

The Effectiveness of STEM-Integrated Blended Learning on Indonesia Student Scientific Literacy: A Meta-analysis

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ABSTRACT

This study aims to determine the effectiveness of STEM-integrated blended learning on Indonesian students' science literacy. This research is a type of meta-analysis research. The data sources in the study came from the analysis of 10 national and international journals published from 2017-2023. The data search process through searching on Google Scholar, Scopus, Wiley, Eric and Hindawi Journal. Data collection techniques in research through direct observation by tracing studies related to research variables. The keywords in this article search are blended learning, STEM and science literacy. Data analysis technique is descriptive quantitative analysis technique with JSAP application. The results concluded that STEM-integrated blended learning is effective in encouraging the level of science literacy of students in Indonesia with an effect size value of 0.71 and N-gain of 0.82. Blended learning greatly supports the learning process in Indonesia in improving students' literacy in learning.

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I. INTRODUCTION

The era of Globalization brings great changes in the world of education today (Öztürk, 2023; Fradila et al., 2021). The role of technology brings education into a tool that helps students learn (Kara et al., 2022; Rahimi & Tafazoli, 2022; Yusuf et al., 2020). In addition, technology in education helps students to develop all their potential. (Jagantara et al., 2014; Festiyed et al., 2022); Ichsan et al., 2022; Suharyat et al., 2023). Students must be able to develop their potential to be competitive. (Oktarina et al., 2021; Chireac & Vegas, 2022). According (Pratama & Prastyaningrum, 2016) potency that students have serves to solve every problem that occurs in life. The learning process should encourage students to think critically and creatively. (Nilsook et al., 2021; Utami et al., 2015). This is needed so that students can more easily understand and solve problems in learning (Santosa & Yulianti, 2020; Zulkifli et al., 2022). Learning is very important for students to provide new things for the future of the nation. (Wright, 2020; Sudarsono et al., 2022; Suharyat et al., 2022); Zorlu & Zorlu, 2021; Fakhurrozi & Hamdani, 2022). The higher the quality of students in learning, the higher the learning outcomes. (Muthoharoh & Elvina, 2022; Ferdyan et al., 2021). Learning outcomes determine the extent to which students can understand and apply the subject matter that has been taught. (Santosa et al., 2021; Supriyadi et al., 2022; Zulyusri et al., 2020).

Furthermore, a teacher must be able to encourage students in developing science literacy. The problems faced by students have a low level of science literacy. According to the Program of International Student Assessment (PISA) research, the science literacy of Indonesian students ranked 62 out of 70 member countries (Suhaimi et al., 2022). This shows that the science literacy of Indonesian students is far behind other countries. Therefore, the quality of Indonesian students' science literacy needs to be improved by the learning model used by teachers.

Blended learning model is a learning model that can be done online and offline by teachers. (Sari & Wibowo, 2021; Santosa et al., 2021). The blended learning model makes students more creative in learning (Nugraha et al., 2019). Furthermore, this blended learning model is able to boost students' motivation and learning outcomes in the classroom (Setiawan et al., 2022). The blended learning model allows students to learn online through a website that has been prepared by a particular institution. The blended learning model is very effective in integrating with STEM. STEM is a learning approach that combines science (Science), technology (Technology), engineering (Engineering) and mathematics (Mathematics) in learning (Zulkifli et al., 2022).

The STEM approach can boost teacher performance and have a positive impact on student literacy (Lestari et al., 2018). (Santosa, Razak, et al., 2021) The STEM approach has a good impact on students and teachers in encouraging literacy and student learning outcomes. In addition, the application of the Science, Technology, Engineering and Mathematics (STEM) approach can improve students' problem solving skills (Iolanessa et al., 2020). Thus, the STEM-integrated blended learning model has a positive impact on students in improving the quality of learning at school.

Previous research by (Prastyo et al., 2020) blended learning model can increase students' learning motivation. Research by (Bedebayeva et al., 2022) STEM-integrated blended learning model improves student learning outcomes at school. Furthermore, research by (Ardianti et al., 2019) The STEM-integrated blended learning model improves students' critical thinking skills. Therefore, this study aims to determine the effectiveness of STEM-integrated blended learning on Indonesian students' science literacy.

