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Connected Type Integrated Science Learning Model of Student Learning Outcomes: Meta-Analysis

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Abstract: Research Meta-analysis it aims to see magnitude of influence Integrated Science Learning Model Connected to the learning outcomes of participants educate. The research method used is meta-analysis, with a research sample amount 15 scientific articles that have been published through Google Scholar accredited _ And indexed Sinta, discussing national scale Integrated Science Learning Model Connected to learning outcomes, in 2012 - 2022. The research results obtained: Effect Integrated Science Learning with the Connected Model at the education level obtained an effect size value at the junior high school level that was higher than at the elementary school level and high school, Influence The Integrated Science Learning Model Connected obtained an effect size value eye lesson chemistry higher than physics, biology and Integrated IPA, and Influence Integrated Science Learning the Connected Model on learning outcomes has the highest effect when use type statistics Pretest - posttest one group only.

Keywords: Connected Models; Effect size; Integrated IPA; Meta Analysis; Results Study

Introduction

21st Century education has been going on for two decades with the characteristics of digital-based learning, amidst increasingly complex developments in information technology and science. Students are required to master science and be able to face global competition. This is because the 21st century is a period of change from civilization to an intellectual society or what is commonly called a knowledge society . The implementation of 21st century learning provides criteria for student achievement, namely being able to master 4 skills. According to the National Education

Association these 4 skills include critical thinking skills. creativity skills. communication skills and communication skills skills. which is commonly referred to as The 4Cs (Critical Thinking, Communication, Collaboration, Creativity and Innovation). Based on the expected 21st century learning goals. then educators need to choose the right strategy in learning so that learning outcomes can be achieved optimally.

Integrated learning is a learning concept designed to adapt to the 21st century education era. The concept of an integrated learning approach involves several subjects in one subject to provide a good and meaningful learning experience for students. This integrated learning practice will be practiced according to students' needs and they can see lesson concepts related to each other and provide students with the opportunity to understand complex problems in real life. Robert Fogarty (1991) in his book " How To Integrate The Curricula" states that in integrated learning there are ten learning models Connected, Nested, Fragmented, Webbed, Sequenced, Shared, Networked, Threaded, Integrated and Immersed. However, according to (Trianto. 2016), there are only three learning models that can be used at the secondary and basic education levels, namely the integrated model , connected model and webbed model . Based on these three models, this research focuses on one model, namely the connected model.

Learning Outcomes is a reference measuring point to determine the success or failure of the teaching and

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learning process . Student learning outcomes are divided into three domains, namely the cognitive domain (knowledge), the psychomotor domain (skills), and the affective domain (attitude). (Mafudiansyah et al, 2020) . In this study the learning outcomes that are measured will be described in general terms, not described specifically. Because the secondary data obtained from the articles being analyzed state the learning outcomes alone without mentioning in what domain. Apart from that, choosing a learning method is very necessary to stimulate students to increase their activities and learning outcomes (Kahar & Rahmawati. 2020) . Therefore, it is important to discuss the integration model in science learning and analyze several previous findings to improve learning outcomes.

However, the reality that occurred in the field was different from what was expected. Currently, education at the elementary, middle and high school levels is still often found to be taught separately. Chemistry teachers teach chemistry, biology teachers teach biology, and physics teachers teach physics. This is because teachers' understanding of integrated learning is still limited so student learning outcomes are still low (Annisa et al., 2021) . Teacher skills in teaching tend to focus on knowledge competence only. so that student learning interest decreases and causes low student learning outcomes. Teachers must provide learning innovations that can achieve learning goals both in terms of cognitive and 21st century skills in one lesson, namely by using integrated learning.

