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Meta-Analysis: The Impact of Digital Media on Indonesian Language Learning Outcomes in Elementary and Secondary Schools in Indonesia

Charlina[1], Elvrin Septyanti[2], Tria Putri Mustika[3]

[1] Universitas Riau, Pekanbaru, Indonesia; charlina@lecturer.unri.ac.id
[2] Universitas Riau, Pekanbaru, Indonesia; elvrin.septyanti@lecturer.unri.ac.id
[3] Universitas Riau, Pekanbaru, Indonesia; tria.putri@lecturer.unri.ac.id

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ABSTRACT

The integration of digital media in education has become essential in addressing curriculum and pedagogical challenges in the digital era. This study investigates the impact of digital media on Indonesian language learning outcomes in elementary and secondary schools across Indonesia. This research employed a systematic literature review and meta-analysis following the PRISMA framework. Articles were sourced through *Publish or Perish*, utilizing databases such as Google Scholar and Scopus. A total of 200 studies were initially identified, and 10 met the inclusion criteria based on relevance, data completeness, and publication year (2017–2022). Quantitative synthesis was conducted using a fixed-effect model and analyzed via JASP 0.19.1 to determine the effect size. The meta-analysis revealed an average effect size of 0.885, indicating a moderate effect of digital media on student learning outcomes. The studies analyzed focused on cognitive (e.g., reading and learning outcomes), psychomotor (e.g., writing and speaking skills), and limited affective domains (e.g., interest in learning). No studies reported negative impacts, and results showed high consistency ($I^2 = 0\%$). Digital media, particularly animated videos and digital books, positively influence Indonesian language learning at the primary and secondary levels. However, most studies emphasize cognitive outcomes, with minimal exploration of affective or psychomotor domains. These findings suggest a need for broader and more integrative approaches in future research and practice. Digital media moderately enhance language learning outcomes in schools. Further efforts are needed to explore its impact across all learning domains and optimize its educational implementation.

Corresponding Author :
Charlina
Universitas Riau, Pekanbaru, Indonesia; charlina@lecturer.unri.ac.id

1. INTRODUCTION

Digital technology is an urgent need in the Education sector and is seen as an integral part of the transformation adopted by the Ministry of Education and Culture in designing a new curriculum and online-based learning system (Dwanda Putra, Zhinta, & Pratama, 2023). The new curriculum must be a

challenge for schools, teachers, and students because these three subjects play an active role in the implementation of the learning process (Suhandi & Robi'ah, 2022). The implementation of online learning in the world of education is expected to provide good benefits for the world of education, including increasing interaction between students and teachers and their peers, unlimited learning support resources, the formation of learning communities with wide-ranging interactions that are not limited by place, and increasing teacher quality because they can find information and teaching materials more widely and without limits (Sajiatmojo, Negeri, & Selor, 2021). The development of curriculum and technology creates challenges for teachers to adapt to situations that are easy, fast, and digital (Rahma, Harjono, & Sulistyo, 2023).

Curriculum and technology integration are usually applied to the use of learning media in the learning process. Learning media are tools and techniques used as intermediaries for communication between a teacher and students, which are used in order to make communication and interaction between teachers and students effective in the learning process at school (Hutabri, 2019). Learning media should be a tool used to convey learning materials to make them more interesting and effective. The use of appropriate learning media can help students understand the concepts being studied, so that they are no longer abstract (Narestuti, Sudiarti, & Nurjanah, 2021). Although each learning material has a different level of difficulty, it provides different challenges to learning materials that can be delivered either without the need for special tools or those that really need the support of learning media.

Teachers are asked to continue to innovate to create learning media that facilitate the learning process. Moreover, there have been many trainings to improve teacher competency in utilizing technology, both organized by the Ministry, *Balai Guru Penggerak*, and even campuses that carry out community service activities targeting school teachers. The use of technology in the learning process encourages the creation of various learning media that teachers can choose to use in their learning (Dipan & Zona Ratih Alkindi, 2020).

