



The Effect Artificial Intelligence Based Discovery Learning Model on Student Creative Thinking Skills

Erizar^{1*}, Kaso Mustamin², Purwantini³, Abdul Halim⁴, Tomi Apra Santosa⁵

¹STAIN Teungku Derundeng Meulaboh, Indonesia

² UPRI Makassar, Indonesia

³ University 17 August 1945, Indonesia

⁴ University of Muhammadiyah East Kalimantan, Indonesia

⁵ Academy of Engineering Adikarya, Indonesia

* Corresponding Author. E-mail: erizar@yahoo.com

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model discovery learning berbasis artificial intelligence terhadap keterampilan berpikir kreatif siswa. Penelitian ini adalah jenis penelitian meta-analisis. Sumber data berasal dari analisis 12 jurnal nasional dan internasional. Pencarian sumber data melalui google scholar, ProQuest, ScienceDirect, dan Plos ONE. Kriteria Inklusi dalam penelitian ini adalah artikel publikasi dari jurnal nasional dan internasional terindeks SINTA dan Scopus, Penelitian dipublikasikan dari tahun 2016-2023, Penelitian memiliki kelas eksperimen dengan model discovery learning dan kelas kontrol model konvensional, Penelitian memiliki ukuran sampel > 20 siswa. Hasil penelitian menyimpulkan nilai summary effect size atau mean effect size sebesar 0.851 kriteria tinggi. Temuan ini menunjukkan model discovery learning berbasis artificial intelligence memberikan pengaruh terhadap keterampilan berpikir kreatif siswa.

Kata Kunci: *Model Discovery Learning, Artificial Intelligence, Berpikir Kreatif, Meta-analysis*

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Abstract

This research aims to determine the effect of artificial intelligence-based discovery learning models on students' creative thinking skills. This research is a type of meta-analysis research. The data source comes from the analysis of 12 national and international journals. Search for data sources via Google Scholar, ProQuest, ScienceDirect, and Plos ONE. Inclusion criteria in this research are published articles from national and international journals indexed by SINTA and Scopus. The research was published from 2016-2023. The research has an experimental class with a discovery learning model and a control class with a conventional model. The research has a sample size of > 20 students. The research results concluded that the summary effect size or mean effect size value was 0.851, a high criterion. These findings show that the

artificial intelligence-based discovery learning model has an influence on students' creative thinking skills.

Keywords: Discovery Learning Model, Artificial Intelligence, Creative Thinking, Meta-analysis

Introduction

Creative thinking skills are an ability that students must have in facing the industrial revolution 4.0 (Hidayati et al., 2023; Suharyat et al., 2023; Ichsan et al., 2023; Guven et al., 2022). Wulandari & Wardani (2019) that creative thinking helps students in providing ideas or ideas in providing solutions to solve a problem. Creative thinking skills help students to think scientifically in learning (Kristanto, 2023; Suganda et al., 2021; Rahman et al., 2023; Nurtamam et al., 2023; Nogerbek & Kh, 2022). Creative thinking skills provide an important role for students in facing the 21st century (Artayasa, 2020).

Creative thinking skills are a serious problem for students in schools. Students' creative thinking skills in learning are still relatively low (Herdiawan & Langitasari, 2019; Putra et al., 2023; Vishnu et al., 2014). Based on the results of PISA in 2018, Indonesian students' creative thinking skills and science literacy are still low, obtaining a score of 396, ranking 71 out of 79 participating countries (Suharyat et al., 2022; Razak & Santosa, 2022; Oktarina et al., 2021; Suhaimi et al., 2022; Elfira et al., 2023; Sofianora et al., 2023). In teacher learning activities, students do not involve active and creative students in learning (Syafriar et al., 2022; Taş & Minaz, 2022; Winarto et al., 2022). The learning model applied by teachers is not appropriate to stimulate students' creative thinking skills (Nita & Irwandi, 2021).

The *discovery* learning model is one of the learning models that can help students to think creatively (Cintia et al., 2018; Juniarso, 2020). *Discovery* learning is a learning model that encourages the

learning process of students to be more active in finding something through investigation or observation (Suendarti, 2017; Usman et al., 2022; Balim, 2009). This discovery learning learning model trains students to be able to identify their own information (Syawaludin et al., 2022). Furthermore, *discovery* learning teachers are required to be more creative in creating learning conditions so as to encourage students' creative thinking skills. Sinambela et al., (2018) that the discovery learning model requires students to be more creative in finding their own learning concepts.

The discovery learning model can improve students' creative thinking skills and learning outcomes (Ananda & Atmojo, 2022; Mawaddah et al., 2015; Werdiningsih, 2019; Nahdi et al., 201; Rahman, 2017). Furthermore, research from outside Indonesia states that *the discovery learning* model has a significant influence on students' cognitive skills (Oliveira & Oliveira, 2022; Joolingen, 1992). Not only that, the *discovery* learning model has a positive impact in improving students' critical thinking and problem-solving skills in learning (Ristanto et al., 2022; Hariyanto et al., 2023). The gap in this study is that there is no meta-analysis of the influence of *artificial intelligence-based discovery learning* models on students' creative thinking skills. Based on these problems, this meta-analysis aims to describe the effect of the size of the Artificial intelligence-based *discovery model* on students' creative thinking skills.

