' academic performance. The findings of this study can provide insight to educators and educational practitioners in designing learning strategies that are more adaptive and responsive to individual student learning styles. In addition, the results of this research can also form the basis for the development of more inclusive education policies,

taking into account the diversity of student learning styles in an effort to improve overall academic results.

■ METHODS

Research design and Procedures

In this study, the Group-Contrast meta-analysis technique was applied to assess research findings investigating the impact of technology-based PAI learning in relation to student academic achievement. Typically, the steps involved in conducting a meta-analysis include establishing inclusion criteria, conducting a comprehensive literature search, collecting and coding variable data, and conducting statistical analyzes (Borenstein et al., 2009).

Inclusion Criteria

In order to streamline the search for studies and assess which studies qualify for inclusion in the analysis, it is essential to establish inclusion criteria. These inclusion criteria serve as a filter, allowing research meta-analyses to identify pertinent studies and guarantee that the data used for analysis possess sufficient quality and comprehensiveness. The following criteria have been pre-defined for inclusion:

1. Research conducted in the years 2019 through 2023 will be considered for analysis. This timeframe was selected to ensure that the included studies are contemporary and pertinent to the current research context.
2. Research can be sourced from both domestic and international journals and proceedings. This approach is adopted to encompass a diverse range of literature sources and incorporate research findings from various scientific platforms.
3. Only studies employing experimental or quasi-experimental research methods will be incorporated.
4. Chosen studies should provide data on the mean, standard deviation, and sample size for

both the experimental and control groups. If this specific information is not available, an acceptable alternative is for the studies to report sample sizes along with relevant statistical values such as t-values, p-values, or F-values.

Data Collection

The relevant study collection phase is carried out using online databases such as Google Scholar (<https://scholar.google.com/>), Garuda Portal (<http://garuda.ristekbrin.go.id/>), and Science and Technology Index (<http://sinta.ristekbrin.go.id/journals>). The keywords used in the literature search were “Effectiveness of Technology-Based Learning” AND “PAI” in both Indonesian and English.

Research Sample

In meta-analysis studies, sample refers to the individual studies used to collect data to be analyzed together. The sample in this meta-analysis study is studies that meet the specified inclusion criteria. Based on data collection through an online database, the sample obtained in this research was 18 primary studies that met the inclusion criteria.

Once eligible articles are selected, it is important to identify and record their characteristics through coding. The coding process is very important for collecting research results that will be used in meta-analysis. The coding sheet for this meta-analysis study should include the statistical data necessary to calculate the effect size. This information usually includes the sample size, mean, standard deviation, p-value, and t-value of each primary study. In addition, the coding sheet should contain categorical information such as education level, experimental class capacity, year of research, and type of technology used in the research. A summary of the coding results is presented in Table 1.

Table 1. Studies that will be incorporated into the meta-analysis

Variabel Moderator	Frequency	Percentage (%)
Educational level		
Senior High School (SHS)	11	61.11%
Junior High School (JHS)	1	5.56%
Primary School (PS)	6	33.33 %
Experiment Class Capacity		
Small (≤ 30)	4	22.22%
Large (> 30)	14	77.78%
Research Year		
2019-2020	7	38.89%
2021-2023	11	61.11%
Type of Technology Used		
Edmodo Media	2	11.11%
Video Media	1	5.56%
Blended Learning	4	22.22%
Flipped Classroom	2	11.11%
Lectora Inspire Media	1	5.56%
Hybrid Learning	2	11.11%
Interactive Multimedia	2	11.11%
Flipped Classroom-Based PjBL	1	5.56%
KAHOOT Media	2	11.11%
Digital Animation Media	1	5.56%

Instrument

The instrument used in this meta-analysis uses a coding sheet containing data taken from eligible primary studies. Validity and reliability in this meta-analysis study is carried out by checking for potential publication bias, the aim is to see the extent to which the data from each study in

the sample actually measures the variables studied (Badawi et al., 2023; Borenstein et al., 2009; Kamsurya et al., 2022; Martaputri et al., 2021; Muhtadi et al., 2022; Retnawati et al., 2018). For this purpose the file-Safe N (FSN) approach is used. The FSN test results can be seen in Table 2 below.