In its development, learning media synergizes with digital technology so that many developments of learning media have been digital-based or called multimedia. Learning with the use of multimedia is defined as a learning condition that provides content in verbal and visual forms (Hasanuddin, Asgar, & Jayadi, 2023) Learning involving technology in its implementation can help increase learning motivation. (Ristanto, Mahardika, & Rusdi, 2021). Some of the media referred to in the literature, such as video-based learning media, have extraordinary potential in increasing students' learning concentration. In a learning environment that is increasingly filled with distractions and fast information, the ability of video media to attract students' attention is a significant added value (Burhayani, Nuridah, Saputra, Sarumaha, & Anyan, 2023). Other media used in the learning process include *Zoom*, *Google Meet*, *Moodle*, and so on. This learning system is not carried out face to face, but *online* by utilizing the internet network so that teachers can ensure that the teaching and learning atmosphere remains productive and runs well. Next, Canva has become one of the popular *online graphic design tools* and is very effective in the preparation of learning media. This application provides various templates, graphic elements, and customizable fonts, allowing users to create designs that are in accordance with learning objectives. Next, (Rahmawati, Ambulani, Desty Febrian, Widyatiningtyas, & Sukma Rita, 2024). *game*-based learning media. The advantages of game media in terms of learning materials are that they are made light and easy to understand because the materials are made based on facts and conditions in everyday life. In addition, the use of an easy and simple way of playing makes it easy for players to operate the game (Daniar, Soe'oed, & Hefni, 2022).d

The function of each type of learning media is very diverse. There are media that function as visual media that have the function of being able to channel messages originating from sources that can receive messages that are expressed in visual form. In addition, there is also the function of this visual media to attract attention, to be able to clarify an idea that will be conveyed, to describe several facts so that they are easy to understand and remember, if the facts can be presented in visual form. (Mukarromah & Andriana, 2022). Other opinions Wulandari, Salsabila, Cahyani, Nurazizah, & Ulfiah (2023)detail the functions of media, including (1) to provide concrete experiences to students ; (2) to provide visual media

that can be seen from the level of student enjoyment when learning or reading illustrated texts; (3) to facilitate the achievement of goals to understand and remember information or messages contained in images; and (4) to provide context for understanding texts and help students who are weak in reading to organize information in texts and remember them again. Provide context for understanding texts and help students who are weak in reading to organize information in texts and remember it again.

The question is, does this digital technology-based learning media really contribute to improving student learning, or is it just meeting the demands of the times that teachers must use technology in the learning process? Through the search for previous articles, research topics that utilize digital technology in learning at the school level will be identified and evaluated so that their impacts on learning in schools can be interpreted, both cognitive, affective, and psychomotor impacts.

2. METHODS

This study refers to a systematic literature review using the PRISMA method (I. Lestari & Ilhami, 2022). SLR is a literature review method that identifies, evaluates, and interprets all results from a research topic to answer a specific research question (Habibi & Artha Glory Romey Manurung, 2023). The PRISMA approach and keyword search were extracted and analyzed. Data were obtained through online data searches, Google Scholar, and Publish or Perish. Article publication is limited to a period of 5 years from 2017 to 2022. The characteristics of the articles that are the data include (a) articles published using national or international languages, (b) articles discussing topics regarding the use of digital media in language learning, (c) articles are analyzed qualitatively and quantitatively, (d) articles contain data descriptions in the form of sample size, standard deviation, and average, (e) articles are published in journals indexed by google scholar.

The data selected as research data were 10 articles from 200 articles found. Data that was not included as data due to several factors, including articles that could not be accessed, data that were not included in the last 5 years, and there was no adequate data to calculate *the effect size*. Furthermore, the data was tabulated and analyzed. The results of the data tabulation were processed using the JASP 0.19.1 application. Meta-analysis uses a fixed-effect model to combine results from multiple studies. The results of the meta-analysis will show the interpretation of the effect size. The following is the classification of effect sizes.

Table 1. Effect Size Criteria

Effect Size	Interpretation
0.00-0.20	Weak
0.21-0.50	Not enough
0.51-1.00	Currently
More than 1.00	Tall

To find out the effect size of research that has been conducted, it is first necessary to know the combined standard deviation. The formula used is:

$$Spooted = \frac{\sqrt{(n_1 - 1)Sd_1^2 + (n_2 - 1)Sd_2^2}}{n_1 + n_2}$$

Information:
Spooted : combined standard deviation
n_1 : number of students in the experimental class
n_2 : number of students in the control class
Sd_1^2 : standard deviation of experimental class
Sd_2^2 : standard deviation of control class

Next, after knowing the standard deviation, the next step is to calculate the effect size to find out the category of the magnitude of the effect from the research data sources that have been inventoried. The formula used is as follows.

$$\text{Effect size} = \frac{\text{Mean}_{\text{treatment}} - \text{Mean}_{\text{control}}}{\text{Standard deviation}}$$

$$\text{Effect size} = \frac{\text{Mean}_{\text{after treatment}} - \text{Mean}_{\text{before treatment}}}{\text{Standard deviation}}$$

The PRISMA model in this research process is shown in the following image.

