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A Decade of Implementation of Android Media in Physics Learning

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ABSTRACT
Android is very important in the learning process of natural sciences, especially in physics learning which is often called difficult so that a lot of research discusses its application in every level of education both at the elementary school, junior high school and high school levels. So far there has been no research that discusses further about how much influence the android media has in the process of learning physics. Therefore, the purpose of this study is to determine the degree of influence of the use of android media in physics learning for the last 10 years both at the elementary, middle and high school levels. This research uses a meta-analysis method, which is to analyze in depth the results of research that meet the established inclusion and exclusion criteria. The data was analyzed using JASP software with the input of Effect Size (ES) and Standard Error (SE) values. The results showed that overall the level of influence of android media in physics learning was 83% which is included in the high category. Based on the level of education at the elementary level, 95.3% (high category), junior high school by 73% (medium category), high school level by 84% (high category). The level of influence before Covid-19 was 85% (high category) and after Covid-19 was 82% (high category) and as for based on the focal plane of waves and optics by 71% (medium category), basic physics by 87% (high category) and thermodynamics by 85% (high category). So that when viewed based on the level of education, android media is more appropriate to use at the elementary level than junior high school and high school.

INTRODUCTION

The development of Technology and Information in modern times is very influential for daily life, both students and students. One of them is the use of smartphones [1]. In this era of the 21st century, android-based smartphone users have been widely used by both teachers, students and other communities [2]. Many students and teachers have used android-based smartphones to become a learning medium. Learning media is one of the important components of learning resources. Media is

also a form of mediator used by humans to convey ideas, ideas or opinions expressed and reach the intended recipient [3]. The existence of learning media also determines the success of a learning that will be achieved. Learning media has various forms, but one of the interesting forms of innovation today is the use of technology-based learning media [4], such as software is widely used among students in learning physics science which is said to be difficult and not many students like the subject. This can be used as an excuse to increase students' interest and motivation to learn. According to Febrianti et al. [5] that Science physics is a branch of science in which it studies the symptoms of nature systematically related to daily life so that teachers are required to be able to explain this into a tangible form Anesia et al [6]. Therefore, in the process of learning science physics requires android technology-based learning media at the educational level, elementary school, junior high and high school.

The use of learning media needs to pay attention to the suitability of levels, needs, types and development of students, because Nurrohman et al [7] mentioned that the media that are in demand in the learning process are in the form of text (6.3%), images (10.3%), animation (16.6%), videos (29.1%), games (32.6%) and others (5.1%). This data shows that games or games are the form of media that is most in demand by students. Anggraini et al [8] said that students at primary school age also tend to be interested in easy-to-play games where 77% of children use gadgets to play games, and for educational applications by 23%. Basically, the characteristics of learners can be a benchmark for planning and managing the learning process [9]. For example, by playing children will learn various things both intentionally and unintentionally so that for a combination of games and educational can be used as a learning medium in physics science material. Not only that, it is necessary to understand mature concepts at the elementary school level so that at the next level students are able to follow a material development well [10]. In research by Mabruri et al [11] proved that learning media can also improve the achievement of elementary school students, meaning that learning media has a significant influence on the development of children's understanding. There are several studies that discuss the application of android media in physics learning at the elementary school level, namely carried out by Firdaus et al [12] who developed the educational game "the adventure of the isaac". Furthermore, Indra & Fitria [13] used educational science games assisted by appsgeyser applications for grade V elementary school students, and Rahman et al [14] used android-based augmented reality media for grade III elementary schools. Efan et al [15] developed educational game media "the word physics" on the material of the concept of style for elementary school children. In addition, Zulherman et al [16] conducted a development research with the title "Development of Android-Based Millealab Virtual Reality Media in Natural Science Learning". Not only that, Nurpratiwiningsih & Didik [17] also conducted research developing the "Development of Education Games Map Material as a Learning Media for Elementary School Students".

The application of android media is also widely at the Junior High School level which is applied to several materials such as the subject matter of light. Students are expected to be able to relate the properties of light to events in everyday life [18]. According to Ismatullah & Fathoni [19], class VII junior high school with a sample of 175 students and a percentage of feasibility results of 81.11% (very feasible to use). According to Alfian & Kustijono [20], in class IX on dynamic electrical materials with feasibility results of 92.24% The same case with Kodi et al [21], that in grade VII junior high school students developed an Android-based Physics *Flipbook Media* with research results obtained by all students are 80% of products included in the good category and are suitable for use. “Development of flipbook learning media on material motion of objects in junior high schools” in Rahmawati et al [22] said that 90.39% is very effective and feasible to use. In addition, the development of android-based comic media on the subject of straight motion by Anesia et al [6] in class VII junior high school with an effective rate of 81.7%. Wirjawan et al [23] in their research developed "Android-based physics learning-media apps on circular motion" at the junior high school level with the results obtained 75% can be used in physics learning. The research by Febrianti et al [5] which measured the critical thinking ability of grade VIII junior high school students in science learning using Android application media on vibration and wave materials, was able to provide an increase in all indicators by 78% with a high category. On research by Atika et al [24] develop android-based mobile learning physics teaching materials on static fluid material intended for grade

