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Meta-analysis of the Effect of the Discovery Model in Physics Learning on Critical Thinking Ability and Knowledge Competence of High School Students

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ABSTRACT

21st Century Education requires students to have the competence and ability to think critically, especially in learning Physics. So we need an appropriate learning model, one of which is the discovery model. In fact, there are still many teachers who cannot choose the right learning model, so students cannot develop their competence and critical thinking skills. The solution is to analyze the effect of the discovery model on students' critical thinking skills and knowledge competencies in terms of the type of discovery model and physics material. The articles were analyzed from 16 relevant articles originating from international and national articles. Based on the analysis that has been done, four research results were obtained. From the four research results, it is known that the discovery model in terms of the type of discovery model and physics material influences students' critical thinking skills and knowledge competence.

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I. Introduction

The development of science and technology in the 21st century has greatly influenced education. 21st-century education is a matter of knowledge, skills, attitudes, and mastery of science and technology integrated into education [1]. Education in the 21st century is very important in ensuring students have the ability to think [2]. The ability to think is expected to be a provision in solving the problems they face as well as innovating and changing their mindset [3]. One of the thinking skills required in 21st-century education is the ability to think critically.

Critical thinking ability measures the level of achievement in managing students' thinking in learning. Critical thinking ability is an ability possessed by a person in scientifically solving difficult problems [4]. With critical thinking skills, students can examine the thinking process and evaluate implied thoughts from what they hear and read [5]. The ability to think critically is useful so that students can solve problems by digging up information about problems related to the real world [6]. Critical thinking skills involve analysis, synthesis, evaluation, and concepts [7]. Thus, students' critical thinking skills need to be developed, especially in learning Physics.

Physics studies are learning that is related to natural phenomena. By studying Physics, students can understand concepts, solve problems independently, and relate to everyday life [8]. In learning Physics, students can also develop critical thinking skills [9]. The Learning model needs to be applied to achieve learning objectives [10], especially in improving students' critical thinking skills. Therefore, choosing the right learning model in learning Physics is necessary.

The discovery model is one of the learning models that can be used in learning physics. This discovery model is a learning model that improves students' critical thinking skills [11]. By using the discovery model, students can build their knowledge with scientific experiment activities [12]. Model discovery is divided into two types: the discovery learning model and the guided discovery model [13]. First, the guided discovery model is a model that requires the teacher's role as a facilitator and guide during the learning process [14]. The model-guided discovery will actively involve students and provide opportunities for students to do it themselves, following a process, starting from observing, analyzing, proving, and drawing conclusions related to a problem [15]. But on the

guided discovery model, the teacher's role is still very much needed. The role of the teacher here is as a guide and facilitator who can help direct students in solving problems and finding concepts [16]. Second, the discovery learning model is a discovery model without any direction and instructions from the teachers so that students can solve their problems [17]. The discovery learning model refers to a confusing situation so that later students will be encouraged to analyze the problem and find the solution to the problem itself [18]. With the encouragement of curiosity about problems, students can develop thinking skills, improve their cognitive abilities, and form more complex knowledge later.

In fact, several problems were found at school, which were obtained from several articles that were found. First, the teacher does not provide opportunities for students to be active so that students are less involved in the concept discovery process independently [19]. Second, the lack of experimental activities in schools so that students are less than optimal in understanding the Physics material that has been given by the teacher [20]. Third, learning is not varied, which makes it difficult for students to develop their critical thinking skills [21].

From the problems that have been described, a solution can be found to overcome these problems. The solution is to analyze how much influence the discovery model in learning Physics has on students' critical thinking skills and knowledge competencies. To support this research, relevant sources are needed and come from international & national journals.

The difference between this research and other studies is that this research was conducted by analyzing the effect size of the data from the research results of 16 relevant previous articles and summarizing them into one. It is useful to see the effect of the discovery model on students' critical thinking skills and knowledge competencies. The analysis was carried out regarding the type of discovery model and physics learning material.

