THE EFFECT OF PROBLEM BASED LEARNING MODEL BASED ON REACT APPROACH ON STUDENTS' 21ST CENTURY SKILLS: META-ANALYSIS

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ABSTRACT

This study aims to determine the Problem-Based Learning model based on the REACT approach to students' 21st-century skills. This type of research is meta-analysis research. The data sources in the study came from the analysis of 13 international and national journals that have been published from 2018-2023. The data source search process is Google Scholar, Hindawi, Eric, ScienceDirect, Springer, and ProQuest. The inclusion criteria in this study are 1) Journals or proceedings indexed by Scopus or SINTA; 2) The type of research is experimental or quasi-experimental research; 3) the dependent variable is the students' 21st-century skills and the independent variable is the problem-based learning model based on REACT; 4) The research has data that can be calculated the effect size value and standard error. Data analysis is quantitative analysis with the help of the JSAP application. The results of this study show that the average effect size value is 1.078 with very high criteria. This finding concludes that the REACT-based problem-based learning model has a significant effect on students' 21st-century skills. The REACT-based problem-based learning model makes students more active and easy to understand learning concepts.

Keywords : *Problem-Based Learning, REACT, Education, 21st Century Skills*

1. INTRODUCTION

21st century skills are skills that must be mastered by students to carry out teaching and learning activities in the era of the industrial revolution 4.0 (Rais et al., 2021; Zulkifli et al., 2022; Akcanca, 2020; Castro & Jimenez, 2022). Tipton (2021) 21st century skills encourage students to think critically and problem solve, creatively, collaboratively and communicatively in the learning process. Students who have 21st century skills will find it easier to understand the subject matter (Elfira et al., 2023; Ichsan et al., 2023; Kuloğlu & Karabekmez, 2022; Oktarina et al., 2021; Polat & Erişti, 2022). In addition, 21st century skills help students more quickly access information for students' knowledge sources (Xu & Zhou, 2022; Rahman et al., 2023). 21st century skills also encourage students to master digital literacy to support their learning process (Jayadi et al., 2020; Cengelci & Egmir, 2022). Indonesian students' 21st century skills are still in the low category compared to other countries (Supriyadi et al., 2023; Umam & Jiddiyyah, 2020; Suhaimi et al., 2022; Ramdani et al., 2019). This is based on the results of PISA in 2015 showing the level of science literacy of Indonesian students obtained a score of 396 ranked 71 out of 78 countries (Santosa et al., 2023; Alatas & Fauziah, 2020; Rahman et al., 2023; Supriyadi et al., 2023). This is also caused by teachers not being able to adopt learning models and methods that support students' 21st century skills (Makhrus, 2018). Furthermore, the lack of facilities and infrastructure supports the quality of student learning (Widiana et al., 2022; Festiyed et al., 2022; Santosa et al., 2023; Evendi et al., 2022), thus not helping students to improve their 21st century skills. According to

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Daga (2022) teachers lack understanding of learning models to improve students' higher order thinking skills in learning. Therefore, we need a learning method or model that can improve students' 21st century skills.

Problem-based learning model is a learning model that guides students in solving a problem in learning (Muhammad, 2020; Ferrero et al., 2021; Agnesa & Rahmadana, 2022; Budiarti et al., 2021; Mangionea & Harmon, 2022; Viro et al., 2020). Problem-based learning model can help students in critical thinking and problem solving in learning (Agustin et al., 2019; Amin et al., 2020; Yustina et al., 2022). Research results (Utomo & Haryadi, 2014) The problem-based learning model can improve students' creative ability in learning. Furthermore, the problem-based learning model encourages students to think critically and analyze in learning (Farisi et al., 2017). The Relating Experiencing Applying Cooperating (REACT) approach is a learning approach that helps students be more active in learning (Ibrahim, 2018; Nurzannah et al., 2021; Quainoo et al., 2021). The REACT approach helps students more easily master and understand learning concepts so as to encourage students' 21st century thinking skills (Maltman, 2000; Putri et al., 2019). Furthermore, the REACT approach encourages students to work together more effectively in learning activities. So, the REACT-based problem-based learning model is one of the solutions in improving students' 21st century skills.