VII Junior High School. Analysis of the physics aspects of local wisdom "long roof (bamboo cannon)" in the development of android-based physics comic media in the sound wave chapter, 91% was able to have a very good influence on students [24]. Rany et al [25] conducted the same development research, namely development of physics-based learning media for android integrated with earthquake disaster education with the results obtained in the research 90% effectively used as a learning medium. Among high school students, most of whom have smartphones, especially mobile phones that are used by teachers and students as learning media that are felt to be able to help students in the physics learning process. In the study by Toda et al [26] namely the development of mobile learning as a source of learning physics on straight motion material for class X students with feasibility results obtained by 85.66%. Furthermore Susilawati et al [27] conducted research on the development of e-modules for mastery of the concept of straight motion material with a mask flipbook software with a feasibility presentation of 92.70% included in the excellent category. Continued by research from Tania et al [28], "The Application of Physics Learning Media Based On Android with Learning Problem Based Learning (PBL) to Improve Critical Thinking Skills" in class X SMA with a percentage of eligibility obtained of 82.70%. The research conducted by Rahim et al [29] developed an android-based appypie application for learning outcomes of class XI High School Students on elasticity material and Hooke's law so that student learning completion became 64.7%. The development research conducted by Muqarrobin & Kuswanto [30] namely "Development of an android-based physics e-book to ease students' physics learning and its influence on their learning achievement" with feasibility results obtained 95% at the high school level. Furthermore, Wulandari et al [31] developing physics learning media at senior high school class XI showed that 76.67% were included in the good category and suitable for use. Then in Tuada [32] namely "Development of the Android-Based Interactive Physics Mobile Learning Media (IPMLM) with Scaffolding Approach on the Sound Wave to Improve Student Learning Independence" for class XI senior high school category is very feasible to use with a percentage result of 83%. The android-based supplement book as a learning medium on electromagnetic wave material for high school students with the results obtained by 83.8% is very feasible to use which was carried out in the study by Susanti [33] "Improving the competence of diagrammatic and argumentative representation in physics through android-based mobile learning application about Newton's law for Grade X" was also carried out by Liliarti et al [34].

Several researches on the development of android learning media based on the focus area and subject matter on science material have also been carried out a lot, such as research by Deni et al [35] that developing “newton's law learning media based on interactive android” on including in the field of basic physics with an influence level of 97.82%. Furthermore, in the study by Syaputrizal & Jannah [36], static fluid material that developed the android platform using the app inventor application with a feasibility percentage of 83.01%. Also conducted by Noviatika [37] and Rai [38], developed a mobile pocket book physics on the problem-solving ability of students of momentum, impus and collision materials. Hayati et al [39] and Permana et al [40] conducted development research with the main point of optical tools developing physics flipbooks with a feasibility percentage of 83.03%. Continued by Nurfadilah et al [41] in their research also developed e-learning with Schoology. Then in the research by Cahya et al [42] namely the “Development of Mobile Learning Media Based Android to Support Students Understanding”. Furthermore, research after Covid-19 by Aji et al [43] “Development of physics mobile learning media in optical Instruments for senior high school student using android Studio”. Rohim et al [44] also conducted research on the development of physics learning media assisted by the instagram application to increase student motivation and learning outcomes.

Based on the presentation of the research above, information was obtained that there was no research that discussed more deeply about the degree of influence of using android media, namely based on the level of education, based on the focus area, and based on data before and after Covid-19. So that with this meta-analysis research, it is hoped that it can find out how much the level of influence is seen based on the compulsive value of the effect size for a decade so that it can be used as a reference for researchers who conduct similar research.

METHOD

This type of research uses Meta-Analysis research. According to Ashri et al [45] and Mandailina et al [46], meta-analysis is a statistical method that combines data from previous similar studies to be studied and obtain synthesis in general. The data collection technique uses the Preferred Reporting Items for Systematic Reviews and Meta-analyses method or commonly called PRISMA, this method is carried out systematically by following the correct research stages or protocols. Data collection techniques in this study were obtained from the Searching Journal and Repository Databases such as Scopus, DOAJ, WorldCat, Google Scholar, Garuda Portal, there is the name of the author of the year of publication and the type of research, the field of focus and the value of **r**-count, **t**-count, **f**-count and classical value. The research steps are [47] [48] :

1. Study the research topics to be summarized.
2. Search and collect a number of studies with predetermined keywords, namely physics learning, android media and level of influence from journal indexing databases such as: Scopus, DOAJ, WorldCat, Google Scholer, Garuda Portal.
3. Coding and tabulation of data: publication year 2012-2022, author name, type of research, level of education, material / area of focus, number of samples. The values of **r**-count, **f**- count and **t**-count as well as classical values.
4. Record fisher **(f)**, student **(t)** and correlation **(r)** values and the number of research samples.
5. Convert the values of fand t to the value of **r** to make it easier to calculate the effect size using the following formula:

$$t = \sqrt{F} \tag{1}$$

Used to find the value of **r**-count if it is known **f**- count.

$$r = \frac{t}{\sqrt{t^2 + N - 2}} \tag{2}$$

Used to find the value of r-count if it is specified as a t-count value.

6. Calculating effect size (ES) and standard error (SE) with models in meta-analysis and hypothesis testing of effect size and error standards. The formula can be used as follows:

$$ES = 0{,}5 \times \ln \frac{1+r}{1-r} \tag{3}$$

to find the effect size (ES) value if the value of r is known.

$$SE = \sqrt{\frac{1}{N-3}} \tag{4}$$

Used to find the standard error (SE) value if the number of students is known.

7. Perform data analysis using the help of JASP software.
8. Draw conclusions and interpret the results of meta-analysis research.

The degree of influence category is determined by the value of Effect Size (ES) and Standard Error (SE). ES value categories as per Table 1.

Table 1. ES Value Intervals and Categories

Effect size (ES)	Category
0.00≤ ES < 0.20	Very small
0.20 ≤ ES < 0.50	Small
0.50 ≤ ES < 0.80	Medium
0.80 ≤ ES < 1.30	High
1.30 ≤ ES	Very high

RESULTS AND DISCUSSIONS

Result

From the search results indicated through the indexer database, 101 relevant studies were obtained. However, after conducting sorting that met the complete criteria as many as 53 articles and those that did not meet the criteria as many as 48. Some data did not meet the criteria due to incomplete information that would be used as an analysis such as the year of publication was not listed, 39 data did not mention the number of students in the study, 17 data whose subject matter or material was not clear and 55 data whose correlation values were not taken into account. Thus articles that do not meet these criteria can be used as a reference in research. Thus, only 53 articles can be used to obtain the ES and SE values according to Table 2.