The problem in this research is how is the effect of the discovery model on critical thinking skills in terms of the type of discovery model? How is the effect of the discovery model on knowledge competence in terms of the type of discovery model? How is the effect of the discovery model on critical thinking skills in terms of physics learning materials? and how is the influence of the discovery model on knowledge competence in terms of physics learning material. This research aims to determine the effect size of the discovery model's influence on critical thinking skills in terms of the type of discovery model, the effect of the discovery model on knowledge competence in terms of the type of discovery model, the influence of the discovery model on critical thinking skills in terms of physics learning materials, and the influence of the discovery model on knowledge competence in terms of physics learning materials.

For the research to be more focused and unidirectional, it is necessary to limit the problem. The limitation of the problem in this research consists of three limitations. First, the articles analyzed in this research are from 2016 to 2021. Second, the moderator variable in this research is only limited to the type of discovery model and physics learning material. Third, the related article contains the components needed to find the effect size, the t value, and the number of students or articles with an average value and standard deviation.

II. Method

Meta-analysis

One type of research that is included in the literature review is meta-analysis. Meta-analysis is research that uses statistical methods to analyze research data [22]. Meta-analysis is included in quantitative research [23]. Meta-analysis itself can be interpreted as a quantitative analysis carried out on large amounts of data into a meaningful conclusion [24]. Mets-analysis can also be defined as summarizing several relevant previous studies, then analyzing to conclude [25]. Thus, meta-analysis can be an analysis on top of an existing analysis to draw a meaningful conclusion.

Meta-analysis has several purposes. First, it is useful to increase the statistical power of research results. Second, to obtain an effect size to see the relationship or difference in terms of several moderating variables. Third, overcome the uncertainty or differences in relevant research results [26]. Therefore, meta-analysis can strengthen and clarify the different results of previous studies.

Meta-analysis consists of several steps. First, determine the research topic. Second, choose the type of publication. Third, collect relevant articles. Fourth, record research data. Fifth, calculate the effect size of each article and analyze the research results. Sixth, summarize the research results and make a report [25]. This step makes the research more focused and structured.

The meta-analysis also has advantages and disadvantages. The advantages of the meta-analysis are that it can combine several previous research results quantitatively, provide a good overview between research results, and minimize differences in relevant research results. The disadvantage of the meta-analysis is that the sample used must be large (> 10) and allows biased samples and unnecessary data [22]. Thus, meta-analysis is only suitable for larger data and can reduce differences in the results of previous relevant studies.

Model Discovery

One of the learning models in 21st-century education is the discovery model. The discovery model is a learning model focused on a concept discovery [11]. The discovery model can be defined as directing students to find their knowledge independently [12]. Model discovery involves students in direct discovery [11]. Thus, the discovery model is student-centered to find knowledge and concepts independently.

The discovery of the model is divided into two types. First, model-guided discovery. The guided discovery

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model is a learning model that is carried out with the teacher's guidance [15]. This model is defined as a model that can guide students in exploring information to build new ideas through a real experience [27]. This guided discovery model can also be interpreted as supporting students to obtain information to build their competencies and abilities and discover concepts and principles of a material with the teacher's guidance [28]. Therefore, this guided discovery model is one of the models that can construct the competencies possessed by students and is guided directly by the teacher.

Both models are discovery learning. Discovery learning this model is a model that learns to explore its knowledge so that students can find and understand it themselves [5]. This model can support students in discovering knowledge that they do not know in depth [29]. Thus, this model can support the encouragement of thinking skills and competencies possessed by students.

The discovery learning model and the guided discovery model have their respective advantages. The advantages of the guided discovery model, which are obtained, are long-lasting and easy to apply to new conditions, improves students' reasoning and thinking skills, and increases creativity and problem-solving skills [15]. The advantages of the discovery learning model are that students gain knowledge individually so that it is easy to increase motivation, increase student confidence, provide opportunities for students to develop according to their interests, and prepare mentally to explore real knowledge. Thus, we must choose the right discovery model according to learning needs.

The two discovery models have significant differences. In the guided discovery model, learning is carried out with the teacher's guidance. This means that students' competence and thinking skills are successful because of guidance from the teacher. While in the discovery learning model, learning is more centered on students seeking their knowledge [30]. Therefore, the discovery learning model will challenge exploring student knowledge more than the guided discovery model.

