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META ANALYSIS OF THE EFFECT OF THE USE *PhET SIMULATION* ON LEARNING OUTCOMES OF PHYSICS STUDENTS

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ABSTRACT

PhET simulation is an interactive learning simulation that has been widely studied by previous researchers. This study aims to determine the effect size using the meta-analysis method from previous studies.This type of research is a meta-analysis research. Meta-analysis is research that summarizes research data that has been previously researched and the data are quantitative. The articles analyzed were 26 articles. Data analysis technique is done by calculating effect size using Cohen's equation. The results of the study: the effect size value of the effect of using PhET simulation on learning outcomes of 0.723 is classified as moderate and it is proven that the use of PhET simulation is effectively applied to improve physics learning outcomes of SMA/MA students. The highest category effect size values obtained are: First, it occurs at the level of class X [ES 0.898] with the level of confidence in the data in class XI. Second, on the Fluid material [ES 1.174] with a high level of confidence the data on the Elasticity material. Third, the Demonstration method [ES 1.08] with a high level of confidence in the data on the Simulation method. Fourth, the Conceptual Change model [ES 1.040] with a high level of confidence in the data on the Discovery Learning model. Fifth, on the Skill aspect [ES 0.795] with a high level of confidence in the data on the Knowledge aspect.

Keywords :*Meta Analysis; PhET Simulation; Learning Outcomes*

I. INTRODUCTION

The 21st century is characterized by the ease of availability of information, the information can be obtained anywhere and anytime. The ease of obtaining this information marks the development of increasingly advanced science and technology. The progress of a science and technology will certainly cause a problem in survival. This problem will require the 21st century generation to face various competitions, so to face this competition it is necessary to have a sense of self-awareness in dealing with it by mastering an ability or *skill*. Mastering this ability or *skill* is a skill that must be prepared in survival. These skills in the form of learning innovation skills, technology and media information skills, as well as life and career skills [1] can be prepared through 21st century learning provision in accordance with the objectives of the 2013 Curriculum.

The 2013 curriculum aims to prepare the Indonesian people to become individuals and citizens who are faithful, creative, innovative, and affective and able to contribute to the life of society, nation, state and world civilization [2]. This shows that the 2013 curriculum requires students to think more critically in solving a problem logically. This is one way to train students to grow courage in themselves and to shape students' character both spiritually and socially in facing the scope of learning the 2013 curriculum.

The 2013 Curriculum learning prioritizes students' personal experiences in increasing their learning creativity using a scientific approach. The scientific approach is one approach that is carried out through problem solving, in solving student problems it will be seen that students' efforts will be seen in obtaining knowledge and creative thinking skills and critical thinking needed in solving problems [3]. Through a scientific approach, the learning

that is passed will develop the scientific process. Science learning is what gives students experience to experience the scientific process through critical thinking skills [4].

The use of a scientific approach can be integrated with learning methods or models as well as components of learning tools such as learning media. This approach that is integrated with methods or models and learning media can build student motivation so that learning materials can be understood by students. In addition, the scientific approach is directed at understanding concepts and not memorizing the concepts of learning materials [5]. So this approach is appropriate in learning physics.

Learning physics is learning that is directly related to all activities of daily life. This means that indirectly students experience their own experiences regarding learning physics, and students have interacted and talked with the world of physics as a discourse in everyday life [6]. Physics is a science that discusses natural phenomena and the mechanisms that occur in them. In other words, physics is very closely related to everyday

life [7]. Physics is not only studying theories or formulas, but understanding concepts in depth. So that physics makes students aware of obtaining concepts and networks of physics concepts through exploration, experimentation, elaboration, and confirmation in learning [8].

In learning that is often found in schools, teachers carry out teaching and learning activities with the lecture method and the assignment does not vary [9]. And besides that, the teacher focuses more on physics formulas, so that students do not understand the concept of physics [10]. Physics learning can be supported by learning media to create a fun learning atmosphere, namely by using *PhET Simulation*. *PhET Simulation* is an interactive simulation that explains physical phenomena in the form of an application that can be installed on a computer and can be installed offline [11]. One of the goals of using *PhET Simulation* in learning is to improve scientific knowledge and attitudes and develop thinking skills and science process skills in physics learning.