Table 2. Effect Size (ES) and Standard Error (SE) Results

Study	Types of research	Level of education	Focal plane	N	ES	SE	Category
Study 1	R and D	SHS	Wave and optical	30	0.820	0.070	High
Study 2	R and D	JHS	Wave and optical	14	0.917	0.926	High
Study 3	Quantitative	JHS	Wave and optical	26	0.086	0.209	High
Study 4	R and D	SHS	Wave and optical	28	0.896	0.058	High
Study 5	R and D	ES	Thermodynamics	12	0.978	0.042	High
Study 6	R and D	JHS	Thermodynamics	175	0.811	0.030	High
Study 7	R and D	JHS	Basic physics	20	0.922	0.060	High
Study 8	R and D	SHS	Thermodynamics	39	0.830	0.060	High
Study 9	R and D	SHS	Wave and optical	15	0.377	0.289	Small
Study 10	R and D	SHS	Wave and optical	36	0.929	0.174	High
Study 11	R and D	SHS	Thermodynamics	26	0.879	0.064	High
Study 12	R and D	JHS	Basic physics	35	0.817	0.065	High
Study 13	R and D	SHS	Basic physics	32	1.272	0.186	High
Study 14	Quantitative	SHS	Basic physics	34	0.758	0.180	Medium
Study 15	R and D	SHS	Basic physics	20	0.725	0.243	Medium
Study 16	R and D	ES	Basic physics	29	0.958	0.037	High
Study 17	R and D	SHS	Basic physics	31	0.952	0.038	High
Study 18	R and D	SHS	Thermodynamics	45	0.536	0.154	Medium
Study 19	Quantitative	SHS	Basic physics	50	0.510	0.146	Medium
Study 20	Quantitative	SHS	Thermodynamics	30	0.828	0.192	High
Study 21	R and D	SHS	Thermodynamics	26	0.618	0.209	Medium
Study 22	R and D	SHS	Wave and optical	36	0.576	0.174	Medium
Study 23	R and D	SHS	Wave and optical	29	0.494	0.196	Small
Study 24	R and D	ES	Basic physics	34	1.293	0.180	High
Study 25	R and D	ES	Basic physics	31	0.929	0.189	High
Study 26	R and D	ES	Basic physics	36	0.943	0.039	High
Study 27	R and D	ES	Basic physics	10	0.920	0.086	High
Study 28	R and D	ES	Basic physics	7	1.020	0.500	High
Study 29	R and D	SHS	Basic physics	36	1.256	0.174	High
Study 30	Quantitative	SHS	Basic physics	33	1.338	0.183	Very High
Study 31	R and D	JHS	Basic physics	12	0.693	0.333	Medium

Study	Types of research	Level of education	Focal plane	N	ES	SE	Category
Study 32	R and D	ES	Basic physics	59	0.648	0.134	Medium
Study 33	R and D	SHS	Basic physics	10	0.933	0.079	High
Study 34	Quantitative	SHS	Basic physics	37	0.996	0.171	High
Study 35	Quantitative	SHS	Basic physics	44	0.563	0.156	Medium
Study 36	R and D	ES	Basic physics	10	0.867	0.378	High
Study 37	R and D	SHS	Wave and optical	30	0.996	0.192	High
Study 38	R and D	SHS	Basic physics	35	0.604	0.177	Medium
Study 39	Quantitative	SHS	Thermodynamics	30	0.908	0.192	High
Study 40	R and D	SHS	Wave and optical	20	0.867	0.243	High
Study 41	R and D	SHS	Basic physics	23	0.678	0.224	Medium
Study 42	R and D	SHS	Basic physics	31	0.693	0.189	Medium
Study 43	R and D	SHS	Basic physics	29	0.709	0.196	Medium
Study 44	R and D	SHS	Basic physics	40	0.709	0.164	Medium
Study 45	Quantitative	SHS	Basic physics	36	0.929	0.174	High
Study 46	R and D	SHS	Basic physics	30	1.045	0.192	High
Study 47	R and D	JHS	Thermodynamics	10	0.800	0.126	High
Study 48	R and D	SHS	Basic physics	24	0.753	0.088	Medium
Study 49	R and D	SHS	Thermodynamics	25	0.893	0.062	High
Study 50	R and D	SHS	Basic physics	24	0.761	0.087	Medium
Study 51	R and D	SHS	Basic physics	30	0.918	0.192	High
Study 52	R and D	SHS	Basic physics	55	0.632	0.139	Medium
Study 53	Quantitative	JHS	Basic physics	27	0.515	0.204	Medium
			Average		**0.828**		**High**

The data that meets the complete criteria according to Table 2 above is 53 data. The amount of data according to the type of research obtained as many as 43 data for RnD research and for quantitative research as many as 10 data. Based on 2012-2018 before Covid-19, 27 data were obtained. In 2019-2022 after Covid-19, 26 data were obtained. then viewed based on the level of elementary education obtained as much as 9 data, junior high school as much as 8 data and high school as much as 35 data. Based on the number of samples <50 obtained as many as 49 data, the number of samples >50 as many as 4 data. Furthermore, the focal plane is thermodynamics as much as 10 data and in the focus area of basic physics as many as 33 data, waves and optics as many as 10 data. Based on the calculation results using formulas 1, 2, 3, and 4, the average ES (effect size) value of 0.828 is included in the high category.

Implementation of Android Media in Physics Learning

From the ES and SE values that have been obtained in Table 2, the researcher then conducts data analysis to see the level of influence of android-based learning media from the data that has been obtained. Data analysis using JASP by inputting according to Table 2 as for JASP output as Table 3.