Physics Learning

Physics is one of the subjects studied in SMA/MA. Physics is a science whose aim is to study the components of matter and their interrelationships. Physics can be said to be the foundation of science because physics includes basic knowledge from all fields of science [31]. Physics can be interpreted as a science that provides a direct experience to understand the natural surroundings and develop their competence abilities [32]. Based on some of these opinions, it can be said that physics is a part of natural science that examines the nature and characteristics of objects and phenomena in nature so that students can explore them directly to stimulate their competencies.

Physics learning is one of the lessons taught to high school/MA students. Physics learning contains four components of knowledge that are explored through scientific activities to shape students' thinking skills [33]. Physics learning can be defined as obtaining information through empirical methods logically and systematically [34]. Learning Physics trains students to apply learning materials in everyday life. So, learning Physics is learning that is carried out scientifically and systematically and contains the linkage of four aspects of knowledge related to natural concepts.

Knowledge Competence

The term competence will be familiar in the field of education. Competence itself can be interpreted as a person's ability to determine something [35]. Competence can also be defined as an ability needed by someone to carry out learning [36]. Competence is an ability that consists of three aspects, namely knowledge, skills, and readiness [37]. So, competence is a measure of a person's ability to do something that includes attitudes, knowledge, and skills.

One of the competency achievements that will be discussed is knowledge competence. Knowledge competence is a level of achievement of student learning outcomes in terms of knowledge [37]. Knowledge competence can be defined as an assessment to measure student achievement in the knowledge aspect of understanding a learning concept [36]. Knowledge competence includes remembering, memorizing, understanding, applying, analyzing, and evaluating [38]. Thus, the measurement of student knowledge competence needs to be carried out to see the limits of student achievement to master and understand the learning material.

Critical Thinking Ability

One of the skills required in 21st-century education is the ability to think critically. Critical thinking can be defined as rational, directed, and orderly thinking to analyze, evaluate, and make decisions in solving problems [32]. Critical thinking is a complex thought that considers many aspects [39]. Critical thinking can also be interpreted as a way for students to solve problems logically, systematically, carefully, effectively, and efficiently [40]. Thus, critical thinking is a complex thought to solve a problem.

Critical thinking skills are highly demanded to solve problems, especially Physics. With critical thinking skills, students can analyze problems systematically [39]. In addition, students can also determine the cause and effect of the problems found [5]. This happens because critical thinking skills involve higher-order thinking skills. Critical thinking ability is not an innate ability, so this ability can be trained and developed through learning at school [41]. Thus, students must face life problems and solve them to improve their critical thinking skills.

Critical thinking ability consists of several indicators. The indicators for critical thinking skills are formulating questions, answering questions with tentative assumptions, seeking solutions, providing further explanations regarding the solutions provided, and concluding [42]. Therefore, students' critical thinking

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skills can be measured by referring to critical thinking indicators.

III. Method

This research is a type of meta-analysis research. The meta-analysis aims to measure how big the effect size of the discovery model is on students' critical thinking skills and knowledge competence in learning physics. The meta-analysis data is quantitative and is carried out statistically by summarizing the results of many previous studies.

In the process, the meta-analysis is carried out in several steps. First, determine the research topic to be raised. The topic in this research is a meta-analysis of the influence of the discovery model in learning physics on students' critical thinking skills and knowledge competence. Second, choose a publication that is accredited with sinta. This is because to support the demands of education in terms of the publication of Sinta accredited journals. Third, collect journals that are relevant to the research topic. Fourth, record and process meta-analysis data and make reports.

The articles in this meta-analysis came from international and national journals. The number of articles analyzed were 16 articles on the influence of the discovery model in learning Physics on students' critical thinking skills and knowledge competencies from 2016 to 2021. The identity of the articles can be seen in Table 1.

The variables in this research are divided into three. First, the independent variable is a discovery model. Second, the dependent variable is in the form of critical thinking skills and student knowledge competencies. Third, the moderator variable is the type of discovery model and physics learning material.