Previous research by Dochy et al., (2013) menyatakan model problem based learning dapat meningkatkan pengetahuan siswa dalam belajar sehingga mendorong siswa untuk berpikir kritis. Trullàs et al., (2022) The problem-based learning model encourages students to be more active and creative in learning. Furthermore, the REACT-based problem-based learning model is able to improve students' critical thinking skills (Gera et al., 2023). Research by Risman et al., (2023) The problem-based learning model improves students' cognitive abilities in learning. In fact, many studies on problem-based learning models in the field of education still describe the effect size of problem-based learning models based on the REACT approach to students' 21st century thinking skills. Therefore, the research aims to determine the effect of the Problem Based Learning model based on the REACT approach on students' 21st century skills.

2.LITERATURE REVIEW
2.1.Problem Based Learning

Problem-based learning is a learning model that requires students to solve a problem in learning (Djonomiarjo, 2019). Graaff, (2003) The problem-based learning model can improve students' critical and creative thinking skills in finding solutions to problems. The problem-based learning model has stages that begin with identifying the problem, searching for relevant information to solve the problem at hand (Prasetyo & Kristin, 2020; Kardoyo et al., 2019). Next, Valdez & Bungihan (2019) Problem-based learning model is a learning model based on real life. The problem-based learning model can encourage students' problem-solving skills (Hotimah, 2020).

2.2.REACT

The Relating Experiencing Applying Cooperating Transferring (REACT) approach is a learning approach that can increase student motivation and interest in learning. (Meli et al., 20017). REACT prioritizes contextual learning that can encourage student activeness in learning (Nugraha & Nindiasari, 2019). REACT learning refers to constructivism learning. In addition, learning through REACT trains students to think at a higher level in learning so that they are able to provide solutions in problem solving (Wulandari et al., 2015). The REACT approach is able to connect students' learning experiences and understanding in various learning contexts (Mawarni et al., 2019).

2.3.21st Century Thinking Skills

21st century thinking skills is an ability that students must master to face the era of globalization (Laar et al., 2020; Icela, 2022). In the era of globalization, students must master 21st century skills consisting of critical thinking and problem solving, creative, collaborative and communicative skills (Mutohhari et al., 2021). Students who have 21st century thinking skills will be more active and easy to understand learning content (Supriyadi et al., 2023; Zulyusri et al., 2023; Sulaiman & Ismail, 2020). Karatas & (Arpaci, 2021) stated that 21st century thinking skills help students to master technology that helps in learning activities at school

3.RESEARCH METHOD

This research is a type of meta-analysis research. Meta-analysis is a type of research that analyzes previous studies by collecting data that can be analyzed with statistics (Tsang et al., 2022; Apra et al., 2021; Karim et al., 2022; Ichsan et al. 2022; Ichsan et al., 2023; Venturo & Conerly et al., 2021; Hawes et al., 2022). The steps of meta-analysis in this study are 1) determining the inclusion criteria; 2) Literature search and data coding; 3) evaluate each study; 4) analyze and interpret the data (Siddaway et al., 2019; Juandi et al., 2022; Shang et al., 2012).

3.1.Inclusion Criteria

The inclusion criteria in the meta-analysis in his research are 1) journals or proceedings indexed by Scopus and SINTA published in 2018-2023; 2) Type of experimental or quasi-experimental research using REACT-based problem-based learning and conventional learning control classes; 3) have complete statistical data consisting of mean, standard deviation, sample size, t value.

3.2.Literature Search

The literature search process in this meta-analysis through google scholar, Wiley, Eric, Springer, Hidawi, Plos ONE, and ScienceDirect databases. The keywords used in this meta-analysis are problem-based learning and students' 21st century skills. The determination of data sources must be in accordance with the predetermined inclusion criteria. The process of selecting data sources using the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) method can be seen in Figure 1.

3.3.Statistical Analysis

The analysis in this meta-analysis used the Comprehensive Meta-analysis (CMA) version 3.0 application to calculate the effect size value of each study, conduct a heterogeneity test and determine the meta-analysis model used; calculate the publication bias value and determine the p-value to test the research hypothesis. The effect size value criteria can be seen in Table 1.

