Effectiveness of the Inquiry Based Learning Model Based on Mobile Learning on Students' Creative Thinking Skills: A Meta-Analysis

Suyatmo[1*], Via Yustitia[2], Tomi Apra Santosa[3], Fajriana[4], Unan Yusmaniar Oktiawati[5]

[1] Lecturer in Aircraft Engineering, Aviation Polytechnic of Surabaya, Surabaya, Indonesia.
[2] Lecturer in PGSD, Faculty of Pedagogy and Psychology, Universitas PGRI Adi Buana Surabaya, Surabaya, Indonesia.
[3] Lecturer Civil Engineering, Adi Karya Technical Academy, Jambi, Indonesia.
[4] Lecturer in Mathematics Education, FKIP, Malikussaleh University, Aceh, Indonesia.
[5] Lecturer in Electrical Engineering and Informatics, Gajah Mada University, Yogyakarta, Indonesia.

Abstract: This study aims to determine the effect of the inquiry-based learning model based on Mobile Learning on Students' Creative Thinking Skills. This type of research is quantitative research with meta-analysis methods. The data source comes from analysis of national and international journals. The process of searching for data sources through the Google Scholar, ERIC, DOAJ, Wiley, Taylor of Francis and Plos ONE databases. Inclusion criteria are data sources from national and international journals indexed by SINTA; Scopus, WOS, DOAJ and EBSCO, Research must be related to inquiry models, mobile learning and critical thinking skills, Journals must be published in 2017-2023 and have a value (r), (t), or F N ≥ 25. Research results of 18 studies explains that the inquiry-based learning model based on mobile learning has a significant effect on students' creative thinking skills ($z = 6.713$; $p < 0.001$; CI 95% (0.784; 1.206). The effect size in this study is high criteria ($rRE = 0.885$). These findings show the application of mobile learning-based inquiry learning models has a major effect on students' creative thinking skills.

Keywords: Creative thinking; Inquiry learning model; Learning; Mobile learning

Introduction

Creative thinking is a thought process that students must have to generate new ideas in solving a problem (Ernawati & Maniarta, 2022; Kartikasari et al., 2022; Tabieh & Hamzeh, 2022; Li, 2021). Creative thinking skills have a role for students in solving a problem in the learning process (Made et al., 2020; Suwendra, 2023). Students who have creative thinking skills are able to encourage student creativity in learning (Ndiung et al., 2021; Yustiana el al., 2022; Hasancebi, 2021). Furthermore, creative thinking skills train students in providing new ideas in learning activities (Deswiana et al., 2019; Zainil et al., 2023; Pigza, 2015).

The reality is that in schools students' creative thinking skills are still low (Nurtamam et al., 2023; Suryandari et al., 2021; Fauziah et al., 2014). The low level of students' creative thinking skills can be seen from the lack of activeness and the difficulty of students in solving problems related to analysis (Elizabeth et al., 2018). Furthermore, teachers do not direct students to think at a higher level (Ernawati et al., 2022; Oktarina et al., 2021; Elfira et al., 2023; Ichsan et al., 2023). Teachers still use the lecture learning method so that learning is centered on the teacher (Supriyadi et al., 2023; Jamaludin et al., 2022; Supriyadi et al., 2023; Putra et al., 2023). Learning does not involve students to think creatively to solve a problem (Siburian et al., 2019; Suryono et al., 2023).

Furthermore, one way to develop students' creative thinking skills is with the inquiry-based learning model based on mobile learning. The inquiry-based learning model is a learning model that can encourage students to learn more actively to discover new things through experimentation (Susilowati, 2020; Fitri et al., 2022; Astalini et al., 2023). Research results of Asyari, et al., (2019), the inquiry-based learning model can increase meta-cognitive knowledge so that students have creative thinking skills. Furthermore, the inquiry learning model can foster students' curiosity about something (Adnan et al., 2021).

Inquiry-based learning model based on mobile learning can develop students' creative thinking skills through technology. Mobile learning is a learning that can be done online and offline through the internet network (Türker, 2022; Akkaya et al., 2021). Drolia et al. (2022) learning activities through mobile learning can be done through computers, laptops, tablets, cell phones and other electronic devices (Turan & Yaman, 2022; Shams et al., 2021). Mobile learning makes students learn more independently and creatively (Rahmawati & Mukminan , 2017). The use of mobile learning can foster student learning intentions (Rumengan et al., 2019). Therefore, the inquiry learning model based on mobile learning is one of the learning models to train creative thinking.