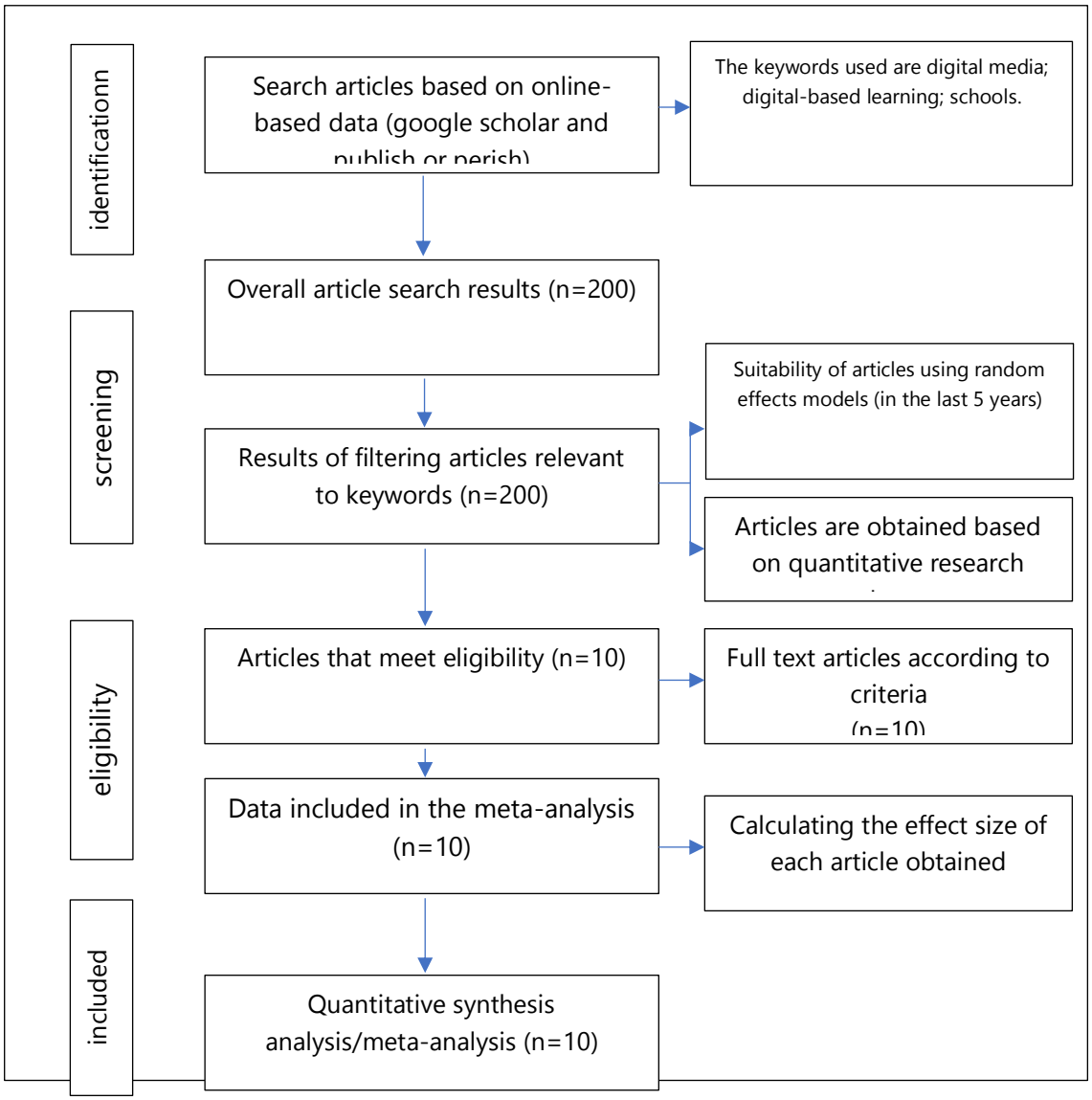

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Model

3. FINDINGS AND DISCUSSION

Based on the results of the article search, data were obtained from 10 articles that met the requirements for adequate articles to determine the magnitude of the effect of using digital media in language learning at school levels, both elementary and secondary schools.

