

User Paper

Ok 7529-Article Text-14791-1-10-20240119.docx

 Document Check (No Repository) - 29

 papers

 Punjab Agricultural University

Document Details

Submission ID**trn:oid:::1:3174997028****Submission Date****Mar 6, 2025, 9:11 PM GMT+5:30****Download Date****Mar 6, 2025, 9:12 PM GMT+5:30****File Name****Ok_7529-Article_Text-14791-1-10-20240119.docx****File Size****160.2 KB****9 Pages****4,030 Words****24,906 Characters**

12% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography
- Quoted Text

Match Groups

-  **13 Not Cited or Quoted 10%**
Matches with neither in-text citation nor quotation marks
-  **1 Missing Quotations 1%**
Matches that are still very similar to source material
-  **0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
-  **0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 11%  Internet sources
- 2%  Publications
- 1%  Submitted works (Student Papers)

Match Groups

-  **13 Not Cited or Quoted 10%**
Matches with neither in-text citation nor quotation marks
-  **1 Missing Quotations 1%**
Matches that are still very similar to source material
-  **0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
-  **0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 11%  Internet sources
- 2%  Publications
- 1%  Submitted works (Student Papers)

Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Internet	ummaspul.e-journal.id	11%
2	Student papers	North East Surrey College of Technology, Surrey	<1%



The Effectiveness of the Internet of Things in Increasing Students Creativity

Enos Lolang^{1*}, Suyahman², Made Darmiati³, Heru Widoyo⁴, Dewi Maharani Rachmaningsih⁵, Tomi Apra Santosa⁶

¹Universitas Kristen Indonesia Toraja, Indonesia

²Universitas Veteran Bangun Nusantara, Indonesia

³Politeknik Pariwisata Bali, Indonesia

⁴STIKIP Amal Bhakti, Indonesia

⁵Universitas Terbuka, Indonesia

⁶Akademi Teknik Adikarya, Indonesia

* Corresponding Author. E-mail: devedeex@gmail.com

Receive: 17/07/2023

Accepted: 15/09/2023

Published: 01/10/2023

Abstrak

Penelitian ini bertujuan untuk mengetahui efektivitas Internet of Things untuk meningkatkan kreativitas mahasiswa. Jenis penelitian ini adalah meta-analisis. Data penelitian berasal penelusuran database google scholar, ScienceDirect, Researchgate dan Springer. Kriteria inklusi dalam penelitian adalah penelitian dipublikasikan dalam jurnal atau prosiding internasional terindeks Scopus, Wos dan Sinta, Penelitian terkait Internet of Things untuk meningkatkan kreativitas siswa, penelitian harus terbitan 2020-2024, dan penelitian memiliki data yang lengkap untuk menghitung nilai effect size. Analisis statistik dalam penelitian dengan aplikasi JSAP .0.8.5. Hasil penelitian menyimpulkan bahwa implementasi Internet of Things (IoT) berpengaruh signifikan terhadap kreativitas siswa dengan nilai summary effect size ($rRE = 1.117$) kategori effect size yang sangat tinggi. Temuan ini menjelaskan Internet of Things efektif membantu siswa dalam meningkatkan kreativitas belajarnya di sekolah.

Kata Kunci: *Internet of Things, Effect Size, Kreativitas, Meta-analysis*

The Effectiveness of the Internet of Things in Increasing Students Creativity

Abstract

This study aims to determine the effectiveness of the Internet of Things to increase student creativity. This type of research is a meta-analysis. The research data came from searching the databases of Google Scholar, ScienceDirect, Researchgate and Springer. The inclusion criteria in the research are research published in international journals or proceedings indexed by Scopus, Wos and Sinta, Research related to the Internet of Things to increase student creativity, research must be published 2020-2024, and research has complete data to calculate the value of effect size. Statistical analysis in research with JSAP application .0.8.5. The results of the study concluded that the implementation of the Internet of Things (IoT) had a significant effect on student creativity with a very high summary effect size ($rRE = 1.117$) in the effect size category. These findings explain that the Internet of Things is effective in helping students increase their learning creativity in schools.