By using the *PhET Simulation,* it can make the teaching and learning process more effective and efficient and achieve learning objectives [12]. In addition to students being able to understand physical phenomena within the scope of physics learning, students can develop conceptual physics [13]. And students do not only learn about formulas, numbers, and theories but also learn about collecting data, obtaining data, presenting data or studying graphs so that students can understand concepts and integrate existing knowledge [14]. This shows that the use of *PhET Simulation* in the physics learning process can help students improve learning outcomes. Through learning that makes students learn to be active, creative, effective and fun [15].

Learning outcomes are a series of learning processes that have been passed and must be achieved by students [16]. Learning outcomes according to the 2013 curriculum cover three domains, namely the domains of attitudes, knowledge and skills. This learning outcome will be assessed based on the student's learning process which states that the student understands the concept or not. Based on the problems that occur in learning activities that are not yet optimal which affect student learning outcomes, the researchers intend to conduct research by utilizing the results of other researchers' research on the use of PhET in improving learning outcomes. And the researcher will summarize the research of other researchers that have existed before in the form of a meta-analysis.

This meta-analysis is the solution that the researcher chose to find out the consistency of the results of previous studies, see if they have a broad scope, can study the effect sizes given and see the research conclusions [17]. So the researchers raised the title Meta Analysis of the Effects of Using PhET Simulation on Physics Learning Outcomes of Senior High School Students to find out how big *effect size* is in physics learning outcomes.

II. METHOD

The type of research used is a meta-analysis research that summarizes various studies using a quantitative approach. Meta-analysis is one form of research, using data from other existing studies (secondary data) [18]. Meta-analysis is also a quantitative research method by analyzing quantitative data from the results of previous studies to accept or reject the hypotheses proposed in these studies. The steps in this study, namely: (1) Identify sample articles. The identification of the articles used as research samples aims to group articles based on predetermined variables. (2) Grouping articles based on the existing moderator and control variables. Articles are grouped based on grade level, learning material, learning method/model, and types of learning outcomes (3) Identifying the mean and standard deviation of both the experimental and control groups, as well as statistical test scores. (4) Calculating *effect size* of each article using Cohen's. Categorization of effect size values can be seen in the Table 1.

Table 1. Interpretation of Effect Size Values (*Effect Size*)

*Effesct Size (*ES)	Kategori
ES≤ 0,15	Negligible
0,15 < ES ≤ 0,40	Low
0,40 < ES ≤ 0,75	Medium
0,75 < ES ≤ 1,10	High
ES > 1,10	Very High

III. RESULTS AND DISCUSSION

A. RESULTS

Based on data from 26 fixed articles. Statistical data for each article were processed to obtain an effect size. The results of the effect size of each article used to obtain a summary of the effect size of the effect of using PhET simulation on learning outcomes based on moderating variables can be seen below.

***Effect Size T*he Effec of Using PhET Simulation on Physics Learning Outcomes of Senior High School Students**

The results of the effect size the effect of using phet simulation on physics learning outcomes of Senior High School students can be seen in table 2.

Table 2. Effect of *PhET Simulation* on SMA/MA Students

N	M*	SE_{M*}	Category	Z*	*p-value*	95% Confidence Interval	
						Lower	Upper
26	0.723	0.082	Medium	8.846	0.000	0.563	0.883

Based on the interpretation of the *summary effect* of using PhET has a significant effect on physics learning outcomes for SMA/MA students. The results of the summary effect size of 0.082 can certainly show that physics learning with the application of PhET simulation has a sufficient influence to improve physics learning outcomes for SMA/MA students.

***Effect Size* The Effect of Using PhET Simulation on Physics Learning Outcomes of Senior High School Students Based on Grade Level**

The results of the effect size the effect of using PhET simulation on physics learning outcomes of SMA/MA students based on grade level can be seen in table 3.

Table 3. The Effect of Using PhET Simulation on SMA/MA Students' Physics Learning Outcomes Based on Grade Level

Level class	N	M*	SE_{M*}	Category	Z*	*p-value*	95% Confidence Interval	
							Lower	Upper
X	7	0.898	0.210	High	4.267	0.000	0.485	1.310
XI	15	0.499	0.128	Medium	3.884	0.000	0.247	0.751
XII	4	0.826	0.153	High	5.386	0.000	0.525	1.127

Based on the interpretation of the summary effect, Based on the results of research conducted, the use of PhET simulation which is applied to the class level has its own influence. the results in class X obtained ES 0.898, class XI with ES 0.499 and class XII with ES 0.826. The effect of using PhET on physics learning outcomes has a significant effect on Class X with a high level of confidence in class XI data.