3.1 Inventory of Articles on the Use of Digital Media in Indonesian Language Learning in Schools

Table 2. Article Inventory

No	Writer	Article Title	Year of publication
1	Dwi Aulia Lestari, Tri Wintolo Apoko	The Effectiveness of Animated Videos via Youtube on Interest in Learning Indonesian in Elementary School Students	2022
2	Angel Nasya Yahzunka & Sri Astuti	The Influence of Using Digital Literacy-Based Pop Up Media on Elementary School Students' Fairy Tale Reading Ability	2022
3	Rahmawati & Karisman	The Influence of the SAVI (Somatic, Auditory, Visual, Intellectual) Learning Model Assisted by Power Point Media on the Indonesian Language Learning Outcomes of Grade IV Students	2022
4	Hanny Rahma Sari & Ika Yatri	Animated Videos via the Canva Application to Improve Elementary School Students' Indonesian Language Learning Outcomes	2023
5	Evika Indria Rani, Andri Pitoyo, & Encil Puspitoninngrum	The Influence of Youtube Video Media "Lapor Pak" on Anecdotal Text Writing Skills of Class X Students of SMAN 6 Kediri in the 2023/2024 Academic Year	2024
6	Windi Febriyanti Nabila & Muhammad Isman	The Influence of the PBL Learning Model Assisted by Powtoon Media on the Ability to Write Anecdotal Texts of Class X Students of SMA Negeri 09 Medan in the 2023/20224 Academic Year	2024
7	Lala Dyah Chandra, Pargito, Dwi Yulianti, Dina Maulina	Development of Animation Learning Media through PBL to Improve Students' Thematic Learning Outcomes	2024
8	Princess Meyriska, Gunta Wirawan, & Sumarli	The Influence of the CIRL Learning Model Assisted by Big Book Teaching Aids on the Writing Skills of Grade III Elementary School Students	2024
9	Febri Maria Andriyani, Maximus Gorky Sembiring, Trini Prastati	The Effectiveness of E-Books in Learning Indonesian Language Reviewed from Digital Literacy as an Effort to Recover Learning Loss (Experimental Study on Grade 5 Elementary School Students)	2024
10	Nurul Khisbiyah, Titik Harsiati, Didin Widyartono	The Effectiveness of Using Digital Comic Media on Speaking Skills	2024

Based on the recapitulation results, 10 articles were obtained, which were included in the meta-analysis category. The articles were obtained since 2022, 2023, and 2024, with details: in 2022, as many as 3 articles; in 2023, as many as 1 article; and in 2024, as many as 6 articles. The types of digital media used include animated videos and e-books.

Table 3. Types of Digital Media Use

Media Types	Level	Amount
Animation Video	Elementary School	4
	Senior High School	2
E-Book or similar	Elementary School	3
	Elementary School	1
Total		10

Digital media that is often applied in learning Indonesian is in the form of animated videos and digital books. The forms presented vary. The form of animated videos is integrated through several applications, such as Canva, Powtoon, and PowerPoint, while digital books, such as digital comics, big books, are available in non-printed form so that teachers can use them as teaching materials in class. The phenomenon found, digital media is widely used for learning Indonesian at the elementary school level. The findings of the research results refer to several skill domains as listed in Table 3 below.

Table 4. Research Findings

Journal Code	Findings	Skills Domain
J1	Student learning interest	Affective
J2	Reading ability	Cognitive
J3	Learning outcomes	Cognitive
J4	Learning outcomes	Cognitive
J5	Writing Skills	Psychomotor
J6	Writing Skills	Psychomotor
J7	Learning outcomes	Cognitive
J8	Writing Skills	Psychomotor
J9	Learning outcomes	Cognitive
J10	Speaking Skills	Psychomotor

The use of digital media tends to be aimed at learning outcomes in the form of students' cognitive and psychomotor abilities, while the use of digital learning media for students' affective aspects is not widely used. Thus, this can be a recommendation for subsequent researchers to review the influence or effectiveness of digital media for students' affective domains, such as students' learning motivation or learning attitudes while learning Indonesian in class. Overall, the impact of using digital media as a supporter of technology-based learning in schools can be seen through the analysis of the magnitude of the effects of the pretest and posttest results that have been carried out in previous studies.

