The Effect of SETS Based Problem Based Learning on Student's Creative Thinking Ability

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Abstract: This study aims to determine the effect of the size of the influence of the SETS-based Problem Based Learning (PBL) model on students' creative thinking ability. This research is Quantitative research with meta-analysis method. Data sources come from national and international journals. The inclusion criteria in the research are research obtained through the google Scholar, IEEE, ERIC, ScienceDirect and ProQuest databases, research published in 2019-2023, research indexed by SINTA, Web of Science (WOS), and Scopus, Research related to Sports and Health Physical Education subjects, Research must have experimental classes with SETS-based Problem Based Learning models and conventional control model classes, and the study must have a sample size(N), Mean, and Standard deviation (SD). Data analysis in this study with the JSAP application. The results of the analysis of 18 studies concluded that there was a positive influence of the SETS-based Problem Based Learning model on students' creative thinking ability (rE = 0.848; Z = 5.109; p < 0.001). This finding explains that the SETS-based Problem Based Learning model has a high influence on students' creative thinking skills in learning Physical Education, Sports and Health.

Keywords: Creative thinking; Effect size; Problem based learning; SETS

Introduction

Creative thinking is an ability that students must have in facing the 21st century (Mursid et al., 2022; Ammaralikit & Chattiwat, 2020; Goddess, 2019; Artayasa, 2020). According to Khuana et al. (2017) that creative thinking is an ability to generate new ideas or ideas in solving a problem. The ability to think creatively involves four aspects of thinking in students, namely *fluency, flexibility, originality* and *elaboration* (Wulandari & Wardani, 2019; Lee et al., 2021; Nufus et al., 2018). The ability to think creatively helps students learn actively and innovatively in the learning process (Hayati et al., 2022; Atthachakara, 2021).

But in fact, students' creative thinking ability in learning Physical Education Sports and Health is still relatively low (Martiani, 2021). The low ability to think creatively of students is caused by the learning process that is centered on the teacher and the teacher does not lead to the learning process of students to think creatively (Wahyudi et al., 2018; Saregar et al., 2021; Nurtamam et al., 2023). In addition, students have not been able to provide solutions in solving a problem (Zulkifli et al., 2022; Razak et al., 2021; Elfira et al., 2023). According to Yustina et al. (2022) the learning model applied by teachers has not been able to stimulate students to think creatively. Therefore, there is a need for an effective learning model to encourage students to think creatively.

Problem-based learning is a learning model that effectively improves students' creative thinking skills in learning (Dwi et al., 2022; Maskur et al., 2013; Mursid et al., 2022; Amin et al., 2020). *Problem-based* learning is a learning model that provides a problem to students and students can provide solutions to the problem (Setyawan & Koeswanti, 2021; Jumadi et al., 2021; Mustofa & Hidayah, 2020). The problem beased learning model can stimulate students to think higher order in learning (Nurkhairo et al., 2022; Munawaroh, 2020).

Problem-based learning models can be based on SETS. SETS is a learning that combines *Science Environment Technology* and *Society* in learning activities (Hairida, 2017; Sutipnyo & Mosik, 2018). SETS learning can encourage students to be more active and creative in learning (Widiantini et al., 2017; Savitri, 2020). In addition, the application of SETS can help students learn to implement the subject matter directly with the environment.

Research from Permatasari et al. (2019) and Duman (2023), *the problem-based learning model* can encourage critical thinking and problem-solving skills in students. Research from Kardoyo et al. (2020), Ulger (2018), Saptenno et al. (2019), Birgili (2015), Anazifa (2017) the application of *problem-based* learning models can help foster students' motivation and creative thinking ability in learning. Therefore, the gap in this study is that *problem-based learning* models are generally used to learn science. In addition, there has not been found the effect of the size of the SETS-based problem-based learning model on students' creative thinking ability in physical education, sports and health learning. Based on these problems, this study aims to determine the effect of the size of the SETS-based *Problem Based Learning* (PBL) model on students' creative thinking skills.

Method

This research is a type of meta-analysis research. Meta-analysis research is a type of research that collects and analyzes experimental research results that can be quantitatively calculated (Uluçına, 2022; Diah et al., 2022; Kaçar et al., 2021; Tamur et al., 2021; Oktarina et al., 2021). This meta-analysis aims to determine the SETS-based *Problem Based Learning* (PBL) model for students' creative thinking skills.

Inclusion Criteria

Researchers searched data from journals or proceedings related to problem-based learning models based on *Science, Environment, Technology and Society* (SETS) on students' creative thinking skills. The data used as research sources have met predetermined inclusion criteria. The inclusion criteria are research obtained through the Google Scholar, IEEE, ERIC,

ScienceDirect and ProQuest databases, research published in 2019-2023, research indexed by SINTA, Web of Science (WOS), and Scopus, Research related to Sports and Health Physical Education subjects, Research must have an experimental class with a SETS-based Problem Based Learning model and a conventional control model class, and research must have a sample size (N), *Mean*, and *Standard deviation* (SD).