The analytical technique used is a quantitative approach. The research data used was taken based on the data already in the article. The effect size calculations can be determined in the following statistical parameters.

a. Pretest-posttest mean and standard deviation.

$$ES = \frac{\bar{X}_{post} - \bar{X}_{pre}}{SD_{pre}} \quad (1)$$

Information:
ES = *Effect size*
$\bar{X}_{post}$ = Average *posttest*
$\bar{X}_{pre}$ = Average *pretest*
SD = Standard deviation

b. Mean and standard deviation of two groups post-test only.

$$ES = \frac{\bar{X}_E - \bar{X}_C}{SD_C} \quad (2)$$

Information:
ES = *Effect size*
$\bar{X}_E$ = Average of the experimental group
$\bar{X}_C$ = Control group average
SD_C = Standard deviation of control class

c. The mean and standard deviation of the two groups pre-posttest

$$ES = \frac{\left(\bar{X}_{post} - \bar{X}_{pre}\right)_E - \left(\bar{X}_{post} - \bar{X}_{pre}\right)_C}{SD_{preC} + SD_{preE} + SD_{postC}} \quad (3)$$

Information:
ES = *Effect size*
$\bar{X}_{postE}$ =Average posttest experimental group
$\bar{X}_{preE}$ =Average pretest experimental group
$\bar{X}_{postC}$ = Mean posttest control group
$\bar{X}_{preC}$ = Control group pretest average
SD_E =Standard deviation of the experimental group
SD_C = Standard deviation of the control group

d. If the standard deviation is not known, it can be done with the t-test.

$$ES = t\sqrt{\frac{1}{n_E} + \frac{1}{n_C}} \quad (4)$$

Information:
ES = *Effect size*
t = T test result
n_E = Number of experimental groups

After the *effect size* is calculated based on the appropriate formula, then the *effect size* is categorized at the following levels in Table 2:

Table 2. *Effect size* Criteria [54]

No	ES	Category
1	ES ≤ 0.15	Can be ignored
2	0.15 < ES <0.40	Low
3	0.40 < ES <0.75	Moderate
4	0.75 < ES <1.10	High
5	ES > 1.10	Very high

IV. Results and Discussion

The results of this research are grouped into four parts. First, the effect of the discovery model in learning Physics on students' critical thinking skills in terms of the type of discovery model. Second, the influence of the discovery model in learning Physics on the competence of students' knowledge in terms of the type of discovery model. Third, the influence of the discovery model in physics learning on students' critical thinking skills in terms of physics learning material. Fourth, the effect of the discovery model in learning physics on students' knowledge competence in terms of physics learning material. The explanation of each research result is as follows.

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Table 1. Article Title and Identity

