Meta-Analysis of Discovery Learning Interventions in Higher Eduaction

by Fahmi Qodrul Asphar

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Abstrak

Pembelajaran penemuan (discovery learning) merupakan metode pengajaran yang aktif dan berpusat pada siswa, di mana siswa didorong untuk secara mandiri mengeksplorasi dan membangun pemahaman mereka sendiri tentang suatu topik. Model ini dapat meningkatkan pembelajaran siswa di berbagai tingkatan Pendidikan termasuk pendidikan tinggi. Akan tetapi, belum adanya meta-analisis secara comprehensive tentang effect size terhadap model penelitian dalam Pendidikan tinggi. Penelitian ini bertujuan untuk menganalisis pengaruh model Discovery learning di pendidikan tinggi. Sumber data berasal dari 13 jurnal nasional dan internasional yang terbit tahun 2022-2024. Sumber data diperoleh melalui database jurnal ilmiah google scholar, ScienceDirect, Wiley dan ERIC. Kriteria inklusi dalam meta-analisis ini adalah penelitian harus metode eksperimen; penelitian berasal dari jurnal terindeks SINTA atau Scopus; Penelitian harus relevan dengan model discovery learning di perguruan tinggi; jurnal harus open acces dan mempunyai data yang lengkap untuk menghitung nilai effect size. Hasil penelitian ini menyimpulkan bahwa model Discovery learning memberikan dampak yang signifikan diterapkan pada perguruan tinggi dengan nilai effect size sebesar 1.062 ; $p < 0.001$) dengan kriteria effect size yang sangat tinggi. Temuan penelitian ini mendukung penggunaan intervensi pembelajaran penemuan dalam pendidikan tinggi.

Kata Kunci:

Abstract

Discovery learning is an active, student-centered teaching method, where students are encouraged to independently explore and build their own understanding of a topic. This model can improve student learning at various levels of Education including higher education. However, there is no comprehensive meta-analysis of the effect size of research models in higher education. This study aims to conduct a meta-analysis of discovery learning interventions in higher education. Data sources come from 13 national and international journals published in 2022-2024. The source data was obtained through the scientific journal database google scholar, ScienceDirect, Wiley and ERIC. The inclusion criteria in this meta-analysis are that the research must be an experimental method; research comes from SINTA or Scopus indexed journals; Research must be relevant to the discovery learning model in higher education; Journals must be open access and have complete data to calculate the effect size. The results of this study concluded that the Discovery learning model had a significant impact applied to universities with an effect size value of 1,062; $p < 0.001$) with very high effect size criteria. The findings of this study support the use of discovery learning interventions in higher education.

Keywords: Discovery Learning; Effect Size; Meta-analysis; Higher Education

Introduction

Learning in higher education plays an important role in improving students' abilities and knowledge. In a more dynamic and interactive atmosphere, students can gain a deeper and broader learning experience, as well as build the skills necessary to contribute to society (Guo et al., 2020). Thus, universities can be an ideal place to develop students' potential and help them become more efficient individuals and contribute to society. College learning also allows students to gain access to a wider and better range of resources, such as laboratory facilities, libraries, and more modern technology (Lonka et al., 2004;Ali, 2020). Thus, students can gain a more realistic and more effective learning experience, as well as build the skills necessary to contribute to society. (Asphar et al., 2021; Bachtiar et al., 2023). In addition, universities can also be an ideal place to develop social skills and communication skills, as well as help students become more efficient individuals

and contribute to society (Kolb & Kolb, 2005; Santosa et al., 2022).
Universities use a variety of dynamic and interactive learning models to enhance students' abilities and knowledge. This model includes discussions, simulations, projects, and presentations, as well as the use of technology such as e-learning and virtual classrooms (Noetel et al., 2021). Thus, students can gain a more realistic and more effective learning experience, as well as build the skills necessary to contribute to society. However, this learning model is still not effective for developing students' higher-order thinking skills. Therefore, there is a need for an effective learning model, namely the discovery learning model (Bruggeman et al., 2021).