Keywords: *Internet of Things, Effect Size, Creativity, Meta-analysis*

Introduction

Student creativity is one of the important things in supporting the learning process in higher education (Anh et al., 2022; Priyanto & Dharin, 2021). Creativity allows students to think outside the box and solve problems in new ways. Students who have creativity can be realized in various forms such as doing assignments in unique ways, making art, or engaging in extracurricular activities that require imagination and improvisation (Hou et al., 2022). Student creativity is not only important for their personal development, but also benefits society (Oktarina et al., 2021; Zulkifli et al., 2022; Razak et al., 2021). (Revilla et al., 2021) stated that creative students have the potential to make a positive contribution to society through innovation in various fields such as technology, art, science, and humanities. Therefore, creativity needs to be honed and developed from an early age, including in college, so that students are ready to become agents of change in the future (Wang & Chang, 2022; Rahman et al., 2023; Ichsan et al., 2023; Subali & Susilo, 2022). One way to develop student creativity is to encourage students to innovate in learning (Prahani et al., 2021; Maulidia & Abidin, 2020).

But in fact, student creativity in Indonesia is still relatively low (Sari et al., 2018; Suryono et al., 2023; Rahman et al., 2023). According to a survey conducted by the Center for Student Assessment and Learning (PAPM) of the University of Indonesia in 2021, only around 15% of students have high creativity. The rest, as many as 40% of students are at the level of medium creativity and the remaining 45% have low creativity. The low creativity of students is caused by several factors. First, the college curriculum is still theory-oriented and lacks room for the development of creativity (Hanif et al., 2019). Second, a campus environment that

does not support the expression of students' ideas and ideas. Third, an academic culture that tends to value obedience and is less tolerant of failure (Lolang et al., 2023), even though the development of creativity requires space to experiment and learn from mistakes (Maulidia & Abidin, 2020; Pramesworo et al., 2023). Furthermore, in learning activities educators do not involve students to learn so that students lack creativity in learning (Santosa et al., 2021; Ichsan et al., 2022; Zulyusri et al., 2023; Luciana et al. 2023). Therefore, there is a need for technology-based learning that can encourage student creativity.

Internet of Things (IoT) is a concept where physical objects are embedded with sensors, software, and other technologies so that these objects can connect, communicate with each other and exchange data through the internet network IoT refers to a network of devices that are connected to the internet and are able to exchange data with each other without the need for human interaction (Abdullah et al., 2024; Frydenberg, 2023; Ghudkam et al., 2023). The application of IoT in learning provides many benefits for educators and learners (Francisti, 2023). According to Almadani (2018), IoT helps create a more interesting and interactive learning environment through the integration of various sensors, cameras, and other smart devices. The utilization of IoT in the classroom also enables real-time data collection and analysis. This helps educators understand learners' learning needs more precisely and provides timely feedback (Rouse, 2016). Thus, the proper application of IoT technology can improve the quality of learning in this digital era (Ozgul & Ucak, 2023; Hou et al., 2022). The government and educational institutions need to continue to develop the use of IoT to create a smarter and more effective learning system.

Previous research has proven that the use of the Internet of Things (IoT) in learning has a positive influence on student learning outcomes and experiences (Hadiati & Saputri, 2022). According to research conducted by Siregar et al. (2018), the implementation of IoT in physics learning shows an average increase in student learning outcomes by 16.7% and competency achievements of 12.6%. In addition, Mustakim's research (2020) also found that IoT is able to increase student motivation and active participation in mathematics learning. The use of IoT technology has proven effective in enriching the student learning experience and improving student academic performance (Ariswan et al., 2023). Many studies on the Internet of Things in learning have not been meta-analyzed to determine the overall impact of research on the Internet of Things on student creativity. Therefore, this study aims to determine the effectiveness of the Internet of Things to increase student creativity.

Methods

This research is a type of meta-analysis research. Meta-analysis is a type of research that collects and analyzes primary studies that can be analyzed quantitatively (Utomo et al., 2023; Supriyadi et al., 2023; Tamur et al., 2021; Diah et al., 2022; Rahman et al., 2023). This meta-analysis aims to determine the influence of the Internet of Things on student creativity.