The results in research related to summary effects in articles related to class level grouping can be classified into effect size categories, each grouping data can be seen in table 4.

Table 4. Grouping Effect Size Categories Based on Class Levels

No	Category	Class Level Grouping	Nilai *Effect Size*
1	Negligible	-	-
2	Low	-	-
3	Medium	Kelas XI	0.499
4	High	Kelas XII Kelas X	0.826 0.898
5	Very High	-	-

Based on the interpretation of the effect size category, the effect of using PhET is classified as moderate, namely class XI [ES 0.499] and the effect size category is classified as high, namely class XII [ES 0.826] and class X [ES 0.898]. On the interpretation of the effect size category at the class level, it can be seen that the X, XI and XII grades have their own categories and have an influence in improving physics learning outcomes.

The results of research on the effect of using PhET simulation on physics learning outcomes for high school students based on grade level can be observed in the graph, which can be seen in Figure 1.

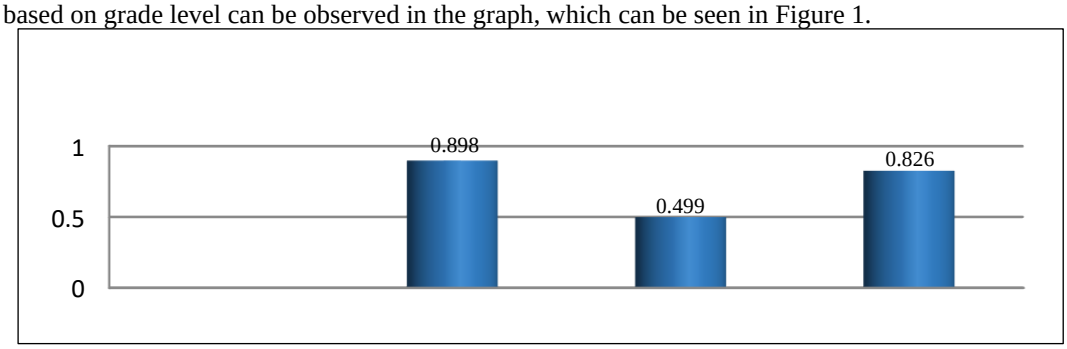

Fig. 1. Graph of the Influence of the Use of PhET Simulation on Senior High School Students' Physics Learning Outcomes Based on Class Levels

Based on the results of the graph interpretation, it can be seen that the one with the highest data interpretation is indicated by the class level in class X [ES 0.989]. The effect of using PhET on physics learning outcomes has a significant effect on Class X.

Effect Size The Influence of the Use of PhET Simulaton on Senior High School Students' Physics Learning Outcomes Based on Subject Materials

The results of the effect size of the effect of using PhET simulation on high school/MA students' physics learning outcomes based on the subject matter can be seen in table 5.

Table 5. The Influence of the Use of PhET Simulation on Senior High School Students' Physics Learning Outcomes Based on Subject Materials

							95% Confidence Interval	
Subject Materials	**N**	**M***	**SE_{M^*}**	**Category**	**Z***	***p-value***	**Lower**	**Upper**
Elasticity	8	0.602	0.118	Medium	5.111	0.000	0.371	0.833
Law of Gravity	2	0.645	0.202	Medium	3.182	0.001	0.248	1.041
Impulse and Momentum	2	1.154	0.535	Very High	2.156	0.031	0.105	2.049
Static electricity	2	0.504	0.202	Medium	2.500	0.012	0.109	1.395
GLB and GLBB	3	0.574	0.174	Medium	3.303	0.001	0.233	1.341
Static Fluid	2	1.174	0.183	Very High	6.428	0.000	0.816	1.358
Dynamic electricity	3	0.799	0.233	High	3.434	0.001	0.343	1.456
Dynamic Fluids	2	0.384	0.209	Low	1.835	0.067	-0.026	1.410
Optical Instruments	2	0.404	0.240	Medium	1.682	0.093	-0.067	1.471

Based on the interpretation of the summary effect, that the value of the Summary effect size on the subject matter obtained is different. RESULTS summary effect size material Elasticity [ES 0.602], Law of Gravity [ES 0.645], Impulse and Momentum [ES 1.154], Static electricity [ES 0.504], GLB and GLBB [ES 0.574], Static Fluids [ES 1.174], Dynamic electricity [ES 0.799], Dynamic Fluids [ES 0.384], and Optical Instruments [ES 0.404]. The effect of using PhET on physics learning outcomes has a very significant effect on the Static Fluid material with a high level of confidence in the Elasticity material data.