Code	Article Title	Identity
CT[43]	The Effect of Experimental Skills toward Senior High School Students' Critical Thinking Abilities through Discovery Learning Model	**Author**: Laili Komariah & Mira Karimah Year: 2018 Journal name: *Advances in Social Science, Education and Humanities Research*
CT[18]	The Influence of the Discovery Learning Learning Model on Critical Thinking Ability Viewed from the Learning Style of Class XI Science Students at SMAN 4 Bantaeng	**Author**: Andi Fitriani Hafrah, A. Muhammad, A. Kaharuddin Year: 2021 Journal name: Makassar State University Journal
CT[44]	The Effectiveness of the Discovery Learning Model with Brainstorming on Students' Critical Thinking Ability	**Author**: Nurhasanah, & Djukri Year: 2019 Journal name: Educational Journal
CT[45]	Students' Critical Thinking Ability Through Discovery Learning Assisted with Physics Teaching Materials Based on Scientific Approach	**Author**: Candra Dewi, Budi Astuti, Sunyoto Eko Nugroho Year: 2018 Journal name: *Unnes Physics Education Journal*
CT[46]	The Effectiveness of Physics Learning Online Based on Guided Discovery Models to Improve Critical Thinking Skill	**Author**: Eko Mhd Ramadan, Jumadi Jumadi, Dwi Ulan Rahmawati Year: 2020 Journal name: *Advances in Social Science, Education and Humanities Research*
CT[47]	Effectiveness of Web-Based Simulation Integrated with Guided Discovery Learning to Enhance Students' Critical Thinking Skills in Physics	**Author**: Riki Perdana, Riwayani, Jumadi, & Dadan Rosana Year: 2019 Journal name: *Advances in Social Science, Education and Humanities Research*
CT[48]	Application of the Guided Discovery Model to Improve Critical Thinking Skills on Heat Material at Khadijah High School Surabaya	**Author**: Adnin Ulfa Yunianti, Setyo Admoko Year: 2016 Journal name: Journal of Physics Education Innovation
CT[49]	Application Of Guided Discovery Learning Model To Enhance Critical Thinking Skills On Secondary Grades Class Of Students SMA N 9 Pekanbaru In Learning Physics	**Author**: Rahman Bimantara, Muhammad Nasir, M. Rahmad Year: 2016 Journal name: Student Online Journal (JOM) in the Field of Teacher Training and Education
KP[16]	Application of Virtual Laboratory Assisted Discovery Learning to Improve Physics Competence of High School Students.	**Author**: Masril, Hidayati, Yenni Darvina Year: 2018 Journal name: Science Education Research Journal
KP[50]	The Effect of Phet Media Assisted Discovery Learning Model on Physics Learning Outcomes of Class XI Students of SMAN 1 Kediri Academic Year 2017/2018	**Author**: Hamidah Lidiana, Gunawan, Muhammad Taufik Year: 2018 Journal name: Journal of Physics and Technology Education
KP[20]	Application of the Discovery Learning Learning Model to Improve Physics Learning Outcomes on Business and Energy Materials for Class X MIA2 Students at SMA Negeri 3 Sampolawa Even Semester Year 2018/2019	**Author**: Candra Dewi, La Tatang, Muhammad Yuris Year: 2020 Journal name: Journal of Physics Education Research
KP[17]	The Effect Of Discovery Learning Model On Students Learning Outcome At SMA Muhammadiyah 09	**Author**: Rahmi Nazliah, et al Year: 2020 Journal name: International Journal of Innovative Science and Research Technology
KP[51]	The Effect of Guided Discovery Learning Models in Improving Student Learning Outcomes on the Main Material of Straight Motion in Class X Semester I SMA Negeri 3 Binjai TP 2017/2018	**Author**: Setrie Frimayri and Abd.Hakim S Year: 2018 Journal name: Journal of Physics Learning Innovation
KP[52]	Guided Discovery Learning Model to Improve Learning Outcomes and Scientific Attitudes of Learners in Physics Subjects Class XI	**Author**: Suciarsy Year: 2018 Journal name: Journal of Physics Education, University of Muhammadiyah Makassar
KP[15]	The Effect of Guided Discovery Learning Model on Physics Learning Outcomes of Class XI Students of MAN 1 Palu	**Author**: Sugeng Wibowo, H. Amiruddin Hatibe and Marungkil Pasaribu Year: 2020 Journal name: Online Creative Journal
KP[53]	The Effect of Collaboration-Based Guided Discovery Learning Model with Flash Media on Science Process Skills and High Cognitive Learning Outcomes of Physics High School Students	**Author**: Erna Pardede, Motlan, Retno Dwi Suyanti Year: 2016 Journal name: Journal of Physics Education

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The Effect of the Discovery Model on Critical Thinking Ability in terms of the Type of Discovery

The first research results are the effect of the discovery model in physics learning on critical thinking skills in terms of the type of discovery model. The discovery model found in the article is divided into two types: a discovery learning model and the guided discovery model. Of the 8 articles found, 4 articles used the discovery learning model, and 4 used the guided discovery model. The average value of effect size in terms of the type of discovery model is presented in Table 3.