Data Collection

Data collection in this meta-analysis searched the databases of Google Scholar, ScienceDirect, Researchgate and Springer. Data search keywords are Internet of Things, Student Creativity and the Influence of Internet of Things on Student Creativity. From the data search, 224 relevant articles were obtained. Furthermore, the articles were selected using the PRISMA method

which can be seen in (Figure 1), then 14 articles that meet the inclusion criteria can be seen in Table 2.

Eligibility Criteria

To obtain valid data in the meta-analysis, it is necessary to have eligibility criteria. The eligibility criteria in this study are research published in international journals or proceedings indexed by Scopus, Wos and Sinta, Research related to the Internet of Things to increase student creativity, research must be published 2020-2024, and research has complete data to calculate the value of effect size.

Data Analysis

Data analysis in the meta-analysis calculated the effect size value of the primary study (Glass, 1974). According to Borenstein et al., (2009) The stages of the data analysis procedure for meta-analysis research consist of calculating the effect size value of the study, conducting heterogeneity tests and determining the estimation model, checking publication bias, and calculating the p-value to test the effect size. Statistical analysis with the help of JASP 0.8.5 application. Furthermore, the effect size criteria are guided by the effect size criteria Cohen et al., (2007) which can be seen in Table 1.

Table 1. Effect Size Value Criteria

Effect Size	Category
$0.00 \leq ES \leq 0.20$	Low
$0.20 \leq ES \leq 0.80$	Medium
$ES \geq 0.80$	High

Result and Discussion

Hasil From searching the Google Scholar, ScienceDirect, Researchgate and Springer databases related to the influence of the Internet of Things on student creativity, 14 journals were obtained that met the inclusion criteria. Articles that meet

the inclusion criteria are calculated for effect size values which can be seen in Table 2.

Table 2. Effect Size and Standard Error values

Study Code	Year	Effect Size	Standard Error	Index
Study 1	2020	1.44	0.34	Scopus Q4
Study 2	2020	0.95	0.39	Scopus Q2
Study 3	2023	2.10	0.52	Sinta 2
Study 4	2020	1.19	0.49	Sinta 2
Study 5	2023	0.76	0.22	Sinta 2
Study 6	2023	0.57	0.18	Scopus Q1
Study 7	2023	0.82	0.33	Scopus Q3
Study 8	2021	1.29	0.47	Sinta 3
Study 9	2022	2.40	0.72	Sinta 3
Study 10	2022	2.07	0.30	Scopus Q1
Study 11	2023	1.37	0.32	Scopus Q2
Study 12	2021	0.82	0.28	Scopus q4
Study 13	2020	0.66	0.15	Wos
Study 14	2023	0.83	0.41	Sinta 2

Table 2, the results of the analysis of 14 journal effect size values ranged from 0.66 to 2.40 and standard error ranged from 0.22 to 0.52. According to the effect size criterion Cohen et al., (2007) Of the 14 journals analyzed, three articles with medium effect size values (21.42%) and 11 articles with high effect size criteria (78.58%). This finding explains the influence of the Internet of Things on student creativity. Furthermore, testing heterogeneity and determining estimation models with random and fixed effect

models. The heterogeneity test results of the 14 articles can be seen in Table 3.

Result 3. Heterogeneity Test Results

	Q	Df	p
Omnibus Test of Model Coefficients	61.316	1	< 0.001
Test of Residual Heterogeneity	36.827	13	< 0.001

Note. P value are approximate

Note. The Model was estimated Using Restricted ML Methods.

Based on Table 3, the results of the heterogeneity test obtained a value of Q = 61,316 greater than the value of 36,827, then the 14 articles analyzed were heterogeneously distributed. Next, check publication bias with funnel plot analysis and Egger's test (Tamur & Wijaya, 2021; Chamdani et al., 2022; Hariyadi et al., 2023). The results of the publication bias test with funnel plots can be seen in Figure 1.