Research results related to summaries in articles related to grouping subject matter can be classified into effect size categories, each data grouping can be seen in table 6.

Table 6. Grouping *Effect Size* Categories Based on Subject Matter

No	**Category**	**Classification of Study Materials**	***Effect Size* Value**
1	Negligible	-	-
2	Low	Dynamic Fluids	0.384
3	Medium	Elasticity	0.602
		Law of Gravity	0.645
		Static electricity	0.504
		GLB and GLBB	0.574
		Optical Instruments	0.404

4	High	Dynamic electricity	0.799
5	Very High	Impulse and Momentum	1.154
		Static Fluid	1.174

Based on the interpretation of the effect size category, the influence of using PhET is low, namely Fluid Dynamic material [ES 0.384], the category is classified as medium, namely the material of Elasticity [ES 0.602], Law of Gravity [ES 0.645], Static Electricity [ES 0.504], GLB and GLBB [ES0.574], and Optical Instruments [ES 0.404]. The effect size category is high, namely Dynamic Electricity [ES 0.799] and the effect size category is very high, namely Impulse and Momentum [ES 1.154], and Static Fluid [ES 1.174].

The results of research on the effect of using PhET simulation on physics learning outcomes for high school students based on subject metter can be observed in the graph, which can be seen in Figure 2.

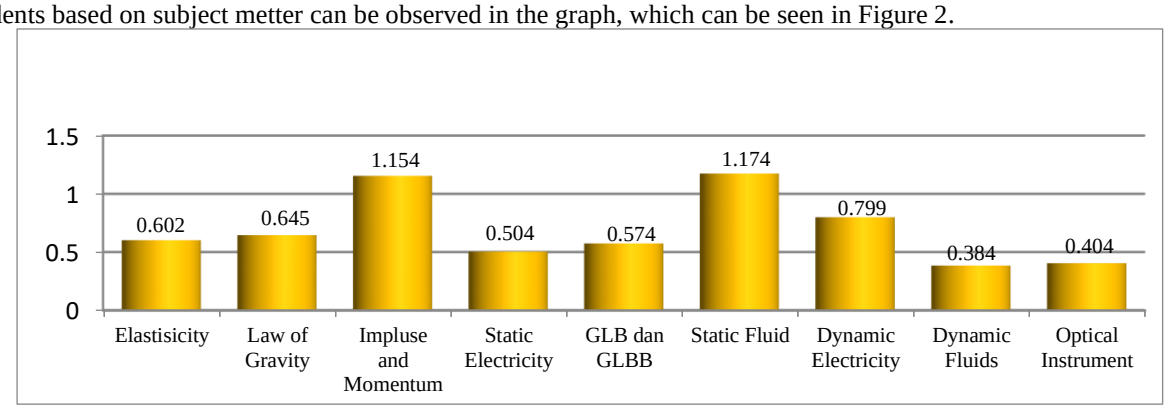

Fig. 2 . Graph of the Influence of the Use of PhET Simulation on Senior High School Students' Physics Learning Outcomes Based on Subject Materials

Based on the results of the graph interpretation, it can be seen that the one with the highest data interpretation is indicated by the subject matter, namely the static fluid material with an effect size of 1.175. The effect of using PhET on physics learning outcomes has a significant effect on static fluids and has no effect on dynamic fluid materials

***Effect Size*The Influence of the Use of PhET Simulaton on Senior High School Students' Physics Learning Outcomes Based on Learning Methods**

The results of the measure of the effect of using PhET simulation on high school/MA students' physics learning outcomes based on learning methods can be seen in table 7.

