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Meta-analysis The Influence of the Flipped Classroom Model on Problem Solving Ability in Revolution 4.0 Era

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Abstract

This study aims to determine the effect of the flipped classroom model on the problem-solving ability of students in the industrial revolution era 4.0. This study is a type of meta-analysis research. Data sources come from 13 national and international journals published in 2021-20224. The inclusion criteria in this study are research derived from journals indexed by Sinta and Scopus, research related to the influence of the flipped classroom model on students' problem-solving abilities, tracing data sources from Researchgate, SciencedDirect, Mendeley, and ERIC, and research has complete data to calculate the value of effect size. Data analysis with the help of Microsof Excel and Jamovi applications. The results of this study concluded that the application of the flipped classroom model had a significant effect on students' problem-solving abilities with an average effect size value of 0.862 and Standard Error of 0.312. This finding has a positive impact on teachers to apply this flipped classroom model in developing students' problem-solving skills.

Keywords: Flipped Classroom; Troubleshooting; Meta-Analysis, Effect Size

Introduction

Problem-solving ability is one of the critical skills that is very important for students in the era of revolution 4.0 (Treepob et al., 2023; Ozpinar &; Arslan, 2023). Problem-solving skills help students face various challenges in daily life (Ichsan et al., 2023; Suryono et al., 2023), both in academic contexts and outside the school environment. Students who have good problem-solving skills tend to be better able to identify, analyze, and solve problems in an effective and efficient manner. They can also develop strategies as well as creativity in finding solutions to complex problems, thus preparing them for the challenges they face in the future. (CetİIn, 2023)

Furthermore, problem-solving skills also help students to develop self-confidence and mental toughness (Mahanal et al., 2022; Nurtamam et al., 2023). When students can cope well with problems, they feel more competent and confident in dealing with similar situations in the

future (Rahman et al., 2020; Oktarina et al., 2021). The problem-solving process also involves trying to find alternative solutions, test ideas, and learn from failures. Thus, students learn not only how to cope with concrete problems (Rahman et al., 2023; Elfira et al., 2023), but also develop the mental resilience necessary to face the challenges they may face in their lives (Dikmen, 2022).

But in reality, the problem-solving ability of students in school is still relatively low (Zulkifli et al., 2022; Zulyusri et al., 2023; Rahman, 2019). Many students face difficulties in identifying problems, formulating appropriate solving strategies, and evaluating the resulting solutions (Rachmawati &; Rosy, 2020; Suharyat et al., 2022). In addition, there are challenges in integrating problem-solving skills into the educational curriculum that suits the needs and development of students. Teachers have a crucial role to play in helping students develop these skills (Grahito Wicaksono, 2020; Fitriyah &; Ramadani, 2021). Therefore, research on students' problem-solving abilities needs to continue to be conducted to identify causal factors as well as effective strategies in improving these skills among students (Yusri et al., 2018). Furthermore, the selection of inappropriate models supports students' problem-solving abilities, one of which is with the flipped classroom model.

Flipped Clasroom is a learning model that changes the traditional paradigm in the teaching and learning process by reversing the sequence of activities (Ajmal, 2021) . In a flipped classroom, students are given access to learning materials through videos, reading materials, or other learning resources outside the classroom, while classroom time is used for discussion, collaboration, and application of concepts that have been learned (Diningrat et al., 2023). This approach provides opportunities for students to learn independently, adjust their own learning pace, and allows teachers to provide more personalized guidance to students (Putra et al., 2023; Pratiwi et al., 2022; Nayci, 2021). Thus, flipped classrooms encourage active student participation, promote deeper conceptual understanding, as well as increase interaction between students and teachers in the learning process (Aslan, 2022; Sengul, 2021).

Previous research (Purwijaya et al., 2023) Says the flipped classroom model can boost students' problem-solving skills. Research by Princess et al., (2021) The flipped classroom model can foster students' critical thinking skills in learning. The gap, the number of studies on flipped classroom on solving student problems has not found in-depth conclusions about the effect of flipped classroom size on student problem solving skills. Therefore, this study aims to determine the influence of the flipped classroom model on the problem-solving ability of students in the industrial revolution era 4.0.

Research Methods

This type of research is a meta-analysis study. Meta-analysis research is a type of research that collects and analyzes primary research quantitatively to draw accurate and in-

depth conclusions (Razak et al., 2021; Suharyat et al., 2022; Solehuddin et al., 2023; Rahman et al., 2023; Suparman et al., 2021; Tamur et al., 2020; Rahman et al., 2023). Data sources come from 13 national and international journals published in 2021-20224. The inclusion criteria in this study are research derived from journals indexed by Sinta and Scopus, research related to the influence of the flipped classroom model on students' problem-solving abilities, tracing data sources from Researchgate, SciencedDirect, Mendeley, and ERIC, and research has complete data to calculate the value of effect size. Data analysis with the help of Microsof Excel and Jamovi applications. Furthermore, the effect size criteria can be seen in Table 1.