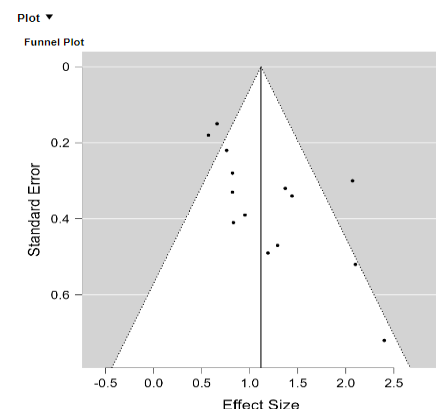


Figure 1. Funnel Plot Standard Error

Based on figure 1, the analysis

of publication bias with funnel plots has not yet been said to be the shape of the curve on whether it is symmetrical or asymmetric. Therefore, it is necessary to conduct further tests of Egger's. Egger's test results can be seen in Table 4.

Table 4. Egger's Test Results

z	p
3.020	0.003

Table 4, showing the results of Egger's test obtained value $Z = 3.020$; $p < 0.003$, then checking publication bias with funnel plots is in a symmetrical curve. The results showed that the analysis of 14 articles did not have publication bias, so no articles were deleted or added. The last step, calculate the p-value with the summary effect size which can be seen in Table 5.

Table 5. Summary Effect Size/Mean Effect Size

	Estimate	Standard Error	z	p
Intercept	1.117	0.143	7.83	<
t			0	0.00

Table 4, showing the results of summary effect size obtained value $z = 7.830$; $p < 0.001$ and standard error of 0.143, the application of the Internet of Things has a high positive influence on student creativity in the learning process ($rRE = 1.117$). This finding implies that the Internet of Things is very effective in encouraging student creativity on campus.

The results of this study are in line with Abbasy & Quesada (2020) The application of the Internet of Things has a positive influence on student creativity. This finding is also supported by the results of the study Dewanto et al., (2023) The Internet of Things can help students learn more creatively, so they have innovation in finding new ideas in learning. Research conducted by Lee et al. (2018) tested the application of the Internet of Things (IoT) in interior design lectures. Students are asked to design smart classroom prototypes by utilizing various IoT sensors. In addition, the Internet of things fosters student creativity in designing designs that are interactive and responsive to user needs (Razzaque, 2019).

Furthermore, another study by Lim et al. (2019) also produced similar findings. In

their research, engineering students were asked to make prototypes of medical devices using IoT modules. Students consider the learning process to be able to train their imagination and creative thinking in combining technological components. According to a longitudinal study conducted by Rahman (2021), the application of IoT in product design lectures is significantly able to increase the originality of student design ideas and variations from year to year. This indicates that consistent use of IoT has a positive impact on student creativity (Ardi et al., 2023).

The use of the Internet of Things and other latest technology has high enough effectiveness to train and hone student creativity. Internet of Things-based learning is effectively implemented in higher education to produce graduates who are innovative and ready to work in the digital era. Research from Wu et al., (2016) concluded that the main challenge of implementing IoT in education is to increase the readiness of lecturers in designing creative and effective learning with IoT. Lecturer training is absolutely necessary. (Burd et al., 2017) The Internet of things is generally effective in training student creativity. However, the readiness of lecturers and mature learning design also determine their success Nazir et al., (2019) Training and mentoring need to be provided to lecturers so that maximum IoT implementation increases student creativity.

Conclusion

From this meta-analysis research, it can be concluded that the implementation of the Internet of Things has a significant effect on student creativity with a very high summary effect size ($rRE = 1.117$) effect size category. These findings explain that the Internet of Things is effective in helping students increase their learning creativity in

schools. The Internet of Things helps students more easily open big data that can train creativity in learning activities.