Table 7. The Effect of Using PhET Simulation on Physics Learning Outcomes of SMA/MA Students Based on Learning Methods

							95% Confidence Interval	
Learning methods	**N**	**M***	**SE_{M*}**	**Category**	**Z***	***p-value***	**Lower**	**Upper**
Simulation	4	0.897	0.343	High	2.614	0.009	0.225	1.569
Demonstration	2	1.085	0.177	High	6.125	0.000	0.738	1.432

Based on the interpretation of the summary effect, the effect of using PhET on physics learning outcomes has a significant effect on the Demonstration method [ES 1.085] with a high level of confidence in the Simulation method [ES 0.897] data. This shows that the demonstration method has a significant effect on improving physics learning outcomes.

The results in research related to summary effects in articles related to grouping learning methods can be classified into categories of effect size, each grouping data can be seen in table 8.

Table 8. Grouping *Effect Size* Categories Based on Learning Methods

No	Category	Classification of Learning Methods	Effect Size Value
1	Negligible	-	-
2	Low	-	-
3	Medium	-	-
4	High	Simulation	0.897
		Demonstration	1.085
5	Very High	-	-

Based on the interpretation of the effect size category, the effect of using PhET on the Simulation [ES 0.897] and Demonstration method [ES 1.085] is both high. This shows that aspects of skills have effect in improving physics learning outcomes.

The results of the research on the effect of using PhET simulation on high school/MA students' physics learning outcomes based on learning methods can be observed in the graph which can be seen in Figure 3.

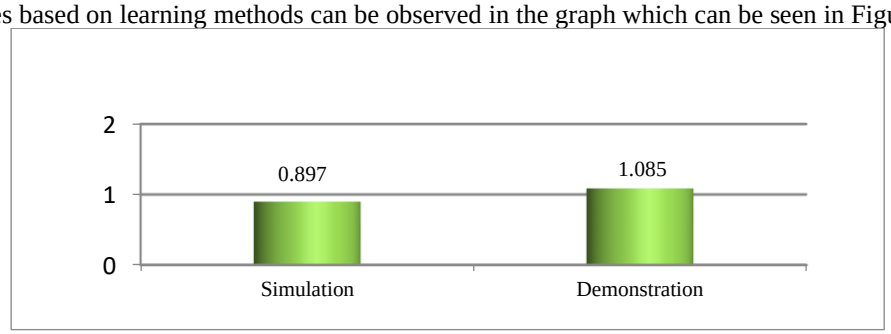

Fig. 3. Graph of the Influence of the Use of PhET Simulation on Senior High School Students' Physics Learning Outcomes Based on Learning Methods

Based on the results of the graph interpretation, it can be seen that the one with the highest data interpretation is shown by the demonstration method with an effect size of 1,085. The effect of using PhET on physics learning outcomes has a significant effect on the demonstration method.

***Effect Size*The Influence of the Use of PhET Simulation on Physics Learning Outcomes of Senior High School Students Based on the Learning Model**

The results of the measurement of the effect of the use of PhET simulation on high school/MA students' physics learning outcomes based on the learning model which can be seen in table 9.

Table 9. The Effect of Using PhET Simulation on Physics Learning Outcomes of Senior High School Students Based on the Learning Model

							95% Confidence Interval	
Learning Model	**N**	**M***	**SE_{M^*}**	**Category**	**Z***	***p-value***	**Lower**	**Upper**
Discovery Learning	6	0.591	0.111	Medium	5.305	0.000	0.372	0.809
Inquiry	3	0.642	0.164	Medium	3.922	0.000	0.321	0.963
PBL or Problem Based	3	0.967	0.198	High	4.880	0.000	0.579	1.356
TGT	2	0.400	0.222	Medium	1.804	0.071	-0.035	0.834
Advance Organizer	2	0.894	0.201	High	4.411	0.000	0.500	1.289
Conceptual Change	2	1.040	0.501	Very High	2.075	0.038	0.058	2.023
Scientific Inquiry	2	0.134	0.128	Low	1.053	0.292	-0.116	0.384

Based on the interpretation of the summary effect, The results of the study related to the summary of the effect size of each learning model, it can be seen that the effect size on the model Discovery Learning [ES 0.591], model Inquiry [ES 0.642], PBL or Problem Based [ES 0.967], TGT [ES 0.400], Advance Organizer [ES 0.894], Conceptual Change model [ES 1.040]. dan model Scientific Inquiry [ES 0.134]. The effect of using PhET on physics learning outcomes has a significant effect on the Conceptual Change Model with a high level of confidence in the data *Discovery Learning.* This shows that in this conceptual change model it has an influence in improving physics learning outcomes.