Table 1. Effect Size Value

Effect Size	Criterion
$0.0 \leq ES \leq 0.2$	Low
$0.2 \leq ES \leq 0.4$	Medium
$ES \geq 0.4$	High

Results and Discussion

From the results of tracing data sources obtained through Researchgate, SciencedDirect, Mendeley, and ERIC related to the influence of the flipped classroom model on the problem-solving ability of students in the industrial revolution era 4.0, 13 studies were obtained that met the inclusion criteria. Data that have met the inclusion criteria are calculated effect size values and error standards which can be seen in Table 2.

Table 2. Value of Effect Size and Standard Error 13 Research

Research Code	Year	EffecT Size	Standard Error	Effect Size Criteria
T1	2023	0.81	0.43	High
T2	2024	2.10	0.62	High
T3	2023	0.70	0.33	Medium
T4	2023	1.12	0.41	High
T5	2023	2.31	0.62	High
T6	2021	1.66	0.48	High
T7	2023	0.96	0.41	High
T8	2022	0.84	0.37	High
T9	2022	0.42	0.28	Medium
T10	2023	0.69	0.25	Medium
T11	2022	0.89	0.38	High

T12	2021	1.08	0.44	High
T13	2024	1.26	0.51	High
Average value of effect size		1.14	0.42	High

Based on Table 2, the highest effect size value is 2.31 with a standard error of 0.62 and the lowest effect size value is 0.42 with a standard error of 0.28. Furthermore, the average value of effect size is 1.14 with a standard error of 0.42, then the application of the flipped classroom model has a positive effect on students' problem-solving abilities. This research is in line with (Nguyen et al., 2021) The flipped classroom model provides a significant influence on students' problem-solving abilities. Research by (Jdaitawi, 2019) The flipped classroom model can encourage student learning outcomes so that students learn more actively.

The flipped classroom model provides opportunities for students to access learning materials independently, allowing them to understand basic concepts before entering the application stage in the classroom. This can increase learning effectiveness by optimizing classroom time to discuss, collaborate, and apply concepts that have been learned. In addition, this model also encourages students to develop self-study skills and initiative, which are important aspects in the era of the industrial revolution 4.0 where independence and the ability to continue learning are highly valued.

In addition, the use of the flipped classroom model can also increase student engagement in learning and facilitate the development of problem-solving skills. By utilizing classroom time for discussion, exploration, and application of concepts, teachers can provide more individualized support to students in overcoming challenges and solving complex problems (Rahayu &; Indriyanti, 2023). Direct interaction between teachers and students also makes it possible to provide real-time feedback, which can help students refine their understanding as well as develop effective problem-solving strategies. As a result, the flipped classroom model can make a significant contribution to the development of students' problem-solving abilities in the era of the industrial revolution 4.0, which requires individuals who are able to adapt quickly and face complex challenges in a rapidly changing environment (Suhartini, 2023). In the context of the industrial revolution 4.0, where information and communication technology is becoming increasingly pervasive in various aspects of life, the ability to learn independently is invaluable. This model gives students the opportunity to develop lifelong study habits, which are crucial in facing the challenges and opportunities offered by an ever-changing world (Sirakaya &; Ozdemir, 2018).

The flipped classroom model can also facilitate the use of technology in learning, which is in line with the demands of the industrial revolution era 4.0. By utilizing digital resources such as learning videos, online platforms, and other interactive learning tools, this model creates a learning environment that is relevant to students' digital lives (Fradila et la., 2021). It

helps students to become more skilled in using technology to learn and solve problems, which is an indispensable skill in various fields of work in the era of the industrial revolution 4.0. As a result, the flipped classroom model not only helps students develop problem-solving skills, but also prepares them for success in an increasingly connected and rapidly changing world. The flipped classroom model also allows teachers to provide more individualized and in-depth feedback to students (Domu, 2023). By engaging students in interactive activities in the classroom, teachers can monitor student understanding in real time and provide specific guidance according to their individual needs. This can help students to identify their weaknesses in problem solving and develop more effective strategies to overcome challenges (Ramadhani &; Umam, 2019; Rachmawati et al., 2019). In the context of the industrial revolution 4.0, the flipped classroom helps students adapt and innovate for their learning success (Gomez, 2018), timely and in-depth feedback is invaluable in helping students reach their full potential.

Conclusion

From the study, it can be concluded that the application of the flipped classroom model has a significant effect on students' problem-solving abilities with an average value of effect size of 0.862 and Standard Error of 0.312. This finding has a positive impact on teachers to apply this flipped classroom model in developing students' problem-solving skills. Overall, research on the effect of the flipped classroom model on the problem-solving ability of students in the industrial revolution 4.0 era shows that this approach has a positive and significant impact. The flipped classroom model provides opportunities for students to learn independently, access learning materials flexibly, and develop lifelong learning skills. In addition, this model facilitates collaboration between students, deeper interaction between teachers and students, and the use of technology in learning.

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