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Meta-Analysis Study: The Effectiveness of Problem Solving Learning in Science Learning in Indonesia

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ABSTRACT

21st century learning has had a huge impact on students and teachers. Students must be guided to be able to think critically to overcome various kinds of problems that occur. Furthermore, teachers as education play an important role in honing problem solving skills in their students. The problem solving learning model is a learning model that directs students to solve problems in the learning process. In addition, the problem solving learning model is not fully capable of being applied by science teachers. Although, in the 2013 curriculum in Indonesia a teacher is required to be able to apply the problem solving model in conducting science learning. Not only that, the limited experience of teachers in applying variations of these learning models is still the main obstacle in learning science. So, teachers in Indonesia must have extensive experience in adopting problem solving learning models. This study aims to determine the effectiveness of the problem solving learning model in learning science in Indonesia. This research is a kind of meta-analysis research. The research sample came from analyzing national and international journals published from 2010-2022. The selection of data used as samples was carried out very strictly and thoroughly. Searching for this research sample through Google Scholar, Eric, Hindawi, Sage, Springer, Proquest, IEEE, DOAJ, and Wiley. The sample selection technique is a purposive sampling technique. In this technique, the data that is used as a sample must have a relationship with the research variable. In searching for sample keywords, namely problem solving learning models in learning science (Biology, Chemistry and Physics) in various schools in Indonesia. Data analysis is descriptive statistical analysis with the OpenMEE application. Data analysis was performed by calculating effect size, standard deviation (SD), average value (mean), and N-gain. The results of this study concluded that the application of the problem solving learning model was very effective in learning science in Indonesia. This learning model is able to increase student learning outcomes with an average score of 86 students in the experimental class and 65.5 in the control class, the effect size value is 1.39 in the high category and N-Gain is 0.55.

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INTRODUCTION

In the era of the industrial revolution 4.0, the development of the world of information and communication technology has been felt by all the people of the world (Baharuddin & Anas, 2016;Lazić et al., 2021). In the era of the industrial revolution 4.0, the development of the world of information and communication technology has been felt by all the people of the world (Ichsan et al., 2022). In addition, learning with the help of technology can train students to

be more independent and creative (Razak et al., 2021). Technology-assisted learning is very helpful for teachers and students in learning (Kiliç, 2022; Putra et al., 2021; Syahril et al., 2021). In the learning process students must be able to master the learning material that has been delivered by the teacher (Rodríguez-Peñarroja, 2022; Atsnan et al., 2018; Moallem, 2019). The teacher is an educator who has a big role in developing students' potential (Santosa et al., 2021).

Student potential is the most important thing in the learning process. The teacher has the main task of developing students' potential in learning science (Yılmaz et al., 2022). Potential students who really need to be developed in terms of problem solving. Students' problem solving skills in learning are still in the low category. Problem solving skills are the main thing for students to solve problems in everyday life (Jannah et al., 2017; Lavasani & Khandan, 2011). Furthermore, problem solving skills are needed by students in learning science. However, science learning is still a lesson that is not liked by students, so this reduces the quality of student learning (Rofiqoh et al., 2015).

A teacher must be able to improve the quality of student learning in science learning (Suharyat et al., 2022). Science learning is a learning material that studies natural phenomena in physics, chemistry and biology (Suhaimi et al., 2022). Science learning has a goal to train students in discovering new things from nature (Nurhamidah, 2018). So, a student must be able to master and understand science subject matter well (Suharyat et al., 2022). Based on the results of PISA, the quality of learning in Indonesia is still far behind compared to other member countries. Indonesian students' problem-solving skills in science learning are ranked 60th with a score of 383(Agustini et al., 2013). Therefore, it is necessary to change the learning model used by teachers in the teaching and learning process.

The problem solving learning model is a learning model that is able to improve students' problem solving abilities in learning (Karantzas et al., 2013; Taleyarkhan et al., 2022; Rodic et al., 2021). Furthermore, the problem solving model is able to improve cognitive abilities at a higher level (Anugraheni, 2019; Andika et al., 2020; Tejeda & Dominguez, 2018). In addition, the problem solving learning model is able to develop scientific attitudes and student learning outcomes (Purwanti & Manurung, 2015). Therefore, this learning model is a solution in improving the quality of science learning in Indonesia.

Previous research by Daryanti et al., (2019) explains the problem solving learning model is able to improve learning outcomes and problem solving skills in students. Research by Suhendri (2015) stated that the problem solving learning model was able to increase student independence in learning. Furthermore, the problem solving learning model increases student learning activities (Cakiroglu et al., 2022). Research by (Yanti, 2017) problem solving learning has an influence on students' creative thinking skills in science learning. Furthermore, the problem solving learning model is effective in increasing students' science learning outcomes(Yuliati & Lestari, 2019; Fitriyah et al., 2015). The problem solving learning model is able to improve student achievement in learning science (Mardianis, 2018).

Based on these problems, this study aims to analyze the effectiveness of the problem solving learning model in learning science in Indonesia.

RESEARCH METHODS

This research is a meta-analysis research. Research meta-analysis is a study that analyzes relevant research sources that can be analyzed statistically (Santosa et al., 2021; Follmer, 2018). The research sample came from analyzing national and international journals published from 2010-2022. The selection of data used as samples was carried out very strictly and thoroughly. Searching for this research sample through Google Scholar, Eric, Hindawi, Sage, Springer,

Proquest, IEEE, DOAJ, and Wiley. The sample selection technique is a purposive sampling technique. In this technique, the data that is used as a sample must have a relationship with the research variable. In searching for sample keywords, namely the problem solving learning model in learning science (Biology, Chemistry and Physics) at the school level in Indonesia. Data analysis in this study is descriptive statistical analysis by calculating the effect size (ES), mean (mean) and N-gain with the help of the OpenMEE application. The criterion for the effect size (ES) value can be seen in table 1.