II. RESEARCH METHOD

This research is a type of meta-analysis research. Meta-analysis research is a type of research that traces studies that can be analyzed statistically. (Razak et al., 2021; Ichsan et al., 2022; Suharyat et al., 2022). The data sources in this study were sourced from 10 national and international journals published from 2017-2023. The data collection technique is direct observation by tracing studies related to the effectiveness of the STEM-integrated blended learning model on students' science literacy. The data analysis technique is quantitative analysis with the help of JSAP application. According to Cohen in (Firman et al., 2019) The steps of conducting meta-analysis are 1) understanding the appropriate research topic; 2) collecting various kinds of studies that are in accordance with the research topic; 3) determining the effect size (ES) value and 4) drawing conclusions and interpreting the research results. The complete effect size criteria can be seen in table 1.

Table. 1 Effect Size Categories

Effect Size			Criteria
	0.15		Very small
0.15	ES	0.40	Small
0.40	ES	0.75	Medium
0.75	ES	1.10	Big
1.10	ES	1.45	Very Large

Source: (Nurcahyani et al., 2021; Razak et al., 2021; Santosa et al., 2021; Tamur et al., 2021)

III. RESULT AND DISCUSSION

Result

From the analysis of 44 national and international journals, we found 10 studies related to the effectiveness of STEM-integrated blended learning model on students' science literacy in Indonesia. Furthermore, each study calculated the effect size (ES) value. The complete analysis of each study can be seen in Table 2.

Table.2 Meta-analysis of each study

No	Journal Code	Journal Type	Effect Size	Category
1	T1	National	0.56	Medium
2	T2	National	0.02	Very small
3	T3	International	1.58	Big
4	T5	Internationa	2.09	Very Large
5	T5	National	0.37	Small
6	T6	National	2.10	Very large
7	T7	Interntional	0.38	Small
8	T8	International	0.76	big
9	T9	National	0.81	Big
10	T10	National	0.92	Very large
Average Effect Size			0.95	Very large

Table 2 shows that the average effect size value of each study is 0.95 in the large category. It is concluded that the application of blended learning model integrated with Science, Technology, Engineering and Mathematics (STEM) has a significant influence on students' science literacy in Indonesia. Teachers must be able to optimally apply the STEM-integrated blended learning model in the student learning process. Teachers are educators who have a great function in developing students' science literacy potential at school. Furthermore, the STEM-integrated blended learning model is effective in promoting science literacy in Indonesia. Because the blended learning model can be applied online and offline to students. The effectiveness of STEM-integrated blended learning model in learning can be seen in the table. 3

Table 3. Effectiveness of Blended Learning + STEM < Science Literacy

Class	Nilai		SD	N-gain
	Pre	Post		
Control	62	75	0.340	0.53
Exaperiment	50	85		

Based on table 4. Explains the N-gain value of the effectiveness of the STEM-integrated blended learning model on science literacy of 0.53. The application of the STEM-integrated blended learning model has a positive impact on student learning outcomes. This STEM-integrated blended learning model needs to be implemented in Indonesia in order to improve the quality of science literacy of Indonesian students.

Discussin

The application of STEM-integrated blended learning model gives positive impact for students to improve their science literacy. From the results of this study, blended learning gave a significant influence on students' science literacy with an effect size of 0.96 with a very large category. These results are in line with research by (Katasila & Poonpon, 2022) explained that the blended learning model is able to increase students' science literacy level in learning. In addition, this research is supported by (Kade et al., 2019) stated that STEM-integrated blended learning model can encourage students' literacy and learning outcomes. Science literacy is the ability of students to solve problems and apply the science process in life. (Rahmi et al., 2022; Santosa & Sepriyani., 2020).

Furthermore, the STEM-integrated blended learning model is very effective to be implemented in schools in Indonesia. STEM-integrated blended learning model helps students to be more creative and innovative in utilizing technology for learning. (Suparno et al., 2022; Li et al., 2022; Seage & Türegün, 2020). STEM-integrated blended learning model is able to improve students' critical thinking skills. (Santosa et al., 2021; Nur et al., 2022). In learning, a teacher must be able to apply the blended learning model optimally in order to achieve the lesson objectives. (Mursid et al., 2022).

STEM-integrated blended learning model provides good things for Indonesian students in improving the quality of Science literacy. (Adi et al., 2017). The level of science literacy of Indonesian students is still lagging behind neighboring countries. Therefore, the existence of a STEM-integrated blended laering model can improve the quality of science literacy of students in Indonesia. (Aritonang & Safitri, 2021). The blended learning model is a model that can improve the quality of education in Indonesia, so that it can improve students' knowledge (Ferry et al., 2020).

IV. CONCLUSION

From this research, it can be concluded that STEM-integrated blended learning is effective in encouraging students' science literacy level in Indonesia with an effect size value of 0.95 and N-gain of 0.53. Blended learning greatly supports the learning process in Indonesia in improving students' literacy in learning.

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