Table 1. Effect Size Value Criteria

Effect Size	Kriteria
$0.00 \leq ES < 0.20$	Ignored
$0.20 \leq ES < 0.50$	Small
$0.50 \leq ES < 0.80$	Medium
$0.80 \leq ES < 1.30$	High
$1.30 \geq ES$	Very High

Source:(Aisyah & Usdiyana, 2022;Suharyat et al., 2022;Sofianora et al., 2023)

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Furthermore, to calculate publication bias using Rosenthal Fail Safe N (FSN). Research has a resistant publication bias if the FSN / (5K + 10) value with k = the number of studies used in the study. The p-value is used to test the hypothesis in this meta-analysis to determine whether the problem-based learning model based on the REACT approach has an influence or not on students' 21st century skills.
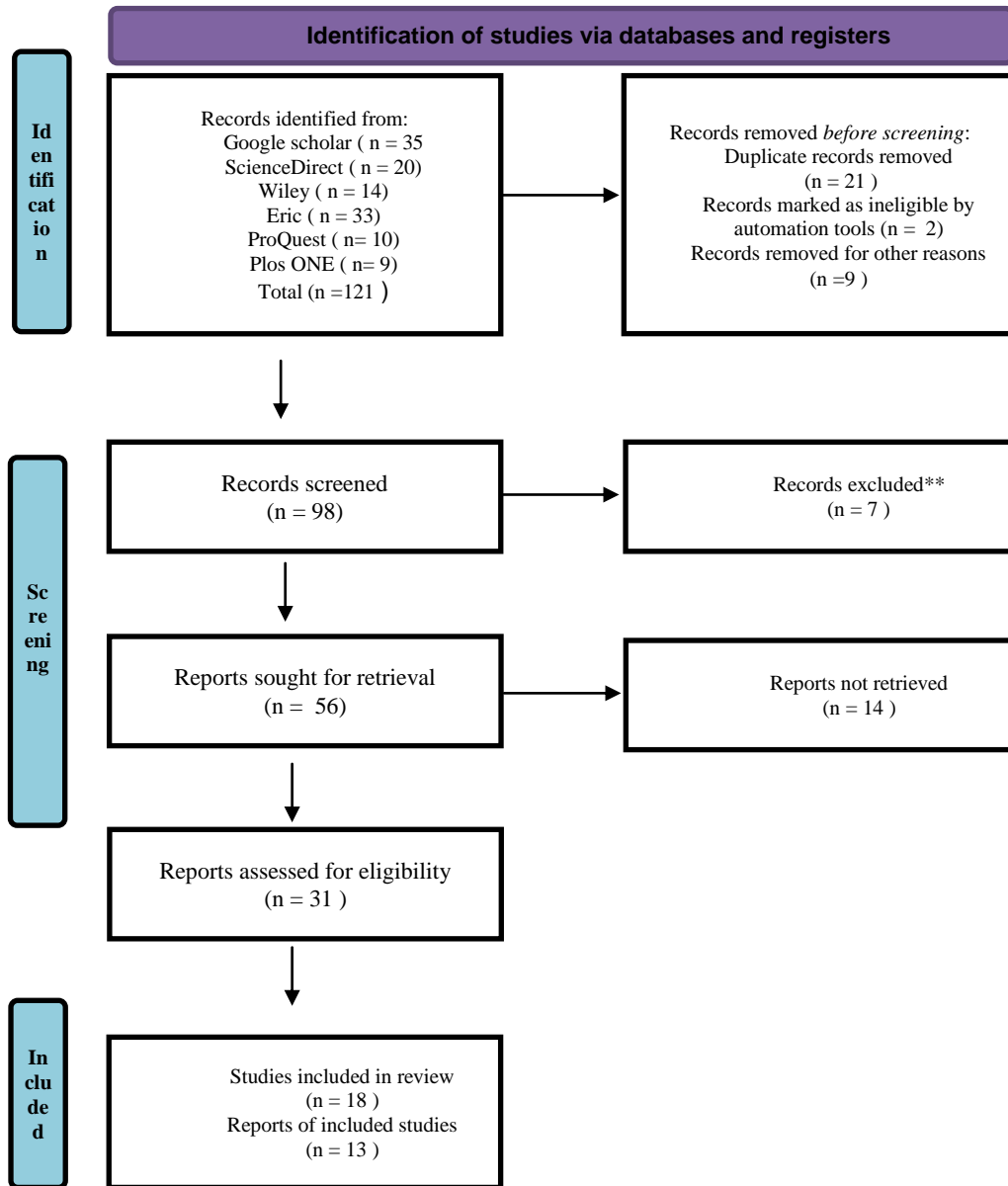