The discovery learning model is a learning approach that allows students to discover concepts and principles independently through experience and experimentation (Hariyanto et al., 2022; Akihary et al., 2023). In this model, the teacher does not provide information

directly, but allows students to find answers on their own through a process of discovery and analysis. Thus, students can build critical and analytical skills, as well as increase motivation and activeness in the learning process. In the discovery learning model, the teacher acts as a facilitator or companion who helps students in the discovery process (Shareefa, 2020). Teachers provide assignments and challenges that allow students to find answers on their own, as well as provide constructive feedback to assist students in improving their abilities. Thus, students can build critical thinking and analytical skills, as well as improve communication skills and cooperation skill (Supena et al., 2021). The discovery learning model also allows students to build confidence and increase motivation in the learning process. By allowing students to find answers on their own, students can build a sense of satisfaction and success that increases their motivation to learn. In addition, the model also allows students to build critical thinking and analytical skills, as well as improve communication skills and cooperation skills (Solissa et al., 2023).

Research on the effectiveness of discovery learning models in universities has shown significant results in improving students' abilities. In this study, the guided discovery learning model has been used to improve students' ability in mathematical problem solving (Syawaludin et al., 2022). The results showed that this model was effective in improving students' ability to solve mathematical problems, as well as improving critical thinking and analysis skills. Thus, the discovery learning model can be an effective alternative in improving the ability of students in higher education.

Other studies have also shown that discovery learning model can increase the effectiveness of learning in higher education (Koto, 2020; Jayanti, 2021). In this study, discussion methods were used

to improve students' ability in critical thinking and analysis (Zahara et al., 2020). The results showed that the discovery learning model can improve students' ability to think critically and analyze, as well as improve communication skills and cooperation skills. Thus, the discussion method can be an effective strategy in increasing the effectiveness of learning in higher education. Therefore, there is a need for meta-analysis research to provide an overview of the effect size of the influence of discovery learning models on universities (Anisa & Astriani, 2022; Affandi et al., 2022).

Meta-analyses play an important role in synthesizing findings from previous studies on the effectiveness of discovery learning in higher education. By combining results from multiple studies, meta-analyses can provide a more comprehensive picture of how discovery learning models affect student learning outcomes. Thus, meta-analysis helps in increasing the certainty and reliability of research results, as well as providing teachers with a more solid foundation for developing effective learning strategies. Therefore, this study aims to conduct a meta-analysis of discovery learning model interventions in higher education.

Methods

This research is a type of quantitative research with a meta-analysis approach. Meta-analysis is a type of research that collects and analyzes previous research quantitatively to obtain more in-depth conclusions (Nurtamam et al., 2023; Ichsan et al., 2023; Zulyusri et al., 2023). Data sources come from 13 national and international journals published in 2022-2024. The source data was obtained through the scientific journal database google scholar, ScienceDirect, Wiley and ERIC. The inclusion criteria in this meta-

analysis are that the research must be an experimental method; research comes from SINTA or Scopus indexed journals; Research must be relevant to the discovery learning model in higher education; Journals must be open access and have complete data to calculate the value of effect size. Data analysis in this study with JSAP 0.8.5 application to calculate effect size, standard deviation and heterogeneity test values. Kriteria nilai effect size dapat dilihat pada Tabel 1.

Tabel 1. Kategori Nilai Effect Size

Effect Size	Ketegori
0.0< -1.00	Weaks
< -.3	Modest
< -.5	Medium
< -.8	Strong
≥ -.8	Very Strong

Source: Cohen's in (Hidayah et al., 2023)

Result and Discussion

Based on the results of data search through the Google Scholar database, ScienceDirect, Wiley and ERIC obtained 206 journals related to the discovery model in universities. Furthermore, the data was selected based on predetermined inclusion criteria, so 13 journals were included in the meta-analysis data. The data selection process through the PRISMA 2020 method can be seen in figure 1.
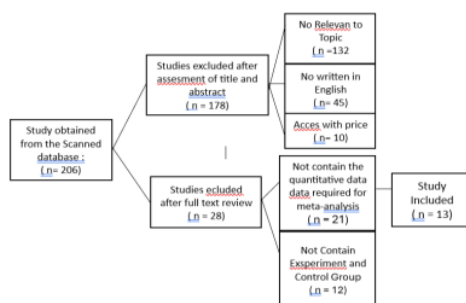

Figure 1. Data Source Selection Process with PRISMA Method

Conclusion

Fr Furthermore, analyzing 13 research journals entered into meta-analysis data based on the characteristics of the research code; year of publication; variable; journal index; effect size; and effect size criteria which can be seen in Table 2.