Previous research by Kılıç et al. (2022) stated that the inquiry-based learning model can improve students' thinking skills and attitude towards learning. Research results of Prameswari et al. (2018), the application of the inquiry learning model has a positive effect on students' critical thinking skills. Furthermore, the inquiry-based learning model has a major influence on improving student learning outcomes (Hosnah, 2010). Research results of Maknun (2020), the inquiry learning model is effective to encourage students' concept understanding and critical thinking skills. Therefore, based on the above problems, this study aims to influence the mobile learning-based model on students' creative thinking skills. inquiry based learning.

Method

Research Design

This research is quantitative research with a meta-analysis approach. Meta-analysis is a research approach that analyzes previous research that can be analyzed statistically (Diah et al., 2022; Öztürk et al., 2022; Santosa et al., 2021; Zulyusri et al., 2023; Gao et al., 2020). This meta-analysis aims to determine the effect of inquiry learning model based on mobile learning on students' creative thinking skills. In meta-analysis, research analysis is carried out systematically and structured,

having rules in selecting and calculating the effect size value (Yusuf, 2023). Next, the method of data source selection is the PRISMA method, which can be seen in Figure 1.
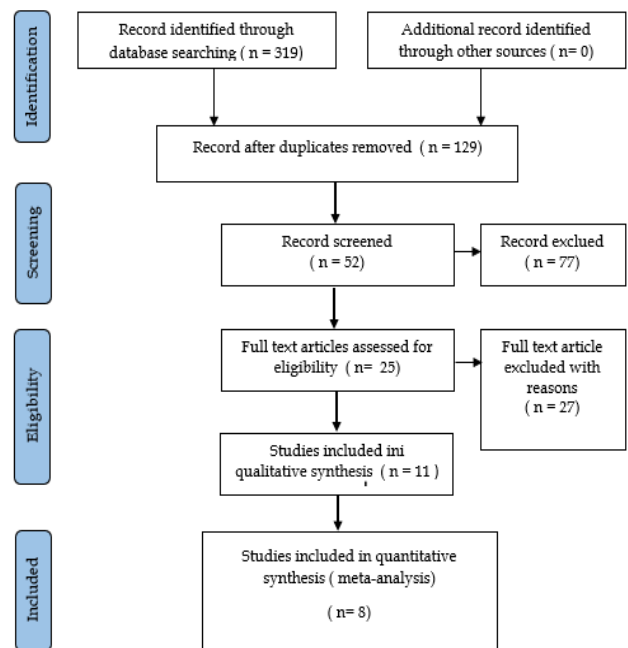
Figure 1. Data Selection through PRISMA method

Inclusion and Exclusion Criteria

In the process of searching for data sources, there are several inclusion criteria, namely: First, the research was searched through the google scholar database, ERIC, Wiley, ProQuest, ScienceDirect and Plos ONE. Second, the research must be published from 2016-2023. Third, the research must have a relationship with the inquiry learning model, mobile learning and creative thinking. Fourth, the research has an experimental class and a control class. Fifth, the research must have a value of (t), (r), or (f) and the sample size must be ≥ 25. The exclusion criteria are research with incomplete data exposure and only a brief review or abstract. Furthermore, for overlapping studies, only studies with large sample sizes were included.

Data Coding

The data coding process in meta-analysis is essential for collecting and analyzing data (Yıldırım, 2022). Therefore, the data coding process in this study took into account aspects such as researcher name, year of publication, sample size (N), (r), (t), and (f) values, journal type and country of origin.

Variable

Three variables were coded from each study, namely: First, the type of publication in the form of journals and proceedings. Second, the level of education

(elementary, junior high, high school and university). Third, the field of research (biology, physics, chemistry and mathematics) and fourth, the affected variable (creative thinking).

Data Analysis

Data analysis in meta-analysis was carried out by 1) analyzing data based on research characteristics; 2) coding data from each study; 3) converting t and f values into r values; 4) calculating the heterogeneity value of each study; 5) calculating the summary effect value or mean effect size; 6) making forest plots and funnel plots; 7) conducting hypothesis testing; 8) checking publication bias from each study. The effect size criteria in this study are based on Cohen (1988) which can be seen in table 1.eria effect size in this study based on criteria.

Table 1. Effect Size Criteria Based on Cohen's (Cohen et al., 2007)

Effect Size	Criteria
0 until .1	Weak
< 0.30	Modest
< 0.50	Medium
< 0.8	Strong
≥ 0.8	Very Strong

Result and Discussion

Results

From the analysis of 319 studies on the effect of mobile learning-based Inquiry Learning model on students' creative thinking skills, there were only 8 studies that met the inclusion criteria. Furthermore, studies that have met the inclusion criteria are analyzed based on research characteristics consisting of the researcher's name, sample size (N), value (t), (r) and (F), and publication type. The results of sample analysis based on research characteristics can be seen in Table 2.