Table 3. JASP output of each category

Variable	Output
N	53
Q_{RE}	131.575
Coefficient	0.843
I^2 (%)	73.420
p-Rank Test	0.225

Table 3 shows that as many as 53 data analyzed obtained a Q value of 131,575 which shows that the research results are heterogeneous, the estimate coefficient value of 0.843 is included in the high category. Then the residual heterogeneity estimate I^2 value of 73,420 and the p-rank test of 0.225 showed that there was no publication of bias in this study.

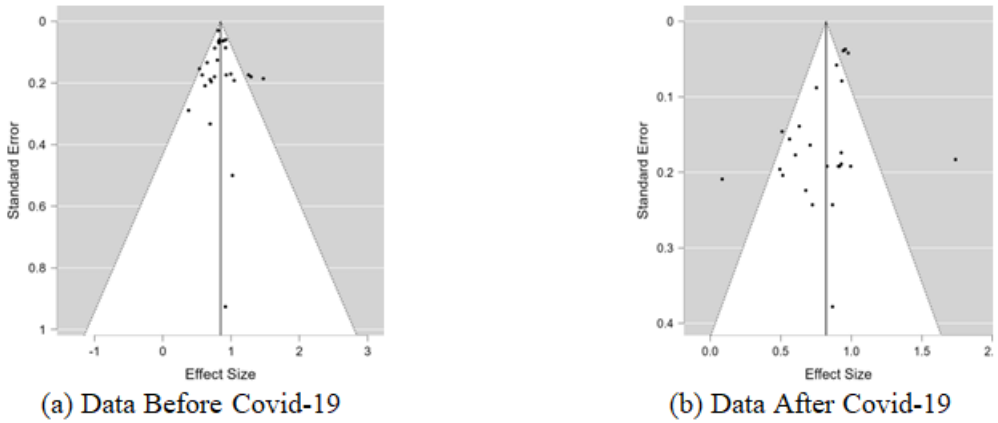
Use of Android Media Before and After Covid-19

Furthermore, researchers want to know the degree of influence of the use of android-based learning media before and after Covid-19, therefore researchers divide two intervals, namely 2012-2019 for data before Covid-19 and 2020-2022 for data after Covid-19. The calculation results obtained using JASP software are coefficient values, p-Rank test and Forest Plot in accordance with Table 4.

Table 4. JASP Outputs Data Before and After Covid-19

Cluster	N	Coefficient	p-Rank Test	Forest Plot	Category
Before Covid-19 (2012-2019)	27	0.846	0.646	0.85 [0.81, 0.88]	High
After Covid-19 (2020-2022)	26	0.822	0.085	0.82 [0.72, 0.92]	High

Table 4 shows that the forest plot value for data before Covid-19 was obtained by 0.85 and after Covid-19 0.82 this shows that the application of android-based learning media in physics learning has a higher effect before Covid-19 compared to after Covid-19. The results of plotting the effect size distribution data can be seen in Figure 1.



(a) Data Before Covid-19 (b) Data After Covid-19

Fig 1. *Distribution of Effect Size of Android Media Implementation before and after Covid-19*

Based on the results of plotting Figures 1 (a) and Figure 1 (b) shows that all circles are closed and give the same results. in Figure 1 (a) the distribution before Covid-19 is seen that some effect size values are pursed in a triangle or interval meaning that all android media uses at that time had a good influence, while in figure 1 (b) after Covid-19 it was slightly different, namely producing a distribution of effect sizes in the triangle, some of which spread.

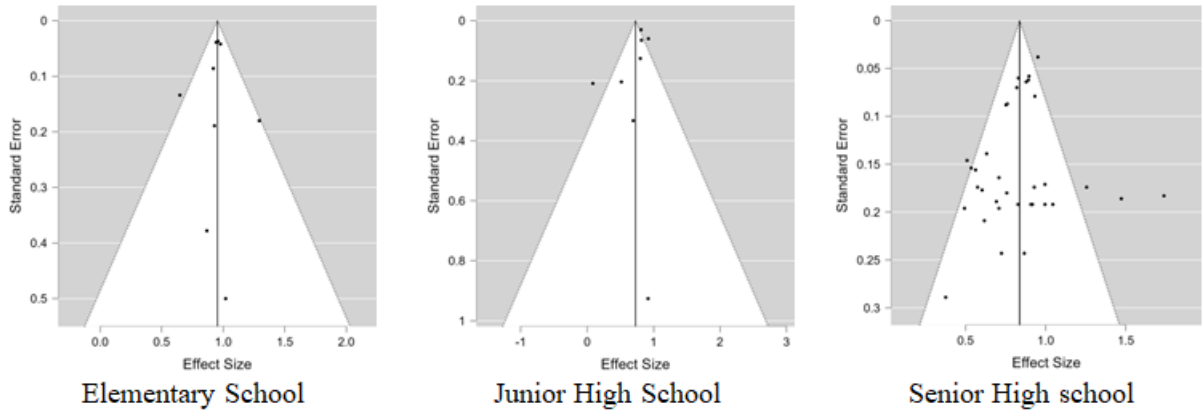
Use of Android Media Based on Education Level and Focus Area

Furthermore, researchers conduct data analysis to determine the level of influence based on the level of education and the area of focus. The level of education includes elementary, middle and high school. Data based on the elementary education level is 9 data, for the junior high school level, 9 data is loaded and for the high school level as much as 35 data. Meanwhile, based on the focal plane, which consists of waves and optics as much as 10 data, basic physics as much as 22 data and thermodynamics as much as 10 data. The results of the output calculation obtained using JASP software are coefficients values, amount of data, p-Rank Test values and forest plots such as Table 5.