Connected type integrated learning model means that learning can be umbrellaed into certain main subjects which form a unit in forming abilities. The connected model is done by connecting the two concepts to one another. One skill with another skill. Besides that, the scope of learning studied in one semester with the next semester is in one subject. The Connected model has been widely used in the teaching and learning process at elementary school, middle school, high school and university levels (Suanah, 2018). Several studies that have been conducted state that integrated learning is able to improve learning outcomes not only in science and physics subjects, but in other subjects the connected model has been proven to improve learning outcomes. In mathematics subjects by Wahyuningsih et al., (2017), Sutiana, (2019) , Harahap, (2020) , and Fitriatien et al., (2021) are able to improve junior high school students' mathematical representation abilities, research by Purwasi (2016) able to improve junior high school students' critical thinking skills, and research by Lestari (2017) is able to improve junior high school mathematics problem solving abilities. In social studies subjects by (Putra et al., 2014) it is able to improve elementary school student learning outcomes. In Music Arts subjects by Maryanto, (2013) it is able to increase the competence of high school students. In fact, the learning strategy course by Chamisijatin et al., (2022) was able to increase student competence through E-Learning.

The research results in the articles that have been collected by researchers, get various varying results. The integrated science learning model connected model is divided into two conditions that influence learning outcomes, namely the medium and very high categories based on the effect size category. Some research on the Connected model influences learning outcomes in the moderate category with an effect size range of 0.45-0.63 (Oktamagia et al., 2013; Fitriani et al., 2012; Nasution & Ratnawulan, 2018; Alfikri et al., 2019; Putra et al., 2013; Muhsina & Pasaribu, 2015). However, in some other studies, the Connected model influences learning outcomes in the very high category with a range of effect size values 1.02 - 3.99 such as research conducted by Haidir et al., (2012) , Ningsih et al., (2017) , Kurniawati et al., (2016) , Yunus et al., (2016) , Sari et al. (2013) , Wulandari et al., (2015) , Taqiya et al., (2019), Nataliastari et al., (2013) , and Partini et al., (2013) .

There is a large amount of research data related to the connected model for improving learning outcomes, so collecting previous research data is really needed to unify the various research results that have been carried out. Search articles and group them from various studies, to draw final conclusions from previous studies. In drawing this conclusion, a systematic method is needed, namely the meta-analysis research method. Therefore, researchers will write a summary of research results regarding the influence of the Connected model of integrated learning on learning outcomes based on educational level and subjects. With this meta-analysis, it is hoped that it will become a reference for readers to use the Connected model of integrated learning in the teaching and learning process.

Method

This type of research is a method of meta analysis with a quantitative approach. The population and sample of this research is a national scale journal in Indonesia regarding the Influence of Integrated Science Learning Type Connected Model on Student Learning Outcomes. The sampling technique is purposive sampling. Purosive sampling is a sampling technique by determining certain criteria (Suhardiman et al., 2022) . The sample criteria are set namely issued within the last 10 years (2012-2022), applied to elementary/middle school/senior high school education levels, the article uses experimental research methods, and the articles collected provide complete information and data that will be used to calculate the effect size.

Meta analysis is a form of research carried out by summarizing several research results from various articles in online journals that have been provided, apart from that the data source used is secondary data, in other words research data is obtained from the results of existing research (Hasanti & Zulyusri, 2022) . The researcher chose the research sample, namely previous research published in the last 10 years (2012-2022), totaling 15 articles accredited and indexed by Sinta, namely previous research in the last 10 years regarding Integrated Learning, Connected Model Type, in order to determine the magnitude of its influence on learning outcomes.

There are many similar studies on the topic of Connected Model Integrated Learning on student learning outcomes, there are several differences in each research result (article on the theme of Connected Model Type Integrated Learning). Therefore, it is recommended to conduct meta-analysis research to obtain more information from research that has been conducted previously and group data based on a number of research results that have been published in various journals. The stages carried out in this research are, providing a code for the article to be analyzed, calculating the effect size of the article that has been coded, and classifying the research data based on education level, subject, and type of statistics used in experimental research. The research article for which the effect size will be calculated can be determined using the formula listed in table 1. The effect size values obtained from the calculations for each article are categorized based on the range of values listed in table 2.