Table 2. Sample Analysis Based on Research Characteristics

Author	N	r	t	F
Sulastri et al., (2019)	28	0.71		
Ulandari et al., (2019)	87	1.16		
Yolida & Priadi, (2021)	28		2.91	
Ernawati & Maniarta, (2022)	130		4.10	
Satriawati (2017)			0.91	
Sabrina & Kuswanto., (2018)	40	2.52		5.14
(Dewi, 2019)	36		1.31	
(Zubaidah et al., 2017)	96	2.10		

Table 2 explains the data analysis based on the characteristics of the researchers where the sample size (N) ranges from 28-130 students. Furthermore, before conducting hypothesis testing, we must first conduct a

heterogeneity test of each research effect size. The results of the heterogeneity test can be seen in table 3 and table 4.

Table 3. Heterogeneity Test Results

	Q	df	p
Omnibus test of Model Coefficients	54.209	1	< 0.001
Test of Residual Heterogeneity	320.145	7	< 0.001

Note. *p value is approximate*

**Table 4.** The Residual Heterogeneity Test Result

	Estimates	Lower bound	Upper Bound
τ^2	0.3780	0.2441	0.7562
τ	0.5147	0.4932	0.9651
I^2 (%)	95.015	92.7110	98.326
H^2	29.541	17.0082	46.910

Based on tables 3 and 4, it explains that the 8 studies are heterogeneously distributed. This can be seen from the p value <0.001; Q = 54.209; τ^2 or t> 0 and I2 (%) = 95.015 close to 100%. The next step is to calculate the summary effect value or mean effect size of the entire research sample. The results of the summary effect size test or mean effect size can be seen in Table 5.

Table 5. Results of the Summary Effect Size or Mean Effect Size Test

	Estimates	SE	z	p	Lower	Upper
Intercept	0.885	0.1728	6.713	< 0.001	0.784	1.206

Based on table 5 explains that the value of Z = 6.713; p < 0.001. This result shows that the application of inquiry-based learning model based on mobile learning affects students' creative thinking skills. Furthermore, the results can be categorized as having a large effect based on the estimated standard error value of 0.885 (0.784; 1.206). In addition, the effect size summary analysis test can be illustrated by the forest plot in Figure 2.
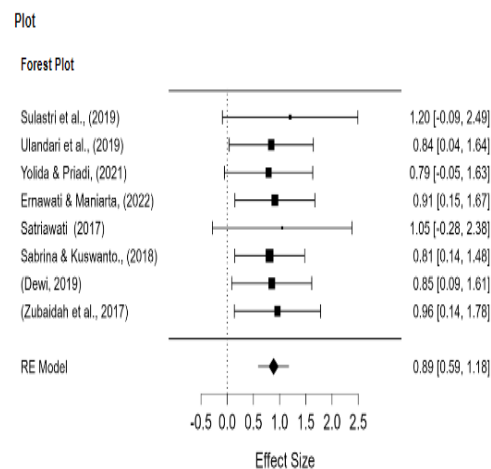
Figure 2. Forest Plot

Based on figure 2 explains that the overall effect size of the study has a significant effect. Furthermore, knowing the publication bias of each study. In this meta-analysis research, publication bias can be known by using funnel plot. Funnel flot effect size of the entire study can be seen in Figure 3.
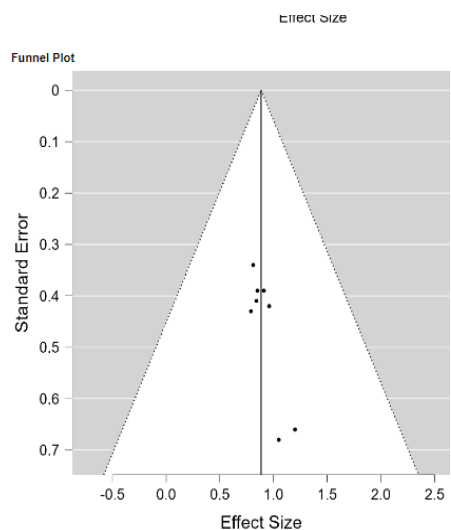

Figure 3. Funnel plot standard error

Based on Figure 3 explains that the points of research that are widespread domina are in the middle of the curve. This shows the effect size but it is difficult to determine whether this meta-analysis is symmetrical or asymmetrical, so the Egger test is needed. The results of the Egger test can be seen in Table 6.

Table 6. Egger Test Results

	z	p
Sei	1.314	1.805

Table 6 explaining the p-value > 0.05, the funnel plot distribution is symmetrical. The funnel plot shows that there is no publication bias in this study. Furthermore, to increase the validity of publication bias, it is necessary to conduct the Fail-Safe N (FSN) test. The results of the fail-safe N test can be seen in table 7.