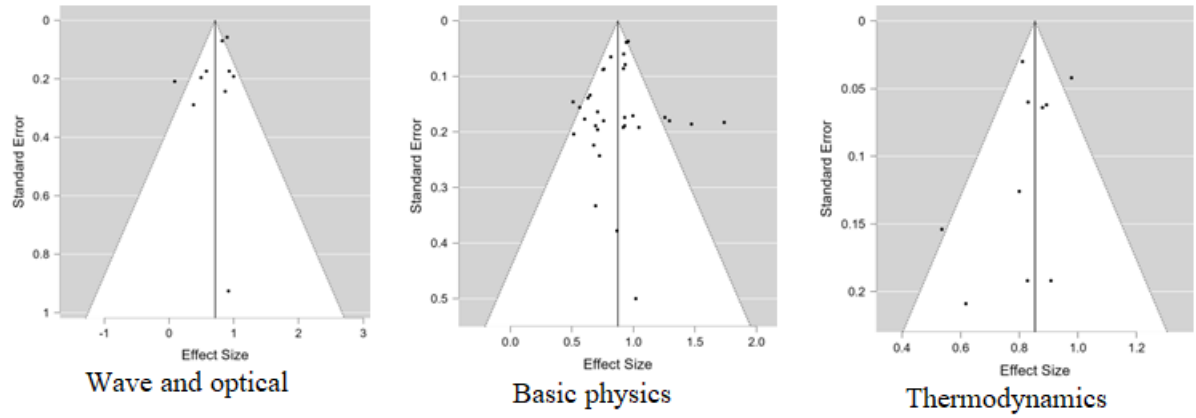
Table 5. JASP Output By Focus Field

Variable	Category	N	Coefficient	p-Rank Test	Forest Plot	Category
Education Level	Elementary school	9	0.953	1.000	0.95 [0.91, 0.99]	High
	Junior High School	8	0.728	0.548	0.73 [0.56, 0.90]	Medium
	Senior High School	35	0.838	0.638	0.84 [0.76, 0.91]	High
Areas of Focus	Wave and optical	10	0.711	0.151	0.71 [0.53, 0.89]	Medium
	Basic physics	33	0.874	0.828	0.87 [0.79, 0.96]	High
	Thermodynamics	10	0.854	0.472	0.85 [0.79, 0.92]	High

Table 5 shows that at the elementary level the coefficient obtained of 0.95 is included in the high category. The junior high school level of 0.72 is included in the medium category and at the high school level, 0.83 is included in the high category. So that based on the level of education 2 data are included in the high category and one data is included in the medium category. Then based on the focal plane on waves and optics, namely the coefficient value of 0.71 is included in the medium category, in the basic physics field of 0.87 it is included in the high category and in the thermodynamics field, which is 0.85, it is included in the high category. So that when viewed from the resulting coefficient, 2 data are included in the high category and one data is included in the medium category. The pattern of data distribution based on education level and focus area can be seen in Figure 2.



(a) Distribution of Data Based on Education Level



(b) Data Distribution By Focal Plane

Fig 2. *Forest plots for education levels and areas of focus*

Figure 2 shows both in education and the focus area of the results of the distribution of the effect size almost entirely in a triangle, this shows that the level of influence of each and each focus area for the

application of android-based learning media is very influential. One of them is in the focus of basic physics where the resulting dark circles do not spread out of the triangle or purse on the triangle, this shows that the use of android media is very influential in the field of basic physics.

Analysis of the Study Characteristic

In addition, researchers also analyze data according to two variables, namely the type of research and the sample size. The type of research taken consists of R &D and quantitative research. The number of data obtained based on R&D research is 43 data. Based on quantitative research obtained as many as 10 data. As for the sample size, it is <50 participants and >50 participants. For data 50 participants, 49 data were obtained. For those <50 participants, 4 data were obtained. The following are the results of the output calculation obtained based on the analysis of characteristic studies using JASP software, namely coefficient values, number of data, p-Rank Test values and forest plots such as Table 6.

Table 6. Moderator Variable Analysis

Variable	Types 7 Intervals	N	Coefficient	p-Rank Test	Forest Plot	Category
Types of Research	Quantitative	10	0.785	0.719	0.79[0.52, 1.52]	Medium
	R & D	43	0.808	0.362	0.81[0.83, 0.91]	High
Sample Size	≤ 50 participant	49	0.860	0.167	0.86[0.80, 0.90]	High
	≥ 50 participant	4	0.695	0.083	0.69[0.55, 0.84]	Medium