Table 2. FSN analysis

z	18.23
p	0.00
Alpha	0.05
z for Alpha	1.96
N	18
P > number of missing studies	1539

According to the findings presented in Table 2, the obtained p-value was lower than the pre-established alpha value. This suggests that the

research can be deemed both reliable and valid. Thus it can be concluded that the sample in this meta-analysis can measure the variables studied.

Data analysis

Data analysis was carried out using CMA Version 3 software. Interpretation of effect sizes in this study followed the classification proposed by Cohen et al. (2018) (See Table 3). Additionally, tests of heterogeneity between studies or groups of variables were performed by assessing Q statistics and p values. If the p

value is less than 0.05, the null hypothesis stating homogeneity of effect sizes in each study or group of variables is rejected, which means a random effects model is used. Conversely, if the p value is greater than 0.05, the null hypothesis is accepted, and the fixed effects model is considered for evaluation.

Table 3. Category effect size group (g)

Classification	Interval
Ignored	$0.00 < g \leq 0.19$
Small Effect	$0.19 < g \leq 0.49$
Medium Effect	$0.49 < g \leq 0.79$
Large Effect	$0.79 < g \leq 1.29$
Very Large Effect	$g > 1.29$

RESULTS AND DISCUSSION

Main Analysis Results

The outcomes of the computations using CMA software yield the data as presented in Table 4 below:

According to Table 4, the effect size range was derived from 18 studies, ranging from -0.314

to 2.279. Among these data, two studies (n = 2) demonstrated a small effect, one study (n = 1) exhibited a moderate effect, three studies (n = 3) displayed a large effect, and twelve studies (n = 12) indicated a very large effect. In summary, the comparison of meta-analysis outcomes based on effect model is provided in the following Table 5:

Table 4. Categories for effect size analysis

No	Author	Effect Size	Std. Error	Category
1	Ansori (2020)	0.249	0.253	Small Effect
2	Ardiansah (2019)	2.028	0.245	Very Large Effect
3	El Qory et al. (2022)	3.601	0.423	Very Large Effect
4	Janah (2023)	2.056	0.353	Very Large Effect
5	Kamaruddin et al. (2022)	0.972	0.289	Large Effect
6	Maghfiroh et al. (2019)	5.982	0.737	Very Large Effect
7	Mariah & Fauziah (2020)	1.172	0.336	Large Effect
8	Masripah et al. (2019)	0.971	0.270	Large Effect
9	Sabila & Sobarna (2022)	0.515	0.301	Medium Effect
10	Samsiyah & Fajar (2021)	1.447	0.378	Very Large Effect
11	Wahidah & Chotbuddin (2021)	1.429	0.307	Very Large Effect
12	Edison (2021)	0.882	0.292	Large Effect
13	Fanani et al. (2021)	0.351	0.298	Small Effect
14	Harun et al. (2021)	1.230	0.402	Very Large Effect

15	Hidayatulloh et al. (2023)	1.256	0.271	Very Large Effect
16	Irwanto (2020)	0.278	0.275	Small Effect
17	Mafruhah et al. (2019)	1.688	0.269	Very Large Effect
18	Panjaitan et al. (2020)	2.888	0.499	Very Large Effect

Table 5. Findings derived from the effect model analysis

Model	k	Effect Size (g)	SE	p	Heterogeneity			
					Q	df (Q)	P	I ²
Fixed-Effect	18	1.241	0.074	0.000	148.292	17	0.000	80.625
Random-Effect	18	1.498	0.049	0.000				

According to the findings presented in Table 5, when the P-value is less than 0.05, it indicates a significant difference among the analyzed studies. Therefore, the Random-Effect model was employed. Under the Random-Effect model, the substantial impact of technology-based PAI learning on student achievement is evident, with a combined effect size of 1.498, categorizing it as a “very large effect.” This suggests that the implementation of technology-based PAI learning has a highly significant influence on student achievement. These results align with previous research by Akçay et al. (2021) and

Higgins et al. (2017), both of whom also observed a significant positive impact of technology on student achievement in elementary schools.

Moderator Variable Analysis

The next analysis was conducted to answer the second research question. Of the 18 studies observed by researchers, they were categorized based on education level, experimental class capacity, year of research, and type of technology used. The moderator variable analysis is visualized in Table 6 below.