Table 7. Result Fail Safe N Test

	Fail safe N	Target Significance	Observed significance
Rosenthal	146	0.050	< 0.001

Based on table 7, the fail-safe N (FSN) value is 146. Furthermore, the value of fail-safe N is compared with the value of k = (5.8) + 10 = 50. Therefore, the value of fail-safe N 146 / 50 = 1.2 > 0.05 means that in this meta-analysis study there is no publication bias.

Discussion

The application of the inquiry-based learning model based on mobile learning has a high effect on students' critical thinking skills. This can be seen from the summary effect value and the overall mean effect size of 0.885 (0.784; 1.206) with strong effect size criteria. Research results Kılıç et al. (2022), the application of the inquiry-based learning model can improve students' thinking skills and learning attitudes. The inquiry-based learning model based on mobile learning trains students to learn more actively and creatively according to their learning interests (Korkman & Metin, 2021; Bird & Rice, 2021; Khasawneh et al., 2023). Furthermore, the inquiry-based learning model based on mobile learning helps students learn more creatively and innovatively through technology, thus training students to think creatively (Bacak & Byker, 2021).

Research results Liu et al. (2022) inquiry based learning is effective for students in finding new ideas in solving a problem. inquiry based learning model can encourage student learning outcomes so that students are more active in the learning process (Öztürk et al., 2022). In addition, research results (Hwang et al., 2013) inquiry based learning model based on mobile learning effectively develops cognitive thinking skills and student learning achievement. Creative thinking is very important for students in providing solutions to problems in learning (Ichsan et al., 2023; Ramdani, 2016; Mursid et al., 2022). Not only that, creative thinking skills help students more easily find sources of information through technology (Kesici, 2022). This is due to inquiry based learning based on mobile learning, students can more quickly access learning information through internet media (Tabieh & Hamzeh, 2022; Syafrial et al., 2022).

Learning through mobile learning can make the learning atmosphere more interesting so that students are more creative in learning (Akkaya et al., 2021; Özcan, 2022). According to Pillena et al. (2019), mobile learning is able to train students in developing their pre-science skills so that it helps them to think creatively. Not only that, mobile learning can help students learn independently and have high learning outcomes (Rahmawati & Mukminan, 2017). Therefore, the inquiry-based learning model based on mobile learning is very suitable to help students develop creative thinking skills in learning activities at school.

Furthermore, in this analytical research, we also analyzed the bias of research publications related to inquiry-based learning models and creative thinking skills. In table 7 Shows that the Fail Safe N test value > 0.05. This means that the research used in this study is resistant to publication bias. Calculation of publication bias is very important in meta-analysis research because

it affects hypothesis testing (Kim et al., 2018; Gao et al., 2020). It can be seen that there is a significant effect of inquiry-based learning model based on mobile learning on creative thinking skills compared to conventional learning.

Conclusion

From this study it can be concluded that the inquiry-based learning model based on mobile learning has a significant effect on students' creative thinking skills (z = 6.713; p < 0.001; CI 95% (0.784; 1.206). Effect size in this study is high criteria (rRE = 0.885). This finding shows that the application of inquiry learning model based on mobile learning has a great effect on students' creative thinking skills. The mobile-based inquiry-based learning model is able to train students to learn independently and creatively through technology. So, this model is very effective in helping teachers in encouraging students' creative thinking skills.

References

Adnan, G., Zulfikar, T., Armia, M. S., Gade, S., & Walidin, W. (2021). Impacts of Inquiry Learning Model on Students' Cognitive and Critical Thinking Ability. *Cypriot Journal of Educational Sciences, 16*(3), 1290-1299. https://doi.org/10.18844/cjes.v16i3.5851

Akkaya, S., Ciğerci, M. F. & Kapıdere, M. (2021). Investigation of the relationship between prospective teachers' attitudes towards mobile learning and their readiness for mobile learning. *International Online Journal of Education and Teaching (IOJET)*, 8(4), 2949–2965. Retrieved from https://files.eric.ed.gov/fulltext/EJ1319321.pdf

Astalini, A., Darmaji, D., Kurniawan, D. A., & Septi, S. E. (2023). Overview the inquiry learning model : Attitudes , student characters , and student

responses what ' s the impact ? *Journal of Education and Learning (EduLearn)*, 17(1), 85~92. https://doi.org/10.11591/edulearn.v17i1.20530

Asy'ari, M., & Ikhsan, M. (2019). The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Metacognition Awareness. *International Journal of Instruction, 12*(2), 455-470. https://doi.org/10.29333/iji.2019.12229a

Bacak, J., & Byker, E. J. (2021). Moving from Levels of Inquiry to the Flexible Phases of In-quiry Theory : A Literature Review of Inquiry-Based Teacher Education. *Journal of Teacher Education and Educators*, 10(2), 255–271. Retrieved from https://www.tused.org/index.php/tused/article/view/189/144