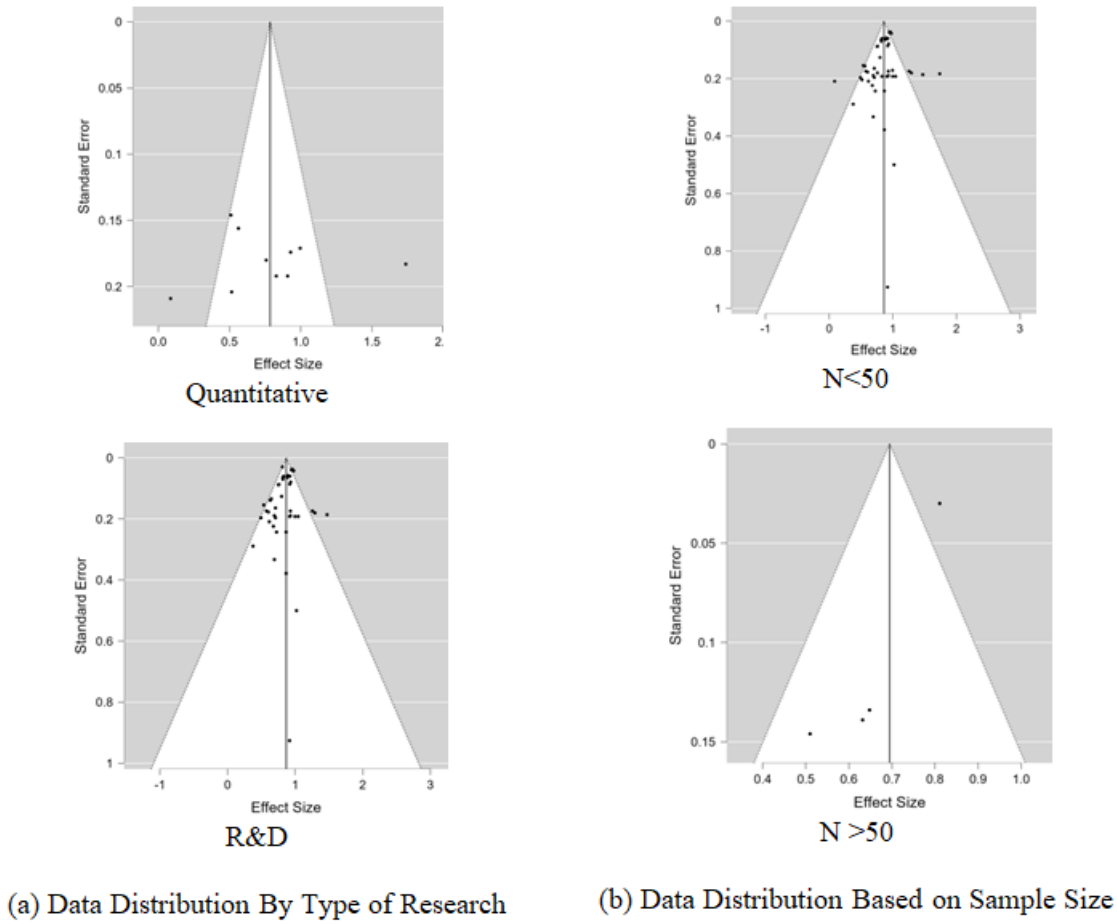


Fig 3. *Forest plots by type of research and sample size*

Table 6 shows that in the variable type of R & D research obtained a coefficient value of 0.78 is included in the medium category, and for quantitative research the coefficient value obtained is 0.80 with a high category. Furthermore, based on the variable sample size <50 participants obtained a coefficient value of 0.86 included in the high category. For sample size >50 participants, the

coefficient value obtained of 0.69 is included in the medium category. Thus when viewed based on the value of the coefficient obtained two data belong to the medium category and two data belong to the high category. The pattern of data distribution based on variable moderators can be seen in Figure 3.

Figure 3 shows the results of the distribution of data based on the type of research and sample size. In this type of research, the results of the distribution of effect size are almost all in triangles or black circles pursed. Likewise, the distribution of the effect size based on the sample size shows the same result, namely that all dark circles are in a triangle. This indicates that the level of influence is well seen based on the type of research and samples are very influential. One of them is in the type of R & D research, the results that look like dark circles do not spread out of the triangle or purse the triangle, this shows that the use of android media is very influential.

CONCLUSION AND SUGGESTION

Based on the results of data analysis and discussions that have been carried out in this study. Then the researcher can draw conclusions. Android media in physics learning has an influence rate of 83% with the High category. The degree of influence of the use of android media on physics learning before Covid-19 is higher than after Covid-19 with an influence level of 0.85 with a high category. Furthermore, the application of android media at the elementary level has the highest level of influence of 95% compared to the junior high school, high school level. Then the degree of influence on the focal plane of basic physics is higher compared to thermodynamics and optical waves with an influence rate of 87%. The degree of influence on the type of R&D research is higher has an influence rate of 81% compared to quantitative research. Finally, the level of influence seen based on the number of samples that are less than 50 has a higher level of influence compared to the number of samples of more than 50. Thus the influence of the use of android media in physics learning is very high but gives different levels of influence. This research still has a lot of flaws and is far from perfect. This is due to the limited ability we have. Therefore, we as researchers really expect constructive criticism and suggestions. We also hope that this research article can be useful to us in particular and readers in general.

REFERENCES

[1] Astuti, I. A. D., Sumarni, R. A., & Saraswati, D. L. (2017). Pengembangan media pembelajaran fisika mobile learning berbasis android. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *3*(1): 57-62.

[2] Sujanem, R., Suswandi, I., & Yasa, P. (2019). Pemanfaatan Media Pembelajaran Fisika Berbasis Android Bagi Guru-Guru Fisika SMA. *International Journal of Community Service Learning*, *3*(4): 279-289.

[3] Damayanti, A. E., Syafei, I., Komikesari, H., & Rahayu, R. (2018). Kelayakan Media Pembelajaran Fisika Berupa Buku Saku Berbasis Android Pada Materi Fluida Statis. *Indonesian Journal of Science and Mathematics Education*, *1*(1): 63-70.

[4] Fitriyani, L. A., & Mintohari. (2020). Pengembangan Media Game Undercover Berbasis Android untuk Meningkatkan Hasil Belajar Materi Tata Surya Mata Pelajaran IPA Kelas VI Sekolah Dasar. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *8*(1).

[5] Febrianti, N. S., Utomo, A. P., & Supeno, S. (2021). Kemampuan berpikir kritis siswa SMP dalam pembelajaran IPA menggunakan media aplikasi android getaran dan gelombang. *Optika: Jurnal Pendidikan Fisika*, *5*(1): 26-33.

[6] Anesia, R., Anggoro, B. S., & Gunawan, I. (2018). Pengembangan media komik berbasis android pada pokok bahasan gerak lurus. *Indonesian Journal of Science and Mathematics Education*, *1*(2): 149-153.

[7] Nurrohman, A. (2021, July). Analisis edugame berbasis android sebagai media pembelajaran di sekolah dasar. In *SINASIS (Seminar Nasional Sains)* (Vol. 2, No. 1).