Reference

- Abbasy, M. B., & Quesada, E. V. (2020). Predictable Influence of IoT (Internet of Things) in the Higher Education. *International Journal of Information and Education Technology*, 7(12), 1–7. <https://doi.org/10.18178/ijiet.2017.7.12.995>
- Abdul Rahman1*, Ilwandri2, Tomi Apra Santosa3, Revi Gina Gunawan4, Yayat Suharyat5, Ringgo Putra6, A. S. (2023). Effectiveness of Problem-Based Learning Model in Science Learning: A Meta- Analysis Study. *JUARA : Jurnal Olahraga*, 8(2), 713–726.
- Abdullah Ardi et al. (2023). The Effect Of The Internet Of Things Integrated Discovery Learning Model On Students Critical Thinking Skills. *International Journal of Teaching and Learning (INJOTEL)*, 1(3), 270–280.
- Abdullah, K. H., Lecturer, S., Safety, O., Gazali, N., Education, P., Riau, I., ... Abdul, T. (2024). Internet of Things (IoT) in Education: A Bibliometric Review. *International Journal of Information Science and Management*, 22(1), 183–202.
- Anh, N. T. Van, Bien, N. Van, Son, D. Van, Thi, N., Khuyen, T., Nam, V., ... Nam, V. (2022). *STEM C lubs: The Promising Space to Foster Students' Creativity*. 2(1), 45–52.
- Ariswan, A., Yogyakarta, U. N., & Irwanto, I. (2023). The Effect of Interface Instrumentation Experiments-Supported Blended Learning on Students ' Critical Thinking Skills and Academic Achievement The Effect of Interface Instrumentation Experiments-Supported Blended Learning on Students ' Critical Thinking S. *IJIM* –, 17(14), 101–125. <https://doi.org/10.3991/ijim.v17i14.38611>
- Borenstein, M., & Hedges, L. V. (2009). *Introduction to Meta-Analysis Introduction*. UK.
- Burd, B., Divitini, M., Armando, F., Perez, F., Siever, B., & Tudor, L. (2017). *Courses , Content , and Tools for Internet of Things in Computer Science Courses , Content , and Tools for Internet of Things in Computer Science Education*. (January). <https://doi.org/10.1145/3174781.3174788>
- Chamdani et al. (2022). Meta-Analysis Study : The Relationship Between Reflective Thinking And Learning Achievement. *ERIES Journal*, 15(3), 181–188.
- Cohen, L., Manion, L., Lecturer, P., Morrison, K., & Lecturer, S. (2007). *Research Methods in Education*. New York,: Routledge is an imprint of the Taylor & Francis Group, an informa business.
- Dharin, P. &. (2021). Students Creativity Development Model and Its Implementation in Indonesian Islamic Elementary School. *Pegem Journal of Education and Instruction*, 11(3), 81–87. <https://doi.org/10.14527/pegegog.2021.00>
- Diah et al. (2022). Meta-Analysis of Focusky Learning Media on Student Learning Outcomes. *INTERNATIONAL JOURNAL OF ASIAN EDUCATION*, 3(2), 20–22. <https://doi.org/10.55943/jipmukjt.v3i2.34>
- Emre Özgül a *, M. A. O. (2023). The effect of internet of things education through distance education on student success and motivation. *Journal of Educational Technology & Online Learning*, 6(2), 1–18.
- Francisti, J. (2023). THE USE OF INTERNET