Table 1. Effect size equation

Types of statistics available	Equality	Equation Code
Pretest-posttest one group only	$ES = \frac{\overline{X}_{post} - \overline{X}_{pre}}{SD_{pre}}$	F1
Two groups posttest only	$ES = \frac{\overline{X}_C - \overline{X}_e}{SD_c}$	F2
Two groups pre-post test	$ES = \frac{(\overline{X}_{post} - \overline{X}_{pre})e - (\overline{X}_{post} - \overline{X}_{pre})c}{SD_{pre\,c} + SD_{pre\,e} + SD_{post\,c}}$	F3
t test for two groups	$ES = \sqrt{\frac{3}{\frac{1}{n_e} + \frac{1}{n_c}}} \text{ or } ES = \frac{2t}{\sqrt{2n}}$	F4
t test for one group only	$ES = \frac{t}{\sqrt{n}}$	F5

(Becker & Park. 2011)

Table 2. Effect size value and its category

Effect size (ES) Value Range	Category
ES ≤ 0.15	Does not mean
0.15 ≤ ES ≤ 0.40	Low
0.40 ≤ ES ≤ 0.75	Currently
0.75 ≤ ES ≤ 1.10	Tall
0.10 ≤ ES ≤ 1.45	Very high

Results and Discussion

Table 3 states that there are 5 articles for Elementary School education level, 9 articles for Middle School education level, and 1 article for High School education spread across 15 accredited and standard articles national. Of the fifteen journals that have been studied regarding the Integrated Science Learning Connected Model article, all effect sizes have been calculated from elementary, middle and high school education levels and the analysis of the magnitude of the influence can be seen based on the effect size categories listed. in table 4.

This research was conducted to determine the effect of connected integrated learning on learning outcomes. Of the 40 articles collected, in this study only 15 articles could be continued to calculate the effect size because they met the specified article criteria. For articles that have been coded, the effect size of each article will be calculated using the formula provided. To analyze the magnitude of the influence and whether the relationship between variables in the articles under study is strong or not, based on the effect size values that have been obtained.

Effect size data based on education level

The educational levels analyzed in this research are elementary school, middle school and high school equivalent. Data from the analysis of the effect size are presented in Table 5. The results obtained from analyzing research articles on the influence of integrated science learning in the Connected model on learning outcomes based on educational level, namely at the high school education level with the number of articles obtained were 1 article, the effect size obtained was 0.51 in the medium category. For junior high school education with a total of 9 articles obtained, the effect size obtained was 1.61 in the very high category. And for

elementary school education with a total of 5 articles obtained, the effect size obtained was 1,084 in the very high category.

Junior high school students are superior in using the connected model to improve learning outcomes. This is because at this age level of education, students experience a stable state of being able to follow and achieve maximum learning results and good learning achievements (Arif, 2018) . Apart from that, junior high school is the best time to develop three aspects of learning outcomes, both cognitive, affective and psychomotor (Zamil & Udyaningsih, 2021) . This integrated model helps students connect several concepts in lessons so that learning combined with critical thinking skills will improve student learning outcomes (Annisa et al., 2021) . Although several arguments support and are in line with research results, the connected model can also be applied at the elementary and high school education levels to improve learning outcomes.

Based on Figure 1, it shows that the average effect size at the SD and SMP levels is included in the very high category. However, at the high school education level, the effect size is in the medium category. Even though the effect size varies, we can say that the connected model of integrated learning can be applied at the elementary, middle and high school levels and is most effective at the middle school level.

Figure 1. Effect size based on education level

Table 3. Research on the Influence of Integrated Learning Connected Models on Learning Outcomes

Article Code	Researcher/Year	Journal Name	Classification
A1	(Oktamagia et al., 2013)	Pillar Of Physics Education	Education level = junior high school Statistical type = Two groups posttest only Lesson Material = Light and Optical Devices (Physics)
A2	(Fitriani et al., 2012)	Unnes Science Education Journal	Education level = junior high school Statistical type = Two groups posttest only Study Material = digestive system in humans (Biology)
A3	(Haidir et al., 2012)	Jurnal Sains dan Pendidikan Fisika.	Education level = junior high school Statistical type = Pretest-posttest one group only Study Material = Light (Physics)
A4	(Ningsih et al., 2017)	Pendidikan Sains Pascasarjana Universitas Negeri Surabaya	Education level = junior high school Statistical Type = Pretest-posttest one group only Study Material = acids and bases and separation of mixtures (Chemistry)
A5	(Kurniawati et al., 2016)	Pillar Of Physics Education	Education level = junior high school Statistical type = Two groups posttest only Lesson Material = Integrated Science
A6	(Nasution & Ratnawulan, 2018)	Pillar of Physics Education.	Education level = junior high school Statistical type = Two groups posttest only Lesson Material = blood fluid (Physics)
A7	(Yunus et al., 2016)	Jurnal Sainsmat	Education level = junior high school Statistical type = Pretest-posttest one group only Study Material = Environmental Pollution (Biology)
A8	(Alfikri et al., 2019)	Pillar of Physics Education	Education level = junior high school Statistical type = Two groups posttest only Lesson Material = sense of hearing and sonar system in living things (Biology)
A9	(Sari et al., 2013)	Universitas Pendidikan Ganesha	Educational level = Elementary school Statistical type = Two groups posttest only Subject matter = hydrostatic pressure (Physics)
A10	(Wulandari et al., 2015)	Pendidikan Kimia FKIP UNTAN	Education level = junior high school Type of statistic = Two groups pre-post test