[8] Anggraini, S. Y., Supriatna, A. R., & Soleh, D. A. (2021). Pengembangan Filter Game Edukasi Berbasis Instagram Pada Muatan IPA Kelas V Sekolah Dasar. *OPTIKA: Jurnal Pendidikan Fisika*, *5*(2): 145-151.
[9] Kartini, K. S., & Putra, I. N. T. A. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Android Pada Materi Hidrokarbon. *Jurnal Pendidikan Kimia Undiksha*, *5*(1): 37-43.
[10] Nirmala, N. S., & Istianah, F. (2020). Pengembangan Media Pembelajaran Flipbook sebagai media belajar pada pembelajaran IPA materi metamorfosis kelas IV di Sekolah Dasar. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *8*(1).
[11] Mabruri, H., Ahmadi, F., & Suminar, T. (2019). The development of science mobile learning media to improve primary students learning achievements. *Journal of Primary Education*, *8*(1): 108-116.
[12] Firdaus, Y. A., & Yermiandhoko, Y. (2020). Pengembangan Media Game Edukasi Petualangan Si Isaac Berbasis Android pada Materi Gaya Kelas IV Sekolah Dasar. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *8*(2).
[13] Indra, W., & Fitria, Y. (2021). Pengembangan Media Games IPA Edukatif Berbantuan Aplikasi Appsgeyser Berbasis Model PBL untuk Meningkatkan Karakter Peduli Lingkungan Siswa Sekolah Dasar. *JEMS: Jurnal Edukasi Matematika Dan Sains*, *9*(1): 59-66.
[14] Rahman, A. Z., Hidayat, T. N., & Yanuttama, I. (2017). Media Pembelajaran IPA Kelas 3 Sekolah Dasar Menggunakan Teknologi Augmented Reality Berbasis Android. *Semnasteknomedia Online*, *5*(1): 4-6.
[15] Erfan, M., Widodo, A., Umar, U., Radiusman, R., & Ratu, T. (2020). Pengembangan Game Edukasi "Kata Fisika" Berbasis Android untuk Anak Sekolah Dasar pada Materi Konsep Gaya. *Lectura: Jurnal Pendidikan*, *11*(1): 31-46.
[16] Zulherman, Z., Amirulloh, G., Purnomo, A., Aji, G. B., & Supriansyah, S. (2021). Development of android-based millealab virtual reality media in natural science learning. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *9*(1): 1-10.
[17] Nurpratiwiningsih, L., & Setiyoko, D. T. (2018). Development of education games map material as a learning media for elementary school students. *Journal of Primary Education*, *7*(3): 249-257.
[18] Fatimah, S., & Mufti, Y. Pengembangan Media Pembelajaran Ipa-Fisika Smartphone Berbasis Android Sebagai Penguat Karakter Sains Siswa. *Kaunia: Integration and Interconnection Islam and Science Journal*, *10*(1): 59-64.
[19] Ismatullah, K., & Fathoni, A. (2018). Pengembangan software fisika berbasis android sebagai media belajar pada materi asas black. *EDUMATIC: Jurnal Pendidikan Informatika*, *2*(2): 114-119.
[20] Alfian, M. A., & Kustijono, R. (2015). Pengembangan Software Fisika Berbasis Android Sebagai Media Belajar Listrik Dinamis. *Inovasi Pendidikan Fisika*, *4*(2): 181-184.
[21] Kodi, A. I., Hudha, M. N., & Ayu, H. D. (2020, January). Pengembangan media flipbook fisika berbasis android untuk meningkatkan prestasi belajar pada topik perpindahan kalor. In *SNPF (Seminar Nasional Pendidikan Fisika)*.
[22] Rahmawati, D., Wahyuni, S., & Yushardi, Y. (2017). Pengembangan Media Pembelajaran Flipbook pada Materi Gerak Benda di SMP. *Jurnal Pembelajaran Fisika*, *6*(4): 326-332.
[23] Wirjawan, J. V. D., Rombe, C. M., Pratidhina, E., & Untung, G. B. (2021, March). Android-based physics learning-media apps on circular motion. In *Journal of Physics: Conference Series* (Vol. 1811, No. 1, p. 012100). IOP Publishing.
[24] Atika, A., Kosim, K., Sutrio, S., & Ayub, S. (2022). Pengembangan Media Pembelajaran Fisika Mobile Learning Berbasis Android Pada Materi Fluida Statis. *Jurnal Ilmiah Profesi Pendidikan*, *7*(1): 13-17.
[25] Rany, T. D., Kuswanto, H., & Abdillah, A. J. (2020). Development of physics-based learning media for android integrated with earthquake disaster education. In *Journal of Physics: Conference Series* (Vol. 1440, No. 1, p. 012029). IOP Publishing.
[26] Toda, S. Y. G., Harso, A., & Astro, R. B. (2021). Pengembangan Mobile Learning Sebagai Sumber Belajar Fisika Pada Materi Gerak Lurus Untuk Siswa Kelas X. *Lensa: Jurnal Kependidikan Fisika*, *9*(2): 124-141.
[27] Susilawati, S., Pramusinta, P., & Saptaningrum, E. (2020). Penguasaan konsep siswa melalui

sumber belajar e-modul gerak lurus dengan software flipbook maker. *UPEJ Unnes Physics Education Journal*, *9*(1): 36-43.

[28] Tania, R. (2021, March). The Application of Physics Learning Media Based on Android with Learning Problem Based Learning (PBL) to Improve Critical Thinking Skills. In *7th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS 2020)* (pp. 583-590). Atlantis Press.

[29] Rahim, H. F., Tazkiyah, A., Purwanto, Y. A., & Suyudi, A. (2019). Pengaruh Mobile Learning Menggunakan Aplikasi Appypie Berbasis Android terhadap Hasil Belajar Siswa SMA Kelas XI pada Materi Elastisitas dan Hukum Hooke. In *Seminar Nasional Fisika dan Pembelajarannya* (pp. 18-22).