Table 3. The effect size of the Discovery Model on Critical Thinking Ability Viewed from the Type of Model Discovery

Model Type Discovery	Journal Code	ES	Average ES	Information
Discovery Learning	CT[43]	1.98	1.12	High
	CT[18]	1.13		
	CT[44]	0.52		
	CT[45]	0.84		
Guided Discovery	CT[46]	1.67	0.98	High
	CT[47]	0.83		
	CT[48]	0.40		
	CT[49]	1.01		

Based on the research data in Table 3, it can be explained that the two types of discovery models have a significant effect on students' critical thinking skills in learning physics. In learning Physics, the use of the discovery learning model has a higher effect with an effect size of 1.12 with a very high category than the guided discovery model with an effect size of 0.98 with a high category. By using the discovery learning model, students can think critically and analyze problems to find answers to these problems [7].

The results of this research are in line with the research of Dewi et al. [45]. They state that students' critical thinking skills increase after applying the discovery learning model. By applying this model in learning Physics, students will have more experience directly and provide opportunities to develop their critical thinking skills [29]. Therefore, it can be said that the use of the discovery learning model in learning Physics has more influence on students' critical thinking skills compared to the use of the guided discovery model.

The Influence of the Discovery Model on Knowledge Competence in terms of the Type of Discovery Model

The result of the second research is the influence of the discovery model in physics learning on knowledge competence in terms of the type of discovery model. The discovery model found in the article is divided into two types, namely the discovery learning model and the guided discovery model. Of the 8 articles found, four articles used the discovery learning model, and 4 articles used the guided discovery model. The average value of effect size in terms of the type of discovery model is presented in Table 4.

Table 4. The effect size of the Discovery Model on Knowledge Competence in terms of the Type of Discovery Model

Model Type Discovery	Journal Code	ES	Average ES	Information
Discovery Learning	KP[16]	0.48	0.99	High
	KP[50]	0.72		
	KP[20]	1.25		
	KP[17]	1.52		
Guided Discovery	KP[51]	0.24	0.91	High
	KP[52]	1.93		
	KP[15]	1.16		
	KP[53]	0.33		

Based on the research data in Table 4, it can be explained that the two types of discovery models have a significant effect on students' knowledge competence in learning physics. Both types of discovery models greatly influence students' knowledge competence from the data obtained. However, if we look again at the use of the discovery learning model, it has a higher effect with an effect size of 0.99 than the guided discovery model with an effect size of 0.91. By using the discovery learning model, students will be more active in learning to analyze and solve their problems [17]. Therefore, The learning that he finds himself will become new knowledge, so that his know-ledge competence will increase and the concepts will stay longer in his brain.

The results of this research are in line with research by Sitanggang and Harahap, which states that the application of the discovery learning model can improve student learning outcomes with an average post-test of 67.57 [55]. By applying the discovery learning model in learning Physics, students can learn to prove and find the relationship between concepts and physics equations through an experiment, discussion and question and answer to remember and understand the concepts being studied [56]. The discovery learning model also requires students to actively construct their knowledge to find a principle and their concept [57]. The direct involvement of students in the process of finding a concept will increase students' knowledge competence [58]. So, it can be concluded that the use of the discovery learning model in learning Physics has more influence on students' knowledge competence than the use of the guided discovery model.

The Effect of Model Discovery on Critical Thinking Ability Judging from the Physics Learning Materials

The third research is the effect of the discovery model in physics learning on students' critical thinking skills in terms of physics learning material. From the articles analyzed, there are several Physics materials. The physics materials include dynamic fluids, static and dynamic fluids, kinetic theory of gases, heat, and spring forces. The effect size of each article based on Physics learning materials can be seen in Table 5.

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Table 5. The effect size of the Discovery Model on Critical Thinking Ability in terms of Physics Learning Materials

Journal Code	Theory	ES	Information
CT[43]&[46]	Dynamic fluids	1.41	Very high
CT[18]	Static & dynamic fluids	1.13	Very high
CT[47]	Kinetic Theory of	0.83	High
CT[48]	Gas	0.40	Medium
CT[49]	Heat	1.01	High
	Spring Force		

Based on the research data in Table 5, it can be described that there are three categories of the effect size of the discover model on students' critical abilities in terms of physics learning materials, namely medium, high, and very high. Physics material that gives a moderate effect is heat material. Physics material that gives a high effect is the kinetic theory of gas and spring forces. At the same time, the Physics material that gives a very high effect is fluid. Dynamic material applied in learning Physics with the discovery model gives the highest effect on students' critical thinking skills, compared to other materials with an effect size of 1.41.