Methods

This research is a type of meta-analysis research. Meta-analysis is a type of research that collects and analyzes data quantitatively (Oktarina et al., 2021; Tamur et al., 2020; Rahman et al., 2023; Suhaimi et al., 2022; Borenstein & Rothstein, 2007; Suharyat et al., 2022). Meta-analysis research was used to see the effect of *artificial* intelligence-based discovery learning models on students' creative thinking skills. Data sources in this study came from 12 national and international journals. The process of searching for data sources through Google scholar, ScienceDirect, ProQuest, and PLoPs ONE. Furthermore, the inclusion criteria in the study are 1) publications come from national and international journals indexed by SINTA and Scopus; 2) Research published from 2016-2023, The study has an experimental class with discovery learning models and conventional model control classes, The study has a sample size of > 20 students.

Data analysis in this meta-analysis calculates the effect size value of the entire study analyzed with the help of the JSAP application. The criteria for the effect size value of the study are guided by the criteria (Cohen et al., 2007) which can be seen in Table 1.

Table 1. Effect Size Value Category

Effect Size	category
$0 < < 0.20$	Low
$0.20 < < 0.80$	Medium
$d > 0.80$	High

Source :(Cohen et al., 2007)

Result and Discussion

From the research search process through the Google Scholar database, ScienceDirect, ProQuest and PLoS ONE, 12 research publications were obtained that met the research inclusion criteria.

Research that meets these criteria is analyzed based on journal code, year of publication, sample size (N), Country, Effect size which can be seen in Table 2.

Table 2. Twelve Studies That Meet the Inclusion Criteria

No	Journal Code	Year	Effect Size	Effect size criteria
1	L1	2022	1.16	High
2	L2	2022	0.98	High
3	L3	2020	0.62	Medium
4	L4	2017	0.89	High
5	L5	2023	1.10	Hihg
6	L6	2023	0.78	Medium
7	L7	2020	0.47	Medium
8	L8	2021	0.84	High
9	L9	2021	0.52	Medium
10	L10	2020	0.85	High
11	L11	2020	0.96	High
12	L12	2022	1.05	High
Average value of Effect Size			0.851	High

Based on Table 2, explain the value of effect size ranges from 0.84 – 1.16 height criteria and effect 0.47 – 0.78 height criteria. Furthermore, the average value of the overall effect size of the study (ES = 0.851) criteria is high. These results show that artificial intelligence-based discovery learning models have an influence on students' creative thinking skills. Research (Saryadi & Sulisworo, 2023; Andriyani et al., 2021) That the *discovery* learning model can stimulate students' creative thinking skills in learning. Artificial intelligence-based *discovery* learning models help students' learning processes be more effective and innovative to solve a problem (Mahdian et al., 2022). The discovery learning model helps students in finding their own knowledge in the learning process (Kari et al., 2022).

Next, determine the publication bias of the entire study to be analyzed. The process of determining publication bias using a *funnel plot* can be seen in figure 1.

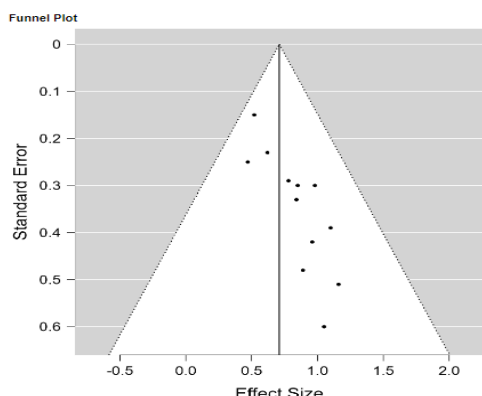


Figure 1. Funnel Plot

Figure 1. Showing the usual analysis of publications with funnel plots has not been clearly seen whether the distribution of effect sizes is symmetrical or asymmetric, it is necessary to carry out the Fail safe N (FSN) test to determine publication bias. From the analysis of the Fail safe N test, get an FSN value of 329. Next, combined in the formula $N / (5k + 10) = 329 / (5.12 + 10) = 4.7 > 1$. The results of the safe N file test showed that the effect size distribution of 12 studies did not have publication bias. Furthermore, testing the heterogeneity of a study in meta-analysis research is very important (Chamdani et al., 2022). Test heterogeneity using two meta-analysis research models, namely random effect model and fixed effect model. The results of analysis with random and fixed effect models can be seen in Table 3.

Table. 3 Analysis with Random and Fixed Effect Models

Type	Hedge's	Q-value	Heterogeneity Statistics		P-Value
			Q _{table}	DF(Q)	
Random	0.851	73.570	21.901	11	< 0.001
Fixed	0.719				

Based on Table 3. explains that the value ($Q_{table} = 21,901$; $Q_{value} = 79,570$) means that there is a significant influence of artificial intelligence-based discovery learning models on students' creative

thinking ability in learning compared to conventional learning models. The discovery learning model helps students learn more actively and creatively in finding new ideas (Permatasari et al., 2018; Gutiérrez et al., 2022). Research results (Lubis et al., 2019; Zahara et al., 2020) That the discovery learning model helps students learn independently and has scientific thinking skills that can encourage students to think creatively.

The ability to think creatively is very important for students in providing and finding solutions to solve a problem (Suganda et al., 2021; Rahman et al., 2023); Taş et al, 2022). Students who have the ability to think creatively are easier to understand and analyze learning concepts (Tok, 2022). In addition, creative thinking skills can train innovative students in the implementation of lesson concepts in life (Ayutthaya & Damrongpanit, 2022). So, the existence of an artificial-based discovery learning model is one solution in improving the quality of student learning. This is because artificial intelligence-based learning encourages students to have creativity and think critically to solve complex phenomena in life (Ramesh et al., 2004; Woschank et al., 2020).

Conclusion

From the meta-analysis study, it can be concluded that the mean effect size value of 0.851 is high. This finding shows that the discovery learning model based on artificial intelligence has an influence on students' creative thinking skills. Artificial intelligence-based discovery learning models train more actively and innovatively by utilizing technology to help the learning process.

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