[30] Muqarrobin, T. F., & Kuswanto, H. (2016). Open Access Development of an android-based physics e-book to ease students ' physics learning And its influence on their learning achievement American Journal of Engineering Research (AJER). 10: 223–229.

[31] Wulandari, N. (2020). Pengembangan media pembelajaran fisika berbasis android di SMA Negeri 3 Ngabang. *Jurnal Pendidikan Informatika dan Sains*, *9*(1): 21-27.

[32] Tuada, R. N. (2021, March). Development of the Android-Based Interactive Physics Mobile Learning Media (IPMLM) with Scaffolding Approach on the Sound Wave to Improve Student Learning Independence. In *7th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS 2020)* (pp. 573-582). Atlantis Press.

[33] Dewi, D. K., Astra, I. M., & Susanti, D. (2018, October). Buku suplemen berbasis android sebagai media pembelajaran pada materi gelombang elektromagnetik untuk peserta didik SMA. In *Prosiding Seminar Nasional Fisika (E-Journal)* (Vol. 7, pp. SNF2018-PE).

[34] Liliarti, N., & Kuswanto, H. (2018). Improving the Competence of Diagrammatic and Argumentative Representation in Physics through Android-Based Mobile Learning Application. *International Journal of Instruction*, *11*(3): 107-122.

[35] Deni, I., Bhakti, D. D., & Helmi, M. N. (2020). Newton's Law Learning Media Based on Android. *RISTEC: Research in Information Systems and Technology*, *1*(1): 51-61.

[36] Syaputrizal, N., & Jannah, R. (2019). Media pembelajaran fisika berbasis m obile learning pada platform android menggunakan aplikasi app inventor untuk meningkatkan kemandirian belajar peserta didik. *Natural Secience*, *5*(1): 800-809.

[37] Noviatika, R., Gunawan, G., & Rokhmat, J. (2019). Pengaruh Model pembelajaran berbasis masalah berbantuan mobile pocket book fisika terhadap kemampuan pemecahan masalah peserta didik. *Jurnal Pendidikan Fisika Dan Teknologi*, *5*(2): 240-246.

[38] Ngurahrai, A. H., Fatmaryanti, S. D., & Nurhidayati, N. (2019). Pengembangan Media Pembelajaran Fisika Berbasis Mobile Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik. *Radiasi: Jurnal Berkala Pendidikan Fisika*, *12*(2): 76-83.

[39] Hayati, S., Budi, A. S., & Handoko, E. (2015, October). Pengembangan media pembelajaran flipbook fisika untuk meningkatkan hasil belajar peserta didik. In *Prosiding Seminar Nasional Fisika (E-Journal)* (Vol. 4, pp. SNF2015-II).

[40] Permana, R. R., Supriyadi, A., Permana, H., Ishak, G. A., Widyanirmala, W., Azizah, N., & Nugraha, A. (2014, October). Pengembangan Aplikasi Android untuk Pembelajaran Mobile Learning pada Pokok Bahasan Alat-alat Optik. In *PROSIDING SEMINAR NASIONAL FISIKA (E-JOURNAL)* (Vol. 3, pp. 108-114).

[41] Nurfadilah, N., Ishafit, I., Herawati, R., & Nurulia, E. (2019). Pengembangan Panduan Eksperimen Fisika Menggunakan Smarthphone dengan Aplikasi Phyphox Pada Materi Tumbukan. *Jurnal Penelitian Pembelajaran Fisika*, *10*(2): 101-107.

[42] Cahya, R. N., Suprapto, E., & Lusiana, R. (2020, February). Development of Mobile Learning Media Based Android to Suport Students Understanding. In *Journal of Physics: Conference Series* (Vol. 1464, No. 1, p. 012010). IOP Publishing.

[43] Aji, S. D., Aprianto, R. D., Abdullah, A. G., & Hudha, M. N. (2019, December). Physics Education (PhyEdu): Mechanical wave media for physics learning. In *Journal of Physics: Conference Series* (Vol. 1402, No. 6, p. 066068). IOP Publishing.

[44] Rohim, A. M., & Yulianti, D. (2020). Pembelajaran Fisika Berbantuan Aplikasi Instagram untuk Meningkatkan Motivasi dan Hasil Belajar Siswa. *UPEJ Unnes Physics Education Journal*, *9*(2): 149-157.

[45] Ashri, E. S., Syaharuddin, S., & Mardatillah, B. L. R. (2022). Metode Linear Regression, ARIMA, dan Neural Network Dalam Prediksi Harga Saham: Sebuah Meta-Analisis. *Indonesian Journal of Engineering (IJE)*, *2*(2): 112-120.
[46] Mandailina, V., Syaharuddin, S., Pramita, D., Ibrahim, I., & Haifaturrahmah, H. (2021). Pembelajaran daring dalam meningkatkan motivasi dan hasil belajar peserta didik selama pandemi COVID-19: Sebuah meta-analisis. *Indonesian Journal of Educational Science (IJES)*, *3*(2): 120-129.
[47] Putri, Y. A., Usman, E. A., & Cahyati, M. T. (2019). Meta-Analisis Pengaruh penggunaan Model Inquiry Based Learning terhadap Kompetensi Keterampilan Peserta Didik dalam Pembelajaran Fisika. *Jurnal Penelitian Pembelajaran Fisika*, *5*(1).
[48] Wahyuni, S., Syaharuddin, S., Ibrahim, M., & Negara, H. R. P. (2022, July). Sebuah Meta-Analisis: Metode Support Vector Machine dan Modifikasinya. In *SEMINAR NASIONAL LPPM UMMAT* (Vol. 1, pp. 17-26).