Table 6. Analysis results judging from the moderator variables

Moderator Variable	k	g	Test of null (2-Tail)		Heterogeneity		
			Z	P	Q	df (Q)	p
Educational Level							
Primary School (PS)	6	0.982	7.454	0.000	27.302	5	0.000
Junior High School (JHS)	1	0.971	3.599	0.000	0.000	0	1.000
Senior High School (SHS)	11	1.405	14.963	0.000	113.069	10	0.000
Qw					140.371	15	0.000
Qb					7.921	2	0.019
Experiment Class Capacity							
Small (≤ 30)	4	1.899	13.392	0.000	22.730	3	0.000
Large (> 30)	14	0.998	11.602	0.000	96.091	13	0.000
Qw					118.821	16	0.000
Qb					29.471	1	0.000

Research Year							
2019-2020	7	1.187	10.866	0.000	82.950	6	0.000
2021-2023	11	1.286	12.918	0.000	64.893	10	0.000
Qw					147.844	16	0.000
Qb					0.448	1	0.503
Type Of Technology Used							
Blended Learning	4	1.082	6.811	0.000	11.688	3	0.009
Flipped Classroom	2	1.732	7.612	0.000	27.483	1	0.000
Hybrid Learning	2	1.248	5.556	0.000	0.003	1	0.957
Digital Animation Media	1	2.888	5.786	0.000	0.000	0	1.000
Edmodo Media	2	0.853	3.566	0.000	54.112	1	0.000
KAHOOT Media	2	1.575	7.793	0.000	0.404	1	0.525
Lectora Inspire Media	1	0.351	1.176	0.240	0.000	0	1.000
Video Media	1	2.028	8.283	0.000	0.000	0	1.000
Interactive Multimedia	2	0.682	3.068	0.002	6.257	1	0.012
Flipped Classroom-Based PjBL	1	0.972	3.361	0.001	0.000	0	1.000
Qw					99.947	8	0.000
Qb					48.345	9	0.000

The moderator variable for educational level consists of three groups, namely elementary, junior high and high school. The results of the test of null (2-tail) analysis in the three groups showed a p value < 0.05 . This value indicates that technology-based PAI learning is effective on student achievement both applied to elementary, junior high and high school groups. Furthermore, the results of the heterogeneity test between groups of educational levels obtained the value of $Q_b = (7.921; p < 0.05)$. This value indicates that the moderator variable of educational level influences the impact of using technology-based PAI learning on student achievement. The use of technology-based PAI learning is most effectively applied at the high school education level compared to other groups. In other words, the effectiveness of technology-based PAI learning is not uniform across all educational level groups. In this context, the use of technology-based PAI learning is most effectively applied at the high school education

level compared to other education level groups (elementary and junior high schools). This finding is in line with research conducted by Juandi et al. (2021) who found that the educational level variable affected the impact of using Geogebra software-based learning media on students' mathematical abilities. Even though there are significant differences between the educational level groups, technology-based PAI learning has proven to be effective in improving students' mathematical abilities in each of these educational level groups.

The moderator variable for experimental class capacity consisted of two groups, namely studies with class capacities $d' 30$ and > 30 . The results of the test of null (2-tail) analysis in the two groups showed a p value < 0.05 . This value indicates that technology-based PAI learning is effective on student achievement both applied to class capacities $d' 30$ and > 30 . Furthermore, the heterogeneity test results between groups of experimental class capacities obtained $Q_b =$

(29.471; $p < 0.05$). This value indicates that the moderator variable is the capacity of the experimental class influencing the impact of using technology-based PAI learning on student achievement. This means that the use of technology-based PAI learning is most effectively applied to class capacities ≤ 30 students compared to class capacities > 30 students. This finding is consistent with meta-analytic studies conducted by Yakar (2021), Karagon and Esen (2019), Juandi et al. (2021), and Purnomo et al. (2022). Their research found that on small sample sizes, the use of learning tends to produce larger effect sizes. These findings provide a recommendation that in order to achieve higher effectiveness in the use of technology-based PAI learning on student achievement, it is advisable to consider class size.