- OF THINGS TECHNOLOGY IN THE PEDAGOGICAL PROCESS. *Proceedings of the 5th International Baltic Symposium on Science and Technology Education, BalticSTE2023*, 65–75.
- Frydenberg, M. (2023). Teaching Case Alexa , Help Me Learn About the Internet of Things ! *Information Systems Education Journal (ISEDJ)*, 21(May), 69–81.
- Ghudkam, S., Chatwattana, P., & Piriyasurawong, P. (2023). An Imagineering Learning Model using Advance Organizers with Internet of Things. *Higher Education Studies*, 13(2), 128–134. <https://doi.org/10.5539/hes.v13n2p128>
- Glass, G. V. (1974). *Primary, Secondary, and Meta-Analysis of Research*.
- Hadiati, S., & Saputri, D. F. (2022). Development of IoT-Based Physics Learning Media and Its Effect on Students ' Critical Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, 8(5), 2241–2246. <https://doi.org/10.29303/jppipa.v8i5.2284>
- Hanif, S., Fany, A., Wijaya, C., & Winarno, N. (2019). Enhancing Students ' Creativity through STEM Project-Based Learning. *Journal of Science Learning*, 2(2), 1–8. <https://doi.org/10.17509/jsl.v2i2.13271>
- Hariyadi, S., Santosa, T. A., & Sakti, B. P. (2023). Effectiveness of STEM-Based Mind Mapping Learning Model to Improve Students ' Science Literacy in the Era of Revolution. *Jurnal Penelitian Pendidikan IPA*, 9(10), 791–799. <https://doi.org/10.29303/jppipa.v9i10.5125>
- Hou, H., Zhang, X., & Wang, D. (2022). Can Educational Robots Improve Student Creativity : A Meta-analysis based on 48 Experimental and Quasi-experimental Studies. *BECE*, 11(1), 1449–1454. <https://doi.org/10.15354/bece.22.ab001>.How
- Ichsan, Tomi Apra Santosa, Ilwandri, Aulia Sofianora, U. Y. (2022). Efektivitas Evaluasi Model CIPP Dalam Pembelajaran IPA di Indonesia : Meta-Analisis. *Jurnal Pendidikan Dan Konseling*, 5(2), 1349–1358.
- Ichsan, Yayat Suharyat, Tomi Apra Santosa, E. (2023). The Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning : A. *Jurnal Penelitian Pendidikan IPA*, 9(1), 150–166. <https://doi.org/10.29303/jppipa.v9i1.2517>
- Lolang, E., Rais, R., Oualeng, A., Prayitno, M. A., Jakarta, U. P., & Kalabahi, U. T. (2023). Analysis Of Educational Messages In The Lion King Movie : Perspectives On Character Education And Environmental Conservation. *COMPETITIVE: Journal of Education*, 2(2), 122–130.
- Maulidia, F., & Abidin, Z. (2020). The implementation of problem-based learning (pbl) model to improve creativity and self-efficacy of field dependent and field independent students. *Malikussaleh Journal of Mathematics Learning (MJML)*, 3(1), 13–17.
- Nazir, S., Ali, Y., & Ullah, N. (2019). Internet of Things for Healthcare Using Effects of Mobile Computing : A Systematic Literature Review. *Wireless Communications and Mobile Computing*, 1–21.
- Occe Luciana1*, Tomi Apra Santosa2, Agus Rofi'i3, Taqiyuddin4, B. N. (2023). Meta-analysis: The effect of problem-based learning on students' critical thinking skills. *Edumaspul: Jurnal*

- Pendidikan*, 7(2), 2058–2068.
<https://doi.org/10.1063/1.5139796>
- Oktarina, K., Santosa, T. A., Razak, A., & Ahda, Y. (2021). Meta-Analysis : The Effectiveness of Using Blended Learning on Multiple Intelligences and Student Character Education during the Covid-19 Period. *IJECA International Journal of Education & Curriculum Application*, 4(3), 184–192.
- Ortiz-revilla, J. (2021). education sciences STEM vs . STEAM Education and Student Creativity : A Systematic Literature Review. *Educ. Sci.*, 11(331), 1–13.
- Prahani, B. K., Suprpto, N., Rachmadiarti, F., Sholahuddin, A., Mahtari, S., Suyidno, & Siswanto, J. (2021). Online Scientific Creativity Learning (OSCL) in Science Education to Improve Students' Scientific Creativity in Covid-19 Pandemic. *Journal of Turkish Science Education*, 18(Special Issue), 77–90.
<https://doi.org/10.36681/tused.2021.73>
- Pramesworo, I. S., Sembiring, D., Sarip, M., Lolang, E., Fathurrochman, I., Jayapura, P. P., ... Toraja, I. (2023). Identification of New Approaches to Information Technology-Based Teaching for Successful Teaching of Millennial Generation Entering 21st Century Education. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, 8(1), 350–370.
- Rahman, A. A., Santosa, T. A., Nurtamam, M. E., & Widoyo, H. (2023). Meta-Analysis : The Effect of Ethnoscience-Based Project Based Learning Model on Students ' Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(9), 611–620.
<https://doi.org/10.29303/jppipa.v9i9.4871>
- Rahman, A., Santosa, T. A., & Suharyat, Y. (2023). *The Effect of Problem Based Learning-STEM on Students ' 21st Century Skills in Indonesia : A Meta-Analysis*. 2(1).
- Razak, Abdul, Santosa, Tomi Apra, Lufri., et al. (2021). Meta-Analysis: Pengaruh Soal HOTS (Higher Order Thinking Skill) Terhadap Kemampuan Literasi Sains dan Lesson Study Siswa Pada Materi Ekologi dan Lingkungan Pada Masa Pandemi Covid-19. *Bioedusiana*, 6(1), 79–87.
- Razzaque, A. (2019). Internet of Things facilitates e- learning. *International Journal of Innovation, Creativity and Change*, 9(9), 38–53.
- Santosa, T. A., Sepriyani, E. M., Lufri, L., & Zulyusri, Z. (2021). Meta-Analysis: Penggunaan Modul Berbasis Hots Pada Materi Ekologi Dan Lingkungan Di Sma. *Jurnal Eduscience*, 8(1), 53–56.
<https://doi.org/10.36987/jes.v8i1.1976>
- Sari, D. K., Banowati, E., & Purwanti, E. (2018). The Effect of Problem-Based Learning Model Increase The Creative Thinking Skill and Students Activities on Elementary School. *Journal of Primary Education*, 7(1), 57–63.
- Subali, B., & Susilo, M. J. (2022). Analogipedia : An Android-Based Module Utilizing PBL Model Based on Analogical Approach to Improve Students ' Creativity. *Anatolian Journal of Education*, 7(1), 45–56.
- Supriyadi, A., Suharyat, Y., Santosa, T. A., & Sofianora, A. (2023). The Effectiveness of STEM-Integrated Blended Learning on Indonesia Student Scientific Literacy : A Meta-analysis. *International Journal of Education and Literature (IJEL)*, 2(1), 41–48.
- Suryono, W., Haryanto, B. B., Santosa, T. A., Suharyat, Y., & Sappaile, B. I. (2023). The Effect of The Blended Learning Model on Student Critical Thinking Skill : Meta-analysis. *Edumaspul - Jurnal Pendidikan*, 7(1), 1386–1397.
- Tamur, M., Fedi, S., Sennen, E., Marzuki,