3.2 Magnitude of the Research Effect on the Use of Digital Media in Indonesian Language Learning in Schools

The purpose of finding effect size in quantitative research is to help plan the right sample size for further studies and also provide an idea of whether the observed effect is large enough to be repeated or implemented in other contexts. The calculation of effect size based on 10 articles can be seen in Table 4 below.

Table 5. Effect Size

Journal Code	Combined Standard Deviation	Effect Size	Category
J1	1.910	1.078	High
J2	2.987	0.181	Low
J3	2.979	1.80	High
J4	1.851	0.90	Medium
J5	15.25	0.967	Medium
J6	3.535	0.707	Medium
J7	3.493	1.02	High
J8	3.517	0.442	Medium
J9	15.75	0.081	Low
J10	11.27	1,675	High
Average		0.885	Medium

Information:
J = Journal

It can be seen that the resulting categories refer to 3 categories: high, medium, and low in chart 1 below.

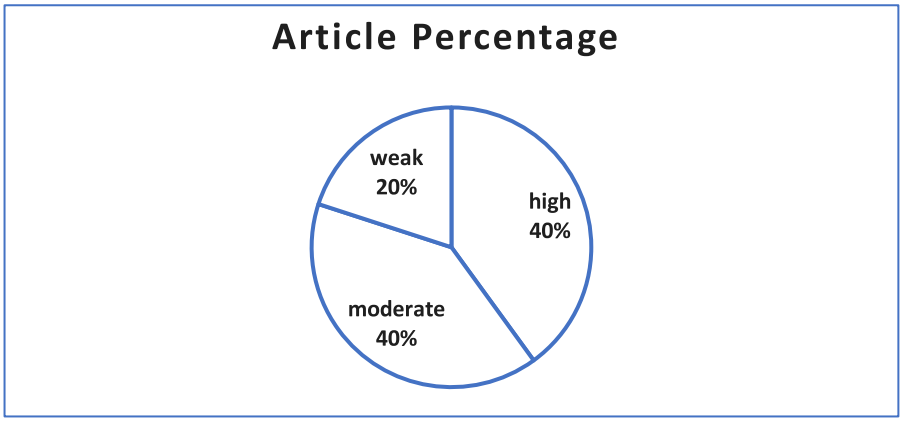

Figure 2. Percentage of ES Article categories

Based on the tabulation of effect size data obtained from 10 articles, the data were then analyzed using meta-analysis. The Fixed and Random Effects can be seen in the following table.

Table 6. Fixed and Random Effects

	Q	df	p
Omnibus test of Model Coefficients	1.420	1	0.233
Test of Residual Heterogeneity	0.265	9	1.000

Note. *p* -values are approximate.
Note. The model was estimated using Fixed Effects method.

The p-value = 0.233 (> 0.05) in the Omnibus Model Coefficient Test data indicates that there is insufficient evidence to state that the overall model coefficient is different from zero. This means that

the model is not significant, or the contribution of the predictors used in the model is not statistically significant in explaining the variation in effects. Furthermore, the Residual Heterogeneity Test indicates that there is variation in effects that cannot be explained by sampling error alone. It is known that a p-value = 1,000 means that there is no evidence of significant residual heterogeneity. This means that after considering the variables in the model, the variation in effects between studies can be fully explained, or the variation is so small that it is not statistically detectable.

Table 7. Coefficients

	Estimate	Standard Error	z	p
intercept	0.957	0.803	1.191	0.233

Note. Wald test.

It is known, in the coefficient table, the standard error value of 0.803 illustrates the uncertainty of the effect size estimate. A fairly large SE indicates that the data variation is relatively high or the number of studies is small. The result of the p-value = 0.233 indicates that the effect is not statistically significant at the conventional level (eg, $p < 0.05$). Thus, there is insufficient evidence that the coefficient is significantly different from zero. This result is consistent with previous findings (eg: Q = 1.420, p = 0.233 from the omnibus test), which also indicates that the model is not significant overall. Furthermore, to help the selected meta-analysis model, it is necessary to calculate the residual heterogeneity estimate. The estimate is obtained as follows.