The results of research related to the summary of articles related to the grouping of learning models that can be classified into the effect size category, each data grouping can be seen in table 10.

Table 10. Grouping *Effect Size* Categories Based on the Learning Model

No	**Category**	**Learning Model Grouping**	***Effect Size* Value**
1	Negligible	-	-
2	Low	*Scientific Inquiry*	0.134
3	Medium	Discovery Learning	0.591
		Inquiry	0.642
		TGT	0.400
4	High	PBL or Problem Based	0.967
		Advance Organizer	0.894
5	Very High	Conceptual Change	1.040

Based on the interpretation of the effect size category, the effect of using PhET is low, namely the model *Scientific Inquiry* [ES 0.134]. In the medium category, namely the model *Discovery Learning* [ES 0.591], Inquiry [ES 0.642] and TGT [ES 0.400], while for the high category, namely PBL or Problem Based [ES 0.967]

and*Advance Organizer* [ES 0.894]. And the category that is classified as very high is the Conceptual Change model [ES 1.040].

The results of the research on the effect of using PhET simulation on high school students' physics learning outcomes based on the learning model can be observed in the graph which can be seen in Figure 4.

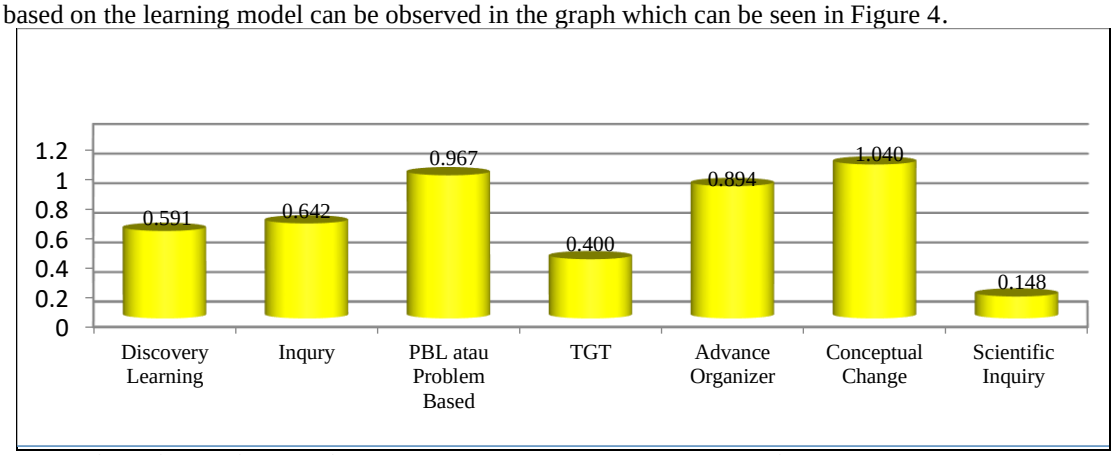

Fig. 4. Graph of the Influence of the Use of PhET Simulation on Physics Learning Outcomes of Senior High School Students Based on the Learning Model

Based on the results of the graph interpretation, it can be seen that the one with the highest data interpretation is shown by the Conceptual Change learning model, with an effect size of 1,040. The effect of using PhET on physics learning outcomes has a significant effect on the conceptual change learning model. and has no effect on the scientific inquiry learning model.

*Effect Size*The Effect of Using PhET Simulaton on Senior High School Students' Physics Learning Outcomes Based on Types of Learning Outcomes

The results of the measure of the effect of using PhET simulation on high school/MA students' physics learning outcomes based on the type of learning outcomes can be seen in table 11.