Dynamic fluid material is a material that is closely related to everyday life. The discovery model integrated on dynamic fluid material will make it easier for students to find their concepts because they are related to the real world. Students' critical thinking skills will increase when faced with the real world.

This is in line with the research of Komariyah and Karimah [43], which states that there is an increase in students' critical thinking skills by applying the discovery model to dynamic fluid material. One of the criteria for good material to support students' critical thinking skills is to relate theory to phenomena in everyday life [59]. Physics learning with the discovery model on dynamic fluid material also follows the physical characteristics, namely inductive and centered on experimental activities [18]. In particular, conducting direct experiments on dynamic fluid material will encourage students' experimental skills so that later it will stimulate students to use critical thinking skills [45]. Therefore, it can be concluded that the dynamic fluid material applied in learning physics with the discovery model greatly influences students' critical thinking skills.

The Influence of the Discovery Model on Knowledge Competence in terms of Physics Learning Materials

The fourth research is the effect of the discovery model in learning physics on students' knowledge competence in terms of physics learning material. From the article's analysis, there are several Physics materials. The Physics materials include GLB & GLBB, Elasticity & Hooke's Law, Work & Energy, and Momentum & Impulse. The effect size of each article based on Physics learning materials can be seen in Table 6.

Tabel 6. The effect size of the Discovery Model on Knowledge Competence in terms of Physics Learning Materials

Journal Code	Theory	ES	Information
KP[16]&[51]	GLB & GLBB	0.36	Low
KP[50]	Elasticity & Hooke's Law	0.72	Medium
KP[20]	Work And Energy	1.25	Very High
KP[15]	Momentum & Impulse	1.16	Very High

Based on the research data in Table 6, it can be described that there are three categories of the effect size of the discovery model on students' knowledge competence in terms of physics learning materials, namely low, medium, and very high. Physics material that gives a low effect is GLB & GLBB material. Physics material that gives a moderate effect is elasticity & Hooke's Law. At the same time, the physics material that gives a very high effect is Work & energy, and momentum & impulse. The Work & energy material applied in learning Physics with the discovery model gives the highest effect on students' knowledge competence, compared to other materials with an effect size of 1.25.

The matter of work & energy is one of the materials closely related to everyday life. Learning physics, especially the matter of work and energy, has so many physical science concepts that are so difficult for students to understand theoretically so that an appropriate learning model is needed to realize it. The discovery model, integrated into the work & energy material, will help students develop their thinking skills, solve problems, and improve their knowledge competencies. This happens because the discovery model, which is integrated into the material, work & energy, is directly related to the real world.

These results are in line with the research of Dewi et al., which states that students' learning outcomes in class X on work and energy materials taught using the discovery learning model have increased [45]. By applying the discovery model to the work and energy material, students can build mastery of concepts and knowledge better than applying other learning models because they are freed to explore their knowledge [20]. The discovery model carried out on the work and energy material focuses on students' curiosity to solve everyday life problems [60]. This is in line with the research of Turrahmah et al. [61]. They stated that the discovery model supports students to be directly involved in finding concepts and principles, especially in work and energy, by conducting direct experiments with the real world. Therefore, it can be concluded that the work & energy material applied in learning Physics with the discovery model greatly influences students' knowledge competence.

V. Conclusion

Based on the data analysis that has been done, there are four research results. First, the discovery model that

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has the most influence on students' critical thinking skills in learning physics is the discovery learning model with an average effect size of 1.12. Second, the discovery model that has the most influence on students' knowledge competence in learning Physics is the discovery learning model with an average effect size of 0.99. Third, dynamic fluid material applied in learning physics with the discovery model greatly influences students' critical thinking skills with an effect size of 1.41. Fourth, the work & energy material applied in learning Physics with the discovery model greatly influences students' knowledge competence with an effect size of 1.25. Thus, it can be concluded that the discovery learning model has a significant influence on students' critical thinking skills and knowledge competencies, especially on dynamic fluid material as well as momentum and impulses.

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