Table 8. Residual Heterogeneity Estimates

	Estimate
τ^2	0.000
τ	0.000
I^2 (%)	0.000
H^2	1.000

Based on the residual heterogeneity estimation, there is no evidence of heterogeneity in the study results. The estimated effects are very consistent across studies. This result confirms the previous "Test of Residual Heterogeneity" which also showed a p-value = 1.000. In the context of meta-analysis, this means that the model is very homogeneous - all studies provide very similar effects, so no additional moderators or random effects models are needed. Visually, the effects in question can be seen in Figure 2 below.

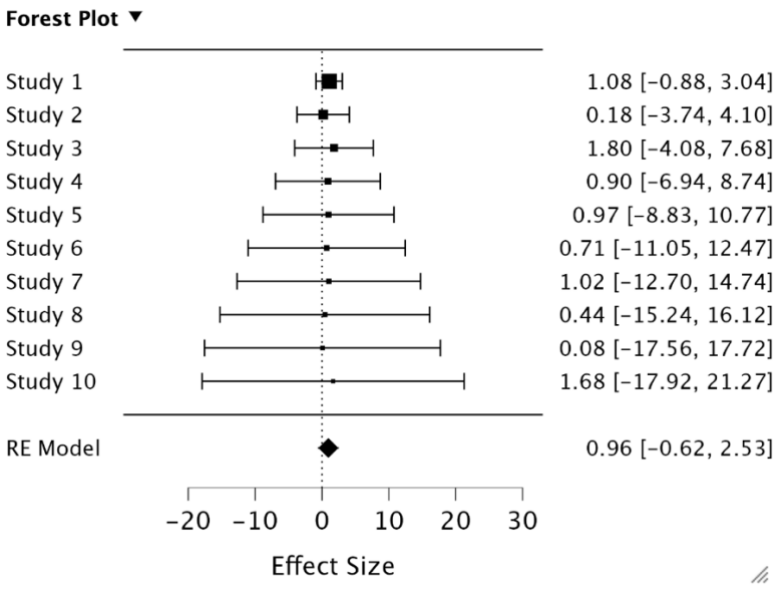

Figure 3. Forest Plot

Figure 2 Forest plot shows that most studies have a positive and significant effect size (do not touch the zero line). The lowest effect size value is 0.081 (very small/almost no effect) and the highest is 1.800 (very large effect). This shows a large variation between studies that may reflect heterogeneity. Although varied, there are no studies with negative or opposite effects. Thus, the direction of the effect is consistent across studies (all effects point to "benefits"). Furthermore, the combined effect results are > 0.8. This means that the combined effect is in the medium to high range. This indicates that the intervention generally has a strong effect. Moderate Effect indicates that although there is a significant influence or relationship between the variables studied, the influence is not very strong, but enough to have a real or important impact in the context of the study. The moderate effect category is often considered a fairly important result because many factors influence the variables in that context, so high effects are very rare. This means that the research results are still relevant to be implemented in the learning process, although not as strongly as expected.

After the forest plot results are seen, the next step to detect publication bias is to look at the following Funnel Plot image.

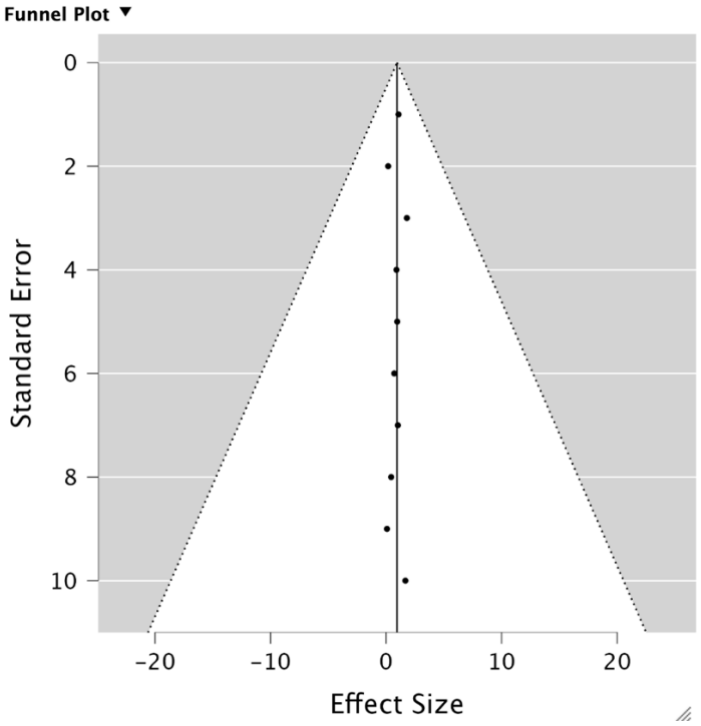

Figure 4. Funnel Plot

The funnel plot shows that all studies had a positive effect, with no small studies showing a null or negative effect. This results in a slightly asymmetrical appearance and indicates the possibility of mild publication bias. However, because the number of studies is only 10, interpretation should be done with caution, as the funnel plot is most stable when used with ≥ 10 studies.