Figure 1: Data Source Selection Process through the PRISMA Method

4.RESULTS AND DISCUSSION

From the analysis of 121 national and international journals on the effect of the Problem Based Learning model based on the REACT approach on students' 21st century skills, only 13 journals met the inclusion criteria. Journals that have met the inclusion criteria are used as data

sources in this meta-analysis. Furthermore, the data source of each study was calculated the effect size value, Standard Error and Effect Size Criteria which can be seen in Table 2.

Table 2. Effect Size Value and Standard Deviation of Each Data Source

No	Journal Code	Year	Journal Type	Effect Size	SD	Crietria Effect Size
1	J1	2022	Nasional	0.52	1.03	High
2	J2	2018	Internasioal	0.69	0.41	Medium
3	J3	2021	Internasional	1.34	0.81	Very High
4	J4	2018	Nasional	2.21	1.17	Very High
5	J5	2020	Nasional	1.90	0.78	Very High
6	J6	2020	Internasioal	0.72	0.44	Medium
7	J7	2020	Nasional	0.87	0.59	High
8	J8	2023	Nasional	0.94	0.72	High
9	J9	2022	Internasional	0.61	0.30	Medium
10	J10	2023	Internasional	0.92	0.51	High
11	J11	2022	Nasional	1.33	0.96	Very High
12	J12	2019	Nasional	1.20	0.69	Very High
13	J13	2019	Nasional	0.77	0.39	Medium
	Average effect size			**1.078**		**High**

Based on Table 2. shows that the average value of effect size (ES = 1.078) with high criteria. This result concluded that the problem-based learning model based on Relating Experiencing Applying Cooperating (REACT) had a significant effect on students' 21st century thinking skills. Furthermore, determining the heterogeneity of data sources can be seen in Table 3.

Table 3. Heterogeneity Test Results

Model	n	Hedge's g	SE	95% CI	Q	P	Keterangan
Fixed	13	0.966	0.071	[0.719: 0.891]	49.180	0.00	Rejec H_0
Random	13	0.981	0.129	[0.617; 1.460]			

Based on Table 3. The results of the heterogeneity test value (Q = 49.180; p < 0.05) then the effect size in the study is heterogeneously distributed and the meta-analysis model used is a random effect model. Random effect model is the model used in data analysis. The average effect size value is 0.981. This result explains that the REACT-based problem-based learning model has a positive impact on students' 21st century skills than conventional learning. Furthermore, determining publication bias by using funnel flot which can be seen in Figure 2.
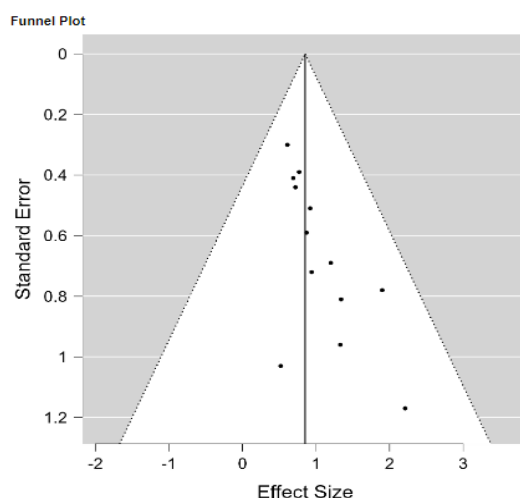
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Figure 2. Funnel Flot Standard Errorar

Based on Figure 2. Shows that the effect size value is not symmetrical to the vertical line, it is necessary to do the Roshental Fail- Safe N (FSN) test. The results of the Roshental Fail Safe-N (FSN) test can be seen in Table 4.