Table 11. The Effect of Using PhET Simulation on Physics Learning Outcomes of senior high school Students Based on Types of Learning Outcomes

Types of Learning Outcomes	N	M*	SE_{M^*}	Category	Z*	*p-value*	95% Confidence Interval	
							Lower	Upper
Pengetahuan	19	0.789	0.095	Tinggi	8.293	0.000	0.603	0.976
Keterampilan	7	0.795	0.084	Tinggi	9.172	0.000	0.625	0.965

Based on the interpretation of the summary effect, it was found that the effect size on the knowledge aspect was 0.789 and the skill aspect had an effect size of 0.795. The effect of using PhET has a significant effect on the type of learning outcomes in the aspect of physics learning skills for senior high school students.

Research results related to summaries in articles related to grouping types of learning outcomes can be classified into effect size categories, each data grouping can be seen in table 12.

Table 12. Grouping *Effect Size* Categories Based on Types of Learning Outcomes

No	Category	Classification of Learning Methods	*Effect Size* Value
1	Negligible	-	-
2	Low	-	-
3	Medium	-	-
4	High	Knowledge Skills	0.789 0.795
5	Very High	-	-

Based on the interpretation of the effect size category, the effect of using PhET on the type of learning outcomes in terms of Knowledge [ES 0.789] and Skills aspects [ES 0.795] is both high. This shows that aspects of skills have effect in improving physics learning outcomes because it is in the high category. This shows that skills can improve physics learning outcomes based on the effect size categories

The results of the research on the effect of using PhET simulation on senior high school students' physics learning outcomes based on the type of learning outcomes can be observed in the graph which can be seen in Figure 5.

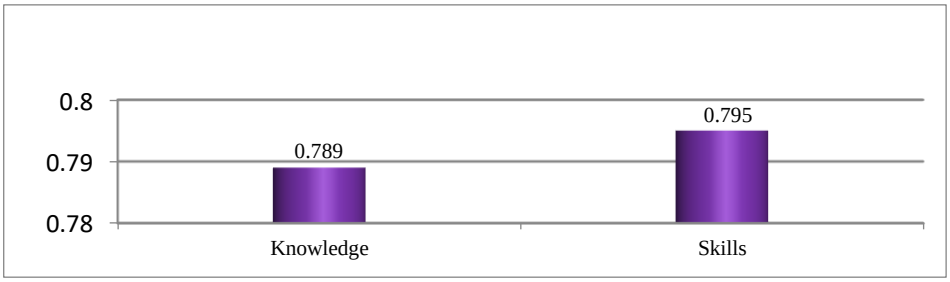

Fig. 5.Graph of the Influence of the Use of PhET Simulation on Physics Learning Outcomes of SMA/MA Students Based on Types of Learning Outcomes

Based on the results of the graph interpretation, it can be seen that the one with the highest data interpretation is indicated by the type of learning outcomes in the skills aspect with an effect size of 0.795. The effect of using PhET on physics learning outcomes has a significant effect on aspects of skills in improving physics learning outcomes.

B. DISCUSSION

This research was conducted to see the effect size value of the effect of using PhET simulation on the physics learning outcomes of senior high school students based on several variables. After 26 articles were analyzed and focused, the control variables and moderator variables were obtained, namely the effect of using PhET simulation on learning outcomes, grade level, subject matter, learning methods/models and types of learning outcomes.

The first result is based on the effect of using PhET simulation on senior high school students' physics learning outcomes. Based on the results of the summary effect analysis of 0.723. The influence given by the use of PhET simulation is quite significant on the learning outcomes of senior high school students, in this case physics learning outcomes have an influence in the moderate category in the use of PhET simulation in senior high school physics learning. This shows that learning physics using PhET simulation is quite effective to be applied in improving senior high school physics learning outcomes.

The results of the second study have the effect of using PhET simulation on physics learning outcomes for senior high school students based on grade levels consisting of grades X, XI and XII. Based on these results, it can be seen that the use of PhET simulation is effectively applied at the X, XI and XII grades in improving physics learning outcomes. Meanwhile, when compared from the effect size results obtained, class X [ES 0.898] and XII [ES 0.826] are in the high category, while class XI [ES 0.499] is classified as moderate in physics learning. This shows that the use of PhET simulation is very effective for use at the X grade level in improving physics learning outcomes for SMA/MA students. Side by side with the highest level of data confidence in class XI with 15 data.