- Nurjaman, A., & Ndiung, S. (2021). A meta-analysis of the last decade STEM implementation: What to learn and where to go. *Journal of Physics: Conference Series*, 1882(1). <https://doi.org/10.1088/1742-6596/1882/1/012082>
- Tamur, Maximus, & Wijaya, T. T. (2021). Using Problem-Based Learning to Enhance Mathematical Abilities of Primary School Students : A Systematic Review and Meta-Analysis. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, 5(1), 144–161.
- Utomo, W., Suryono, W., Santosa, T. A., & Agustina, I. (2023). The Effect of STEAM-Based Hybrid Based Learning Model on Students ' Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(9), 742–750. <https://doi.org/10.29303/jppipa.v9i9.5147>
- Wang, R. N., & Chang, Y. C. (2022). Effect of Intrinsic Motivation on Junior High School Students' Creativity: Mediating Role of Cognitive Flexibility. *International Journal of Educational Methodology*, 8(2), 297–312. <https://doi.org/10.12973/ijem.8.2.297>
- Wantu, H. M., Dwihapsari, Y., Santosa, T. A., & Agustina, I. (2023). Effectiveness of The Internet of Things (IoT) -Based Jigsaw Learning Model on Students ' Creative Thinking Skills : A-. *Jurnal Penelitian Pendidikan IPA*, 9(10), 912–920. <https://doi.org/10.29303/jppipa.v9i10.4964>
- Wu, J., Chen, J., Dou, W., Wu, J., Chen, J., & Dou, W. (2016). The Internet of Things and interaction style : the effect of smart interaction on brand attachment. *Journal of Marketing Management*, 00(00), 1–15. <https://doi.org/10.1080/0267257X.2016.1233132>
- Zulkifli Zulkifli, Agus Supriyadi, Erwinsyah Satria, & Tomi Apra Santosa. (2022). Meta-analysis: The Effectiveness of the Integrated STEM Technology Pedagogical Content Knowledge Learning Model on the 21st Century Skills of High School Students in the Science Department. *Psychology, Evaluation, and Technology in Educational Research*, 1(2), 68–76. <https://doi.org/10.55606/ijel.v1i2.32>
- Zulyusri, Tomi Apra Santosa, Festiyed, Yerimadesi, Yohandri, Abdul Razak, S. (2023). Effectiveness of STEM Learning Based on Design Thinking in Improving Critical Thinking Skills in Science Learning : A. *Jurnal Penelitian Pendidikan IPA*, 9(6), 112–119. <https://doi.org/10.29303/jppipa.v9i6.3709>