Tabel 2. Analisis 13 Jurnal Penelitian Berdasarkan Karakteristik

Kode Jurnal	Tahun	Negara	Indeks Journal	ES	Kriteria Effect Size
AP1	2022	Indonesia	SINTA	1.08	Very Strong
AP2	2022	Indonesia	SINTA	0.72	Strong
AP3	2024	Inggris	Scopus	2.13	Very Strong
AP4	2024	India	Scopus	1.56	Very Strong
AP5	2024	China	Scopus	1.27	Very Strong
AP6	2023	China	Scopus	2.08	Very Strong
AP7	2024	Indonesia	SINTA	1.15	Very Strong
AP8	2022	Indonesia	SINTA	0.98	Very Strong
AP9	2023	Spanyol	Scopus	0.42	medium
AP10	2023	Inggris	Scopus	1.16	Very Strong
AP11	2023	Turki	Scopus	2.23	Very Strong
AP12	2022	Indonesia	SINTA	0.65	Strong
AP13	2023	Meksiko	SINTA	0.71	Strong

Based on table 2, the effect size value ranges from 0.42 to 2.13. According to chiteria, Cohen's effect size in (Hidayah et al., 2023) 9 studies had a very strong effect size value, 1 study had a medium effect size value and 3 studies had a strong effect size value. Next, analyze the average value of effect size or summary effect size using random effect size which can be seen in figure 3.

Tabel 3. Summary Effect Size

	Estimate	Standar Error	Z	P
Intercept	1.062	0.412	0.714	< 0.001

Table 3, summary effect size value of 1,062; z= 0.714. This finding implies that the discovery learning model has a significant impact on universities with very strong categories with p < 0.001. This research is in line with (Inde et al., 2020) menyatakan model Discovery Learning is effective for improving student learning outcomes. This finding is supported by research (Martaida et al., 2017) The discovery learning model has a significant influence on students' critical thinking skills in the learning process.

The application of Discovery Learning (DL) in higher education has garnered significant attention in recent years due to its potential to enhance student learning outcomes. A meta-analysis of DL interventions in higher education reveals a positive correlation between DL and improved learning outcomes. This analysis, which aggregated data from multiple studies, found that DL interventions resulted in a significant average effect size of 1.062 , indicating a substantial impact on learning outcome. The findings of this meta-analysis suggest that DL interventions are particularly effective in enhancing critical thinking skills, which are essential for higher education students (Satriani et al., 2021). The analysis also highlights the importance of teacher facilitation in DL, as student-led discovery learning outperforms both direct instruction and unassisted discovery learning (Ananda et al., 2022).

Moreover, the meta-analysis indicates that DL interventions can be effective across various educational levels, including high school and college students (Usman et al., 2022). The results of this analysis support the notion that DL can be a valuable tool for educators seeking to improve student learning outcomes in higher education (Ariyati et al., 2020; Ayodele & Nasiru, 2021). The effectiveness of DL interventions in higher education can be attributed to several factors, including

the ability of DL to promote active learning, foster critical thinking, and encourage student autonomy (Rosdiana et al., 2017). Additionally, DL allows students to engage with complex concepts in a more meaningful and interactive manner, which can lead to deeper understanding and retention of material. meta-analysis of DL interventions in higher education provides compelling evidence of the positive impact of DL on student learning outcomes. The findings of this analysis underscore the importance of incorporating DL into educational curricula and highlight the need for further research to better understand the mechanisms by which DL enhances learning outcomes in higher education (Anwar et al., 2023).

Conclusion

From the results of this meta-analysis, it can be concluded that the Discovery learning model has a significant impact applied to universities with an effect size value of 1,062; p < 0.001) with very high effect size criteria. The findings of this study support the use of discovery learning interventions in higher education.

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Meta-Analysis of Discovery Learning Interventions in Higher Eduaction

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