			Lesson Material = addictive substances and the human respiratory system (Chemistry)
A11	(Taqiya et al., 2019)	Mimbar PGSD Undiksha	Educational level = Elementary school Type of statistic = Two groups pre-post test Subject matter = IPA
A12	(Putra et al., 2013)	Universitas Pendidikan Ganesha	Educational level = Elementary school Statistical type = Two groups posttest only Subject matter = IPA
A13	(Nataliastari et al., 2013)	Universitas Pendidikan Ganesha	Educational level = Elementary school Statistical type = Two groups posttest only Subject matter = IPA
A14	(Partini et al., 2013)	Universitas Pendidikan Ganesha	Education level = elementary school Statistical type = Two groups posttest only Study Material = Science
A15	(Muhsina & Pasaribu, 2015)	e-Jurnal Mitra Sains	Education level = high school Statistical type = Two groups pre-post test Subject Matter = Physics and Mathematics (Vector Concept)

Table 4. Effect size calculation results

Article Code	ICE	ES category
A1	0.63	Currently
A2	0.59	Currently
A3	2.07	Very high
A4	3.48	Very high
A5	1.14	Very high
A6	0.45	Currently
A7	3.99	Very high
A8	0.47	Currently
A9	1.24	Very high
A10	1.67	Very high
A11	1.35	Very high
A12	0.54	Currently
A13	1.27	Very high
A14	1.02	Very high
A15	0.51	Currently

Table 5. Average effect size based on education level

Educational level	Number of Articles	Effect size	Category
Elementary School	5	1,084	Very high
Junior High School	9	1.61	Very high
Senior High School	1	0.51	Currently

Effect size data based on subjects

The subjects analyzed in this research are Physics, Biology, Chemistry and Integrated Science. Data from the analysis of the effect size are presented in table 6. The results obtained from analyzing research research articles on the effect of integrated science learning Connected models on learning outcomes based on subjects, namely in physics subjects the effect size obtained was 0.98 with the high category. In biology subjects the effect size obtained was 1.68 with a very high category. In chemistry subjects the effect size obtained was 3.48 in the very high category. And in the Integrated Science subject, the effect size obtained was 1.06 in the very high category.

Integrated Science is one of the integrated subjects that has been developed according to curriculum improvements and the development of increasingly advanced science in Indonesia. This subject presents physics, biology, and chemistry material which is packaged in a single science subject that is applied at the SMP/MTs level. Integrated Science learning covers the ability to be curious, the ability to learn and think, as well as an attitude of responsibility towards the environment, nature and society (Febryana et al., 2015). The results of this study are in line with the concept of the connected model which has an authentic and holistic learning approach. Even so, the integrated model of the connected type can still be used in other subjects to improve learning outcomes.

Table 6 . Average Effect Size Based on Subjects

Subjects	Subjects	Article Code	Effect size	Category
Physics	Light And Optical Devices	A1	0.98	Tall
	Light	A3		
	Blood Fluid	A6		
	Hydrostatic Pressure	A9		
	Vector Concept	A15		
Biology	Digestive System in Humans	A2	1.68	Very high
	Environmental pollution	A7		
	Sonar System and the Sense of Hearing in Living Creatures	A8		
	Addictive Substances and the Human Respiratory System	A10		
Chemistry	Acid Bases and Separation of Mixtures	A4	3.48	Very high
		A5		
		A11		
Integrated IPA		A12	1.064	Very high
		A13		
		A14		