Table 4. Roshental Fail Safe N (FSN) Test Results

Classic Fail Safe N	
Z-value for observed studies	13.074
The P-value for observed studies	0.00
α	0.05
Tails	4.00
Z for alpha	2.17
Number of observed studies	13
Number of missing studies that would bring p-value >	159.
α	00

Based on Table 4. Shows the value of the Roshental Fail Safe N (FSN) test of 159, then 159 / (5.13 + 10) = 2.12 > 1, meaning that each study in this meta-analysis is resistant to publication bias. Therefore, no studies were deleted and added in this meta-analysis. Furthermore, hypothesis testing was conducted to determine the effectiveness of REACT-based problem-based learning model on students' 21st century skills by using random effect model hypothesis testing.

Table 5. Hypothesis Test Results with Random Effect Model

Etimation Model	n	Z	p	Effect Size	SE	95 % CI
Random Effect Model	13	5.746	0.000	0.85	0.129	[0.617; 1.460]

Based on Table 5. Shows that the effect size value with random effect size is 0.85. Furthermore, the z value of 5.746 or $p < 0.05$ means that the application of the REACT-based problem-based learning model is effective for improving students' 21st century thinking skills

compared to the conventional learning model. Thus, the REACT-based problem-based learning model is very necessary to be applied in various types of subjects.

4.1. Discussion

The application of problem-based learning model based on Relating Experiencing Applying Cooperating (REACT) has a very high influence on students' 21st century thinking skills. It can be seen from the average value of Effect Size (ES = 1.078). Research results Anazifa (2017) stated that the application of the problem-based learning model has a positive influence on students' 21st century thinking skills. The problem-based learning model increases students' cognitive potential to think in solving a problem (Widiawati & Joyoatmojo, 2018; Rochmawati & Ridlo, 2020; Eliyasni et al., 2019; Yustina et al., 2020). The REACT-based problem-based learning model encourages students' interest and motivation in learning so as to stimulate students' 21st century thinking skills (Sahin, 2015; Novitra et al., 2021; Güven, 2022). Furthermore, research results Baran et al., (2021) REACT-based problem-based learning helps students be more active to encourage their 21st century thinking skills in learning.

REACT-based problem-based learning helps students be more active to encourage their 21st century thinking skills in learning (Perdana et al., 2021; Khamdit & Siridhrungsri, 2022; Turhan, 2021). In 21st century skills, students must master critical thinking and problem solving skills, be creative, collaborative and communicative in learning (Aslan, 2022; OK & Kaya, 2021; Semilarski & Soobard, 2021; Suharyat et al., 2023). Adanya, model REACT-based problem-based learning can improve the quality of student learning in improving 21st century skills. Widada et al., (2019) stated that the REACT approach is able to help students in encouraging problem-solving skills in learning. Therefore, the REACT approach helps students understand the content and learning objectives more easily (Putra et al., 2023; Fitriani, 2018).

Based on Table 5, the REACT-based problem-based learning model is effective in improving students' 21st century thinking skills in learning. The problem-based learning model makes it easier for students to express ideas in learning (Tiwow, 2020; Permatasari et al., 2019). Research results Maryam et al., (2022) REACT-based problem-based learning model is effective to develop students' critical thinking and learning outcomes in learning. Atabey et al., (2021) The problem learning model helps students to develop knowledge to improve students' 21st century thinking skills in the learning process. Therefore, the REACT-based problem-based learning model is one of the solutions in solving problems to improve the quality of students' thinking in learning. In addition, the REACT-based problem-based learning model helps teachers and students to achieve the learning objectives that have been determined. (Tanjung et al., 2022; Chaidam & Poonputta, 2022; Lestari, 2021). Furthermore, the REACT-based problem-based learning model makes it easier for teachers to deliver learning materials to students.

5. CONCLUSION

From the results of this study, it can be concluded that the average effect size value is 1.078 with very high criteria. This finding concludes that the REACT-based problem-based learning model has a significant effect on students' 21st century skills. The REACT-based problem-based learning model makes students more active and easier to understand learning concepts. Furthermore, the REACT-based problem-based learning model is very important to be applied in various kinds of subject matter in schools to encourage students' 21st century thinking skills

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THE EFFECT OF PROBLEM BASED LEARNING MODEL BASED ON REACT APPROACH ON STUDENTS' 21ST CENTURY SKILLS: META-ANALYSIS

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