Based on the findings, most studies have positive and significant effect size values, with confidence intervals that do not touch the zero line. This indicates that the intervention or variable studied has a consistent positive effect on the dependent variable in each study analyzed. The range of effect size values varies, indicating a very large effect. This fairly wide variation indicates heterogeneity between studies, namely differences in results that may be influenced by different methodological characteristics, populations, or contexts in each study. However, no studies were found with negative or contradictory effect sizes. In other words, all studies show effects that lead to benefits or influences that support the main hypothesis.

The combined effect (summary effect) obtained from the fixed effect model shows a value above 0.8, which is included in the category of moderate to high effects. According to Cohen's d interpretation, this indicates that the intervention studied generally has a strong effect. A moderate effect implies a statistically significant effect and is strong enough to provide a meaningful practical impact in the context of real-world application, such as in educational or learning environments. This effect shows that even though the effect is not extreme, the research results are still relevant and worthy of implementation, because they make a real contribution to improving learning outcomes or other variables studied. Furthermore, the results of the funnel plot analysis show that all studies are on the positive side, and there are no small studies with zero or negative effect sizes. This produces a somewhat asymmetric pattern, which may indicate the possibility of mild publication bias, namely the tendency to publish studies with significant results only. However, considering the number of studies in this meta-analysis was only 10, the interpretation of the funnel plot needs to be done with caution, because methodologically the funnel plot is most stable when used on the number of studies ≥ 10. Thus, although there are indications of publication bias, these findings are not strong enough to be concluded definitively without the support of further analysis, such as the Egger test or the trim and fill method.

Overall, the findings of this meta-analysis indicate that the interventions studied have a consistent and significant positive impact. Although with varying levels of effect strength. The combined effects that are in the moderate to high category strengthen the argument that the research results have relevance and potential for meaningful implementation, especially in the context of developing evidence-based learning practices or educational policies. To support the results of this study, D. A. Lestari & Apoko (2022) recommend that teachers use animated videos via YouTube in the Indonesian language learning process so that students become more enthusiastic about learning. Furthermore, R. Rahmawati & Kasriman (2022) concluded that learning activities using the SAVI model assisted by PowerPoint media create active learning and increase student concentration so that student learning outcomes improve. Teachers are expected to be able to implement the SAVI learning model, assisted by PowerPoint media, so that students are more enthusiastic during learning activities. Similarly, Sari & Yatri (2023) argue that learning using animated videos can be used as a reference for learning that can improve student learning outcomes in boring learning, and teachers must be creative in carrying out learning in the classroom, so that students can get optimal learning outcomes.

Other forms, such as the use of digital literacy-based Pop Up Book media, can create effective learning so that it can be used to improve students' reading skills (Yahzunka & Astuti, 2022). Increasing digital literacy is an important step in utilizing digital learning resources effectively. so that digital media has great benefits in the Indonesian language learning process (Maria Andriyani, Gorky Sembiring, & Prastati, 2024).

4. CONCLUSION

Based on the data that has been analyzed, it can be concluded that the use of digital media as a supporter of technology-based learning in schools. Provides an effect size of 0.885. This figure shows a moderate category which means that the use of digital media helps the learning process in schools, especially at the elementary and secondary education levels. However, these results indicate that more optimal efforts are needed in utilizing digital media at every level of education to support student learning expectations or outcomes, not only in cognitive aspects, but also affective and psychomotor. Thus, this study recommends academics: teachers and lecturers. Teachers in elementary and secondary schools pay attention to the use of technology in learning for the benefit of affective and psychomotor assessment. Teachers can design formative assessments to support students' affective and psychomotor assessments. Lecturers as academics can collaborate with teachers to develop learning models, learning media, and learning assessments so that the use of technology in learning is more complex and meaningful.

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