Table 1. Effect size criteria

Effect Size	Kriteria
0 ≤ ES ≤0.2	Low
0.2 ≤ ES≤ 0.8	Medium
ES ≥ 0.8	Hight

Sumber :(Oktarina et al., 2021; Field & Gillett, 2010)

RESULTS AND DISCUSSION

Result

In this study, a meta-analysis of 12 national and international journal data related to the effectiveness of problem solving learning in science learning in Indonesia was carried out. In this analysis 12 national and international journals were calculated and analyzed consisting of author, country, effect size, number of samples (N) and type of journal and level of education which is complete in table 2.

Table 2. Meta-Analysis of Research Samples

No	Author	State	Effect Size	N	Journal Type	Educational stage
1	Muzanni & Muhyadi, (2016)	Indonesia	0.12	12	National	SD
2	Mardianis (2018)	Indonesia	0.78	23	National	SD
3	Fitriyah et al., (2015)	Indonesia	1.33	75	Nationa	SMP
4	Harefa, (2020)	Indonesia	0.29	32	National	SMP
5	Sarah et al., (2018)	Indonesia	1.67	62	National	SMP
6	Supardi et al., (2011)	Indoensia	0.45	30	National	SMA
7	Yanti, (2017)	Indonesia	2.25	76	National	SD
8	Permana, (2018)	Indonesia	3.12	24	National	SD
9	Sadiqin et al., (2017)	Indonesia	0.12	66	National	SMP
10	Pradipta et al.,(2014)	Indonesia	2.13	30	National	SD
11	Cheng et al., (2018)	China	0.78	60	International	SMA
12	Argaw et al., (2017)	Ethiopia	1.36	57	International	Student
13	Sari et al., (2021)	Indonesia	2.78	50	International	Student
14	Hestiana & Rosana, (2020)	Indonesia	1.80	237	International	SMP
15	Fahmi et al.,(2021)	Indonesia	2.01	20	Prosiding International	SMP
			Average value Effect Size (ES) = 1.39		National = 11 International = 4	Amount (n) SD = 5 Amount (n) SMP = 6 Amount (n) SMA = 2 Student (n) = 2

Based on table 2. Describes the meta-analysis of 15 national and international journals related to problem solving learning models in science learning in Indonesia. From these data there are 11 national journals, 4 international journals with an average effect size (ES) of 1.39 in the high category. So, the application of the problem solving learning model has an influence on science learning for students in Indonesia. Therefore, learning problem solving is a solution in learning science at school. Not only that, learning problem solving models are very effectively applied by teachers in schools. This can be seen from the calculation of the N-gain value which can be seen in the table. 3

Table. 3 The N-Gain Value of the Effectiveness of Problem Solving Learning in Science Learning

No	Class	Mean	N-Gain
1	Experiment	86	0.55
2	Control	65.5	

Based on table 3. Explaining the N-gain value of the effectiveness of Problem Solving learning in science learning in Indonesia. Furthermore, learning the problem solving model can improve student learning outcomes in learning science. This can be seen from the average value of student learning in the experimental class of 86 and the control class of 65.5. Furthermore, learning the problem solving model becomes a learning model that is able to improve problem solving in science learning materials for students in Indonesia. The problem solving learning model is effective in improving science learning for students in Indonesia. This can be seen from the N-gain value of 0.55. So, the problem learning model has a positive impact on the science learning process of students in Indonesia.

Discussion

The application of the problem solving learning model has a positive impact on the science learning process in Indonesia. The problem solving learning model is more effective to apply in science learning. This is in accordance with the results of research on the application of problem solving learning models that affect student learning outcomes in learning science. This can be seen from the results of the calculation of the effect size of 1.39 in the high category. Furthermore, the problem solving learning model is effectively applied in science learning to students in Indonesia. Based on the N-gain result of 0.55. This is in line with research by Kirtikar, (2013) problem solving learning models effectively improve students' understanding of concepts.

Furthermore, the problem solving learning model affects students' cognitive and psychomotor abilities in learning. (Fitriyanto & Nurhayati, 2012; Fitria et al., 2017). Learning is a teaching and learning process that is carried out between the teacher and students to achieve the learning objectives that have been set (Santosa & Yulianti, 2020). So the problem solving learning model is one of the learning models that is able to develop problem solving abilities in students (Bahar & Aksüt, 2020). Problem solving ability is very necessary for students in increasing scientific ability in learning science (Sari et al., 2021; Aynas & Aslan, 2021; Magaji, 2021). Science learning is one of the lessons that encourages students to think at a higher level (Santosa & Sepriyani., 2020).

Science learning with problem solving learning models makes students more creative and independent in learning (Shin & Park, 2014). If students learn more creatively and independently, students are younger in mastering learning concepts (Ali et al., 2010; Tsai, 2002; Kim & Xin, 2022). So, with the existence of a problem solving model it will help teachers to more easily achieve learning goals (Kamakchi & Can et al., 2021). For this reason, teachers will find it easier to develop student potential (Yusuf et al., 2020). The potential of students in learning science is mainly related to increasing students' knowledge in science learning applications. Knowledge is all information obtained by students from

sources that have been read (Ferry et al., 2020). In addition, the problem solving model will make it easier for students to access information in learning.

CONCLUISON

In the research it can be concluded that the application of the problem solving learning model is very effectively applied in science learning in Indonesia. This learning model is able to increase student learning outcomes with an average score of 86 for the experimental class and 65.5 for the control class, the effect size is 1.39 in the high category and the N-gain is 0.55. So, learning the problem solving model has a positive impact on teachers in improving the quality of science learning for students in Indonesia.

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