Bird, T. D., & Rice, A. H. (2021). The Influence of CASE on Agriculture Teachers ' Use of Inquiry-Based Methods. *Journal of Agricultural Education*, 62(1), 260–275. https://doi.org/10.5032/jae.2021.01260

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences Second Edition*. Lawrence Erlbaum Associates,.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education*. Retrieved from https://repository.stkipjb.ac.id/index.php/lecturer/article/download/1362/1139

Deswiana, E., Tri, H., & Yolida, B. (2019). Pengaruh Project Based Learning terhadap Peningkatan Kemampuan Berpikir Kreatif dan Self-efficacy. *Jurnal Bioterdidik*, 7(3), 13–21. Retrieved from https://repository.lppm.unila.ac.id/48513/

Dewi, C. A. (2019). The Effect of Chemo-Entrepreneurship Oriented Inquiry Module on Improving Students ' Creative Thinking Ability. *Journal of Turkish Science Education*, 16(2), 253–263. https://doi.org/10.12973/tused.10279a

Diah, H. R., Dayurni, P., Evasufi, L., & Fajari, W. (2022). Meta-Analysis Study : The Effect of Android-Based Learning Media on Student Learning Outcomes. *International Journal of Asian Education*, 3(4), 253–263. https://doi.org/10.46966/ijae.v3i4.300

Drolia, M., Papadakis, S., Sifaki, E., & Kalogiannakis, M. (2022). Mobile learning applications for refugees: A systematic literature review. *Education Sciences*, 12(2), 96. https://doi.org/10.3390/educsci12020096

Elfira, I., & Santosa, T. A. (2023). Literature Study : Utilization of the PjBL Model in Science Education to Improve Creativity and Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(1), 133–143. https://doi.org/10.29303/jppipa.v9i1.2555

Elizabeth, A., & Sigahitong, M. M. (2018). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kreatif Peserta Didik SMA. Prisma Sains: *Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 6*(2), 66-76. https://doi.org/10.33394/j-ps.v6i2.1044

Ernawati, E., & Maniarta, T. (2022). Implementation of free inquiry approach based on blended learning on creative thinking and student collaboration skills. *Jurnal Pendidikan Biologi Indonesia*, *8*(3), 216–225. https://doi.org/10.22219/jpbi.v8i3.22254

Ernawati, M. D. W., Rusdi, M., Asrial, A., Muhaimin, M., Wulandari, M., & Maryani, S. (2022). Analysis of problem based learning in the scaffolding design: Students' creative-thinking skills. *Cypriot Journal of Educational Sciences*, *17*(7), 2333–2348. https://doi.org/10.18844/cjes.v17i7.7551

Fauziah, M., Marmoah, S., Murwaningsih, T., & Saddhono, K. (2020). The Effect of Thinking Actively in a Social Context and Creative Problemsolving Learning Models on Divergent-Thinking Skills Viewed from Adversity Quotient. *European Journal of Educational Research, 9*(2), 537-568. https://doi.org/10.12973/eu-jer.9.2.537

Fitri, L. S., Rosyida, F., Putra, A. K., Wirahayu, Y. A., & Selviana, N. (2022). The Effect of Geographical Inquiry Learning Using SETS Approach to Complex Problem-Solving Abilities on Environmental Conservation Material. *Pegem Egitim ve Ogretim Dergisi*, *12*(4), 61–69. https://doi.org/10.47750/pegegog.12.04.07

Gao, J., Yang, L., Zhao, J., Wang, L., Zou, J., Wang, C., & Fan, X. (2020). Comparison of problem-based learning and traditional teaching methods in medical psychology education in China : A systematic review and meta-analysis. *PLos ONE*, *15*(12), 1–11. https://doi.org/10.1371/journal.pone.0243897

Hasançebi, F., Güner, Ö., Kutru, C., & Hasancebi, M. (2021). Impact of Stem Integrated Argumentation-Based Inquiry Applications on Students' Academic Success, Reflective Thinking and Creative Thinking Skills. *Participatory Educational Research, 8*(4), 274-296. https://doi.org/10.17275/per.21.90.8.4

Hosnah, W. M. (2010). Pengaruh Model Pembelajaran Inkuiri Terbimbing. *Jurnal Pembelajaran Fisik*, *6*(2), 190–195. https://doi.org/10.19184/jpf.v6i2.5020

Hwang, G. J., Wu, P. H., Zhuang, Y. Y., & Huang, Y. M. (2013). Effects of the inquiry-based mobile learning model on the cognitive load and learning achievement of students. *Interactive Learning Environments, 21*(4), 338–354. https://doi.org/10.1080/10494820.2011.575789