The results of the third study have the effect of using PhET simulation on senior high school students' physics learning outcomes based on the subject matter. Based on the results of research conducted on Elasticity, Law of Gravity, Momentum and Impulse, Static Electricity, GLB and GLBB, Static Fluids, Dynamic Electricity, Dynamic Fluids, and Optical Instruments, these results have different effect sizes. The results of this study are categorized based on the results of the effect size which is relatively low, namely the Dynamic Fluid material [ES 0.384]. The category of effect size results that are classified as moderate can be seen in the materials of Elasticity [ES 0.602], Law of Gravity [ES 0.645], Static Electricity [ES 0.504], GLB and GLBB [ES 0.574], and Optical Instruments [ES 0.404]. Meanwhile, the category of high effect size results is Dynamic Electricity [ES 0.799]. And the category of effect size results that are classified as very high, namely the material Impulse and Momentum [ES 1.154], and Static Fluids [1.174]. This shows that the Static Fluids material has a very large influence in improving learning outcomes, so that the material is very effectively applied using PhET simulation. Side by side with the highest level of data confidence in the material Elasticity of 8 data. Meanwhile, the Fluid Dynamic material is not suitable for use in the use of PhET to improve learning outcomes. so that the material is very effectively applied using PhET simulation. Side by side with the highest level of data confidence in the material Elasticity of 8 data. Meanwhile, the Fluid Dynamic material is not suitable for use in the use of PhET to improve learning outcomes. so that the material is very effectively applied using PhET simulation. Side by side with the highest level of data confidence in the material Elasticity of 8 data. Meanwhile, the Fluid Dynamic material is not suitable for use in the use of PhET to improve learning outcomes.

The results of the fourth study have the effect of using PhET simulation on senior high school students' physics learning outcomes based on the learning method. Based on the treatment of the type of learning method in the

Simulation method and the Demonstration method. Both methods are included in the category of high effect size results, namely the Simulation method [ES 0.897] and the Demonstration method [ES 1.083]. This shows that the Demonstration method has a significant effect on learning outcomes using PhET in learning. Side by side with the highest level of data confidence in the Simulation method of 4 data.

The results of the fifth study have the effect of using PhET simulation on senior high school students' physics learning outcomes based on the learning model. Based on the treatment of the type of learning model in this study, the results of the effect sizes were different. The use of PhET which is categorized as a low effect size result is the Scientific Inquiry model. The result category of effect size model which is classified as moderate is the Discovery Learning model [ES 0.591], Inquiry model [ES 0.642], TGT model [ES 0.400]. The result category of the effect size model that is classified as high is the PBL or Problem-Based model [ES 0.967] and the Advance Organizer model [ES 0.894]. and the category of effect size model results that are classified as very high, namely the Conceptual Change model [ES 1.040]. This shows that the use of PhET simulation will be very effectively applied in high school/MA physics learning by using the Conceptual Change model to improve learning outcomes. Side by side with the highest level of data confidence in the Discovery Learning model with a total of 6 data. And the use of PhET is not suitable for using the Scientific Inquiry model in learning.

ResultsThe sixth study is the effect of using PhET simulation on senior high school students' physics learning outcomes based on aspects of learning outcomes. Based on the learning aspects that receive treatment from the use of PhET simulation, namely the Knowledge aspect and the Skill aspect. Based on the research on physics learning outcomes with aspects of Knowledge and Skills, they both have interpretations that result in a relatively high effect size, namely in the Knowledge aspect [ES 0.789] and the Skill aspect [ES 0.795]. The use of PhET simulation on physics learning outcomes has a significant influence on aspects of student skills, so that the use of PhET simulation is effectively applied in learning physics for senior high school students. Side by side the highest level of data confidence in the Knowledge aspect with 19 data.

IV. CONCLUSION

Based on the results and discussion of the meta-analysis research, it can be concluded that the effect of using PhET simulation has a significant effect on the Physics Learning Outcomes of senior high school Students with an ES of 0.723. The effect of using PhET Simulation has a significant effect on the level of class X [ES 0.898]. The effect of using PhET Simulation has a very significant effect on the Static Fluid material [ES 1.174]. The effect of using PhET Simulation has a significant effect on the Demonstration method [ES 1.085]. The effect of using PhET Simulation has a significant effect on the Conceptual Change Model [ES 1.040] in physics learning. And the effect of using PhET Simulation has a significant effect on learning outcomes in the Skills aspect [ES 0.795].

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