The moderator variable for the research year consisted of two groups, namely 2019-2020 and 2021-2023. The results of the test of null (2-tail) analysis in the two groups showed a p value < 0.05 . This value indicates that technology-based Islamic Religious Education learning is effective on student achievement both reported in studies conducted in 2019-2020 and 2021-2023. Furthermore, the results of the heterogeneity test between groups in the year of study obtained the value of $Q_b = (0.448; p > 0.05)$. This value indicates that the moderator variable in the year of the study did not affect the impact of using technology-based PAI learning on student achievement. This means that the use of technology-based PAI learning on student achievement has a level of effectiveness that is not significantly different in studies conducted in 2019-2020 and 2021-2023. This finding is also consistent with the study of Tamur et al. (2022) who found that the research year variable had no effect on the effectiveness of its application on student achievement. These findings have positive implications for the development of sustainable and relevant technology-based PAI learning, as

well as demonstrating the consistency of the effectiveness of these learning methods over different periods of time.

The moderator variable for the type of technology used consisted of ten groups, namely Blended Learning, Flipped Classroom, Hybrid Learning, Digital Animation Media, Edmodo Media, KAHOOT Media, Lectora Inspire Media, Video Media, Interactive Multimedia, and Flipped Classroom-Based PjBL. The results of the analysis of the test of null (2-tail) in the ten groups showed that the Media Inspire group showed a p value > 0.05 , while the other nine groups showed a p value < 0.05 . This value indicates that technology-based PAI learning is effective for student learning achievement whether applied using the types of technology Blended Learning, Flipped Classroom, Hybrid Learning, Digital Animation Media, Edmodo Media, KAHOOT Media, Video Media, Interactive Multimedia, and Flipped Classroom-Based PjBL. However, it is not effective on the Media Lectora Inspire technology type. Furthermore, the heterogeneity test results between groups of the type of technology used obtained the value of $Q_b = (48.345; p < 0.05)$. This value indicates that the moderator variable of the type of technology used affects the impact of using technology-based PAI learning on student achievement. In other words, the type of technology used in technology-based PAI learning has significant differences in its effectiveness in increasing student achievement. This finding is in line with the research of Akçay et al. (2021); and Juandi et al. (2021) who found that the type of technology used can affect the impact of using technology-based learning on students' mathematical abilities. From these findings, it can be concluded that technology-based PAI learning is effective in increasing student learning achievement when using types of technology such as Blended Learning, Flipped Classroom, Hybrid Learning, Digital Animation Media, Edmodo

Media, KAHOOT Media, Video Media, Interactive Multimedia, and PjBL Based Flipped Classroom. However, the effectiveness of technology-based PAI learning does not occur in the Media Lectora Inspire technology type. This information provides important information for the development of more effective technology-based PAI learning strategies that suit the needs of students.

■ CONCLUSIONS

The conclusion of this study is that technology-based learning of Islamic Religious Education (PAI) has a very large influence on student achievement when compared to conventional learning. The heterogeneity analysis carried out also revealed that several factors, such as education level, sample size, and the type of technology used, can affect the effectiveness of technology-based Islamic Religious Education learning on student achievement. This provides a deeper understanding of the variation in effect sizes that occur in the use of technology-based learning, as well as recognizing that the effect can be influenced by certain factors.

These findings make an important contribution to the PAI education literature by providing a more comprehensive understanding of the effectiveness of using technology-based learning media in increasing student achievement in context. In addition, these findings can also be used as a basis for curriculum development and Islamic education teaching, that the application of technology-based learning can be considered a very effective strategy in increasing student achievement in context. However, it is important to consider factors such as educational level, sample size, and type of technology used in the selection and implementation of technology-based learning so that the impact can be maximized.

Regardless of the validity found, it should be remembered that this study has several limitations that need to be considered, including

the variation in study design, sample characteristics, and methods of measurement between the primary studies which form the basis of the meta-analysis. In addition, this research is limited to studies conducted in Indonesia, so the generalization of the findings can only be applied to research in Indonesia and may not include research in other countries. To overcome these limitations, future research can broaden the scope of primary study inclusion, conduct a more in-depth analysis of study quality, and consider other factors that might influence the effectiveness of technology-based Islamic Religious Education learning.

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