Ichsan, I., Suharyat, Y., Santosa, T. A., & Satria, E. (2023). The Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA, 9*(1), 150-166. https://doi.org/10.29303/jppipa.v9i1.2517

Jamaludin, J., Kakaly, S., & Batlolona, J. R. (2022). Critical thinking skills and concepts mastery on the topic of temperature and heat. *Journal of Education and Learning (EduLearn)*, *16*(1), 51–57. https://doi.org/10.11591/edulearn.v16i1.20344

Kartikasari, I. A., Usodo, B., & Riyadi. (2022). The Effectiveness Open-Ended learning and Creative Problem Solving Models to Teach Creative Thinking Skills. *Pegem Egitim ve Ogretim Dergisi*, *12*(4), 29–38. https://doi.org/10.47750/pegegog.12.04.04

Kesici, A. (2022). The Effect of Digital Literacy on Creative Thinking Disposition : The Mediating Role of Lifelong Learning Disposition. *Journal of Learning and Teaching in Digital Age*, *7*(2), 260–273. https://doi.org/10.53850/joltida.1063509

Khasawneh, E., Hodge-zickerman, A., York, C. S., Smith, T. J., & Mayall, H. (2023). Examining the effect of inquiry-based learning versus traditional lecture-based learning on students ' achievement in college algebra. *International Electronic Journal of Mathematics Education*, *18*(1), 1–11. https://doi.org/10.29333/iejme/12715

Kim, N. J., Belland, B. R., & Walker, A. E. (2018). Effectiveness of Computer-Based Scaffolding in the Context of Problem-Based Learning for Stem Education: Bayesian Meta-analysis. *Educational Psychology Review*, *30*(2), 397–429. https://doi.org/10.1007/s10648-017-9419-1

Kılıç, A., & Sciences, E. (2022). The Effect of Layered Inquiry-Based Learning Model on Students ' Skills, Values, and Attitudes. *Journal of Instructional Research*, *11*(5), 118–137. Retrieved from https://files.eric.ed.gov/fulltext/EJ1363668.pdf

Korkman, N., & Metin, M. (2021). The Effect of Inquiry-Based Collaborative Learning and Inquiry-Based Online Collaborative Learning on Success and Permanent Learning of Students. *Journal of Science Learning*, *4*(2), 151–159. https://doi.org/10.17509/jsl.v4i2.29038

Li, U. I. (2021). Creative Thinking Counseling Teaching Program can Improve the Creativity , Creative Tendency , and Self- Concept of Grade 7 Students : A Quasi-Experimental Study. *The Journal of*

Creative Behavior, *0*, 1–20. https://doi.org/10.1002/jocb.491

Liu, Y., He, W., & Zhao, L. (2022). Effects Of Inquiry Learning With Different Task Orders On Fifth Graders' Individual And Situational Interest And Concept Achievement *Journal of Baltic Science Education*, *21*(5), 849–861. https://doi.org/10.33225/jbse/22.21.849

Made, N., Kusadi, R., Sriartha, I. P., & Kertih, I. W. (2020). Model Pembelajaran Project Based Learning Terhadap Keterampilan Sosial Dan Berpikir Kreatif. *TSCJ*, *3*(1), 18–27. https://doi.org/10.23887/tscj.v3i1.24661

Maknun, J. (2020). Implementation of Guided Inquiry Learning Model to Improve Understanding Physics Concepts and Critical Thinking Skill of Vocational High School Students. *International Education Studies*, *13*(6), 117–130. https://doi.org/10.5539/ies.v13n6p117

Mursid, R., Saragih, A. H., & Hartono, R. (2022). The Effect of the Blended Project-based Learning Model and Creative Thinking Ability on Engineering Students' Learning Outcomes. *International Journal of Education in Mathematics, Science and Technology*, *10*(1), 218–235. https://doi.org/10.46328/ijemst.2244

Ndiung, S., Sariyasa, Jehadus, E., & Apsari, R. A. (2021). The effect of treffinger creative learning model with the use rme principles on creative thinking skill and mathematics learning outcome. *International Journal of Instruction*, *14*(2), 873–888. https://doi.org/10.29333/iji.2021.14249a

Nurtamam, M. E., Santosa, T. A., Aprilisia, S., Rahman, A., & Suharyat, Y. (2023). Meta-analysis : The Effectiveness of Iot-Based Flipped Learning to Improve Students' Problem Solving Abilities. *Edumaspul :Jurnal Pendidikan*, *7*(1), 1491–1501. https://doi.org/10.33487/edumaspul.v7i1.6195

Oktarina, K., Suhaimi, S., Santosa, T. A., Razak, A., Irdawati, I., Ahda, Y., ... & Putri, D. H. (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 and Curriculum Application)*, *4*(3), 184-192. https://doi.org/10.31764/ijeca.v4i3.5505