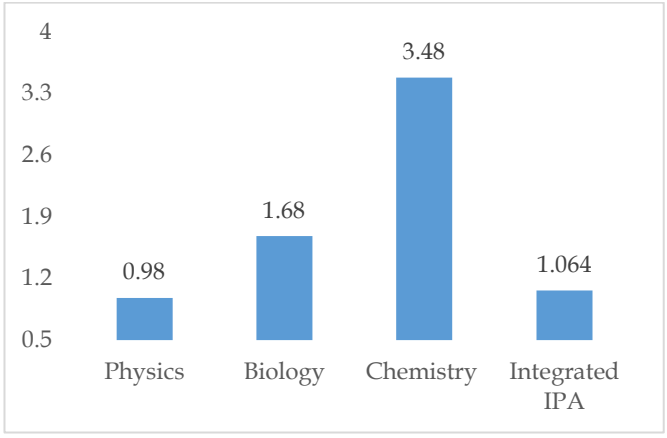

Figure 2. Effect size Based on Subject

Based on Figure 2, it shows that the average effect size for the four subjects is in the very high category. So it can be said that the connected model of integrated learning can be applied in subjects such as physics, biology, chemistry and integrated science. And it is most effectively applied to Chemistry subjects.

Data Effect size Based on Type of Statistics

The types of statistics analyzed in this research are Pretest - posttest one group only, Two groups posttest only , and Two groups pre-post test . The effect size value and the results of the analysis of the magnitude of the influence are shown in table 7.

Based on Figure 3, it shows that the average effect size for the type of statistic Pretest - posttest one group only and Two groups pre - post test is included in the very high category. But in the type of statistics, Two groups posttest only has an effect size in the high category. Although the effects obtained are quite varied, it can be stated that the integrated learning connected model can be applied to these three types of statistics and is most effectively applied to the Pretest - posttest one group only type of statistics , because treatment with this type of statistics is considered much more accurate than the quasi type. another experimental because it compares the conditions before and after being treated (Hastjarjo, 2019) .

Table 7. Average Effect Size Based on Type of Statistics

Types of Statistics	Number of Articles	Effect size	Category
Pretest - posttest one group only	3	3.18	Very high
Two groups posttest only	9	0.816	Tall
Two groups pre-post test	3	1.176	Very high

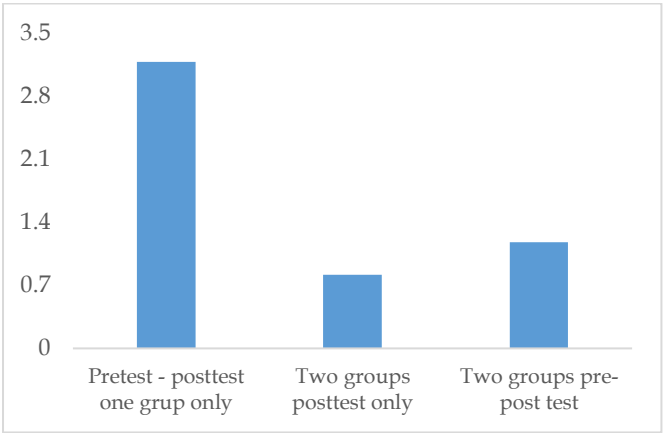

Figure 3. Effect size based on statistical type

The results obtained from analyzing research research articles on the effect of integrated science learning Connected models on learning outcomes based on types of statistics, namely Pretest - posttest one group

only statistics, the effect size obtained was 3.18 in the very high category. In the type of statistic Two groups posttest only, the effect size obtained is 0.816 in the high category. And in the type of statistics, the Two groups pre-post test, the effect size obtained is 1,176 in the very high category.

Conclusion

Data analysis that has been done researcher against 15 journals usage integrated natural science learning model connected give very influence _ tall on level junior high school education rather than elementary and high school. usage integrated natural science learning model connected give very influence _ tall on eye lesson chemistry than eye lesson physics , biology , and Integrated Science . And kind study best in use of the connected model use type statistics Pretest - posttest one group only. Can concluded Integrated Science learning using the connected mode give very influence good to results Study participant educate .

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