Özcan, M. (2022). Evaluation of prospective teachers' digital literacy levels and mobile learning attitudes. *Journal of Educational Technology & Online Learning*, *5*(2), 1–12. https://doi.org/10.31681/jetol.1020586

Öztürk, B., Kaya, M., & Demir, M. (2022b). Does inquiry-based learning model improve learning outcomes ? A second-order meta-analysis. *Journal of Pedagogical Research*, *6*(4), 201–216. https://doi.org/10.33902/JPR.202217481

Pigza, J. M. (2015). Navigating leadership complexity through critical, creative, and practical thinking. *New Directions for Student Leadership, 2015*(145), 35-48. https://doi.org/10.1002/yd

Pillena, L. S., Cahyana, U., & Purwanto, A. (2019). Pengaruh Media Mobile Learning Dan Kemampuan Metakognitif Terhadap Keterampilan Proses Sains Siswa. *Jurnal Tadris Kimiya*, *4*(2). Retrieved from https://sipeg.unj.ac.id/repository/upload/jurnal/5132-19516-1-PB(1).pdf

Prameswari, G., Apriana, R., & Wahyuni, R. (2018). Pengaruh model inquiry learning terhadap kemampuan berpikir kritis matematis siswa pada materi fungsi kuadrat kelas X SMA Negeri 3 Singkawang. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, *3*(1), 35-40. http://dx.doi.org/10.26737/jpmi.v3i1.522

Putra, M., Rahman, A., Suhayat, Y., Santosa, T. A., & Putra, R. (2023). The Effect of STEM-Based REACT Model on Students ' Critical Thinking Skills : A Meta-Analysis Study. *LITERACY : International Scientific Journals of Social, Education and Humaniora*, *2*(1), 207–217. https://doi.org/10.56910/literacy.v2i1.560

Rahmawati, E. M., & Mukminan, M. (2017). Pengembangan m-learning untuk mendukung kemandirian dan hasil belajar mata pelajaran Geografi. *Jurnal Inovasi Teknologi Pendidikan, 4*(2), 157-166. http://dx.doi.org/10.21831/jitp.v4i2.12726

Ramdani, D. (2016). The Effectiveness of Collaborative Learning on Critical Thinking, Creative Thinking, and Metacognitive Skill Ability: Meta-Analysis on Biological Learning. *European Journal of Educational Research Volume*, *11*(3), 1607–1628. https://doi.org/10.12973/eu-jer.11.3.1607

Rumengan, Y., & Talakua, C. (2020). Pengaruh Penggunaan Media Pembelajaran Mobile Learning berbasis Smartphone terhadap Minat Belajar Siswa SMA Negeri 1 Seram Utara Barat. *Jurnal BIOEDUIN: Biology Education of Indonesia, 10*(2), 33-40. https://doi.org/10.15575/bioeduin.v10i2.12087

Santosa, T. A., Razak, A., Arsih, F., & Sepriyani, E. M. (2021). Meta-Analysis : Science Learning Based on Local Wisdom Against Preserving School Environments During the Covid-19 Pandemic. *Journal of Biology Education*, *10*(2), 244–251. https://doi.org/10.15294/jbe.v10i2.48533

Satriawati, G. (2017). The Implementation of Open-Inquiry Approach to Improve Students ' Learning

Activities, Responses. *Journal on Mathematics Education*, *8*(1), 103–114. Retrieved from https://core.ac.uk/download/pdf/267823334.pdf

Shabrina, & Kuswanto, H. (2018). Android-Assisted Mobile Physics Learning Through Indonesian Batik Culture : Improving Students ' Creative Thinking and Problem Solving. *International Journal of Instruction*, *11*(4), 287–302. Retrieved from https://files.eric.ed.gov/fulltext/EJ1191704.pdf

Shams, A., Ajmal, F., & Jumani, N. B. (2021). Effectiveness of Mobile Learning for Academic Progress of MS Education Students: A Case Study of Distance Learning Program at IIUI. *Pakistan Journal of Distance and Online Learning, 7*(1), 33-46. Retrieved from https://files.eric.ed.gov/fulltext/EJ1321374.pdf

Siburian, J., Corebima, A. D., & Saptasari, M. (2019). The correlation between critical and creative thinking skills on cognitive learning results. *Eurasian Journal of Educational Research, 19*(81), 99-114. https://doi.org/10.14689/ejer.2019.81.6

Sulastri, F., Utami, L., & Octarya, Z. (2019). Pengaruh Penerapan Model Pembelajaran Inkuiri Terbimbing (Guided Inquiry) Berbantuan Lembar Kerja Siswa. *Konfigurasi*, *3*(`1), 15–22. http://dx.doi.org/10.24014/konfigurasi.v3i1.6802

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. https://doi.org/10.55606/ijel.v2i1.53

Suryandari, K., Rokhmaniyah, & Wahyudi. (2021). The Effect of Scientific Reading Based Project Model in Empowering Creative Thinking Skills of Preservice Teacher in Elementary School. *European Journal of Educational Research, 10*(3), 1329-1340. https://doi.org/10.12973/eu-jer.10.3.1329

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. https://doi.org/10.33487/edumaspul.v7i1.6087

Susilowati, W. (2020). Meta-Analisis Pengaruh Model Inquiry Learning Terhadap Keterampilan Berfikir Kritis pada Mata Pembelajaran Tematik. *Jurnal Ilmiah Pendidikan Profesi Guru*, *3*(1), 211–216. https://doi.org/10.23887/jippg.v3i1.28193

Suwendra, I. W. (2023). The integration of the self-concept-based Upanishad learning model in blended learning and its impact on character development and creative thinking skills. *Ournal of Education and E-Learning Research*, *10*(1), 51–60. https://doi.org/10.20448/jeelr.v10i1.4342

Syafrial, Ashadi, Saputro, S., & Sarwanto. (2022). Trend Creative Thinking Perception of Students in Learning Natural Science : Gender and Domicile Perspective. *International Journal of Instruction*, *15*(1), 701–716. https://doi.org/10.29333/iji.2022.15140a

Tabieh, A. A. S., & Hamzeh, M. (2022). The Impact of Blended-Flipped Learning on Mathematical Creative Thinking Skills. *Journal of Educators Online*, *19*(3). https://doi.org/10.9743/JEO.2022.19.3.15

Turan, S., Yaman, M. S., Genc, H. I., Donmez, A., Herguner, G., & Yaman, Ç. (2022). Predictive of Perceived Learning: Academic Motivation and Attitudes to Mobile Learning. *Turkish Online Journal of Educational Technology-TOJET, 21*(1), 106-113. Retrieved from https://files.eric.ed.gov/fulltext/EJ1337743.pdf

Türker, M. S. (2022). Syrian Refugees ' Acceptance and Use of Mobile Learning Tools During the Covid-19 Pandemic. *Educational Policy Analysis and Strategic Research*, *7*(1), 164–189. https://doi.org/10.29329/epasr.2022.248.9

Ulandari, N., Putri, R., Ningsih, F., & Putra, A. (2019). Efektivitas Model Pembelajaran Inquiry Terhadap Kemampuan Berpikir Kreatif Siswa Pada Materi. *Journal Cendekia: Jurnal Pendidikan Matematika*, *03*(02), 227–237. https://doi.org/10.31004/cendekia.v3i2.99

Yıldırım, N. (2022). Argumentation-Based Teaching in Science Education: Meta- Analysis. *Education Quarterly Reviews*, *5*(2), 226–237. https://doi.org/10.31014/aior.1993.05.02.483

Yolida, B., & Priadi, M. A. (2021). Pengaruh Model Pembelajaran Inkuiri Terimbing Berbasis Kearifan Lokal Terhadap Kemampuan Berpikir Kreatif Peserta Didik Pada Materi Bioteknologi. *Jurnal Bioterdidik*, *9*(2), 38–48. https://doi.org/10.23960/jbt.ix.ii.05

Yustina, Mahadi, I., Ariska, D., Arnentis, & Darmadi. (2022). The effect of e-learning based on the problem-based learning model on students' creative thinking skills during the covid-19 pandemic. *International Journal of Instruction, 15*(2), 329-348. https://doi.org/10.29333/iji.2022.15219a

Yusuf, F. A. (2023). Meta-Analysis: The Influence of Local Wisdom-Based Learning Media on the

Character of Students in Indonesia. *International Journal of Educational Methodology, 9*(1), 237-248. https://doi.org/10.12973/ijem.9.1.237

Zainil, M., Kenedi, A. K., Rahmatina, Indrawati, T., & Handrianto, C. (2023). The influence of a STEM-based digital classroom learning model and high-order thinking skills on the 21st-century skills of elementary school students in Indonesia. *Journal of Education and E-Learning Research, 10*(1), 29–35. https://doi.org/10.20448/jeelr.v10i1.4336

Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2017). Improving creative thinking skills of students through differentiated science inquiry integrated with mind map. *Journal of Turkish Science Education, 14*(4), 77-91. https://doi.org/10.12973/tused.10214a

Zulyusri, Z., Santosa, T. A., Festiyed, F., Yerimadesi, Y., Yohandri, Y., Razak, A., & Sofianora, A. (2023). Effectiveness of STEM Learning Based on Design Thiking in Improving Critical Thinking Skills in Science Learning: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA, 9*(6), 112-119. https://doi.org/10.29303/jppipa.v9i6.3709