Data Collection

The data collection process is through the journal databases google scholar, ERIC, IEEE, ScienceDirect and ProQuest. The data obtained according to the inclusion criteria were 27 articles. Furthermore, 5 studies were excluded because they had incomplete data and 4 studies that had value that could interfere with publication bias. Therefore, a total of 18 articles were analyzed. The results of selecting data sources are shown in figure 1. Keywords in searching data sources are problem-based learning models, SETS, creative thinking skills, *SETS-based problem based learning* and creative thinking skills.
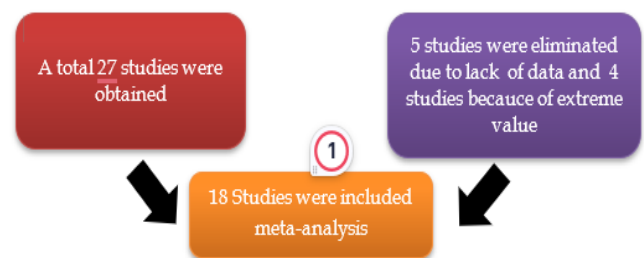
Figure 1. Data source selector process flow diagram

Data Analysis

Meta-analysis research data analysis calculates the effect size value of a study (Aybirdi, 2023). Effect size can meta-analysis is an index that describes the effect of the SETS-based Problem Based Learning (PBL) model on students' creative thinking skills. Data analysis in the meta-analysis consists of calculating the effect size value of each study; conduct heterogeneity tests and determine estimation models; checking the bias of research publications; and calculate the p-value to test the hypothesis. Data analysis in this study with the help of JASP application. The criteria for effect values are guided by (Cohen et al., 2007), namely $d < 0.20$ insignificant effect criteria; $0.20 \leq d \leq 0.50$ low effect criteria; $0.50 \leq d \leq 0.80$ moderate effect criteria and $d \geq 0.80$ high criteria.

Furthermore, publication bias is one of the most important things in meta-analysis research (Cevik & Bakioğlu, 2022; Aspiranti & Larwin, 2021; Joseph, 2023). Publication bias checking using funnel plots, Rosenthal Fail Safe N (FSN) Test and Egger's Test. The comparison criterion in the Rosenthal Fail Safe N (FSN) test is 5K + 10 (where k = number of studies analyzed).

Furthermore, if the FSN value > 5k + 10 then there is no publication bias.

Result and Discussion

Results From research searches related to the SETS-based problem-based learning model on students' creative thinking skills, 18 articles were obtained that had met predetermined inclusion criteria. The data obtained are analyzed based on the characteristics of the article code, year of publication, country, sample size (N) and effect size which can be shown in Table 1.

Table 1. Articles by Characteristics

Journal Code	Year of Publication	Country	N	Effect Size
V1	2020	Indonesian	40	-0.72
V2	2020	Indonesian	26	0.90
V3	2021	Indonesian	60	1.13
V4	2022	India	80	2.07
V5	2020	India	50	0.81
V6	2023	China	48	0.52
V7	2023	Turkish	110	0.94
V8	2021	English	98	1.15
V9	2019	India	40	0.83
V10	2020	Thailand	64	0.77
V11	2023	Thailand	85	0.86
V12	2023	Indonesian	112	1.57
V13	2023	Indonesian	90	2.33
V14	2023	Egypt	228	1.90
V15	2022	Malaysia	118	0.93
V16	2022	Indonesian	42	0.66
V17	2021	Malaysia	36	0.81
V18	2019	Indonesian	40	0.67

Based on table 1, showing 18 articles analyzed based on the characteristics of articles published in 2019-2023, seven studies were obtained from Indonesia, two studies came from Malaysia, two studies from Thailand, three studies came from India, one study came from Turkey, Egypt and England. Furthermore, the overall value of the effect size ranges from 0.66 – 2.35. According to the effect size criteria (Cohen et al., 2007) of the 18 studies analyzed, 1 study had an effect size value (5.55%) insignifican effect effect criteria, four studies had an effect size (11.12%) moderate criteria and thirteen studies had an effect size value (72.23%) high criteria.

Next, carried out heterogeneity tests from 18 studies analyzed. The results of the heterogeneity test can be seen in Table 2 and Table 3.

**Table 2.** Heterogeneity Test Results

	Q	Df	p
Omnibus test of Model Coefficients	97.880	1	< 0.001
Test of Residual Heterogeneity	610.769	9	< 0.001

Note. p value are approximate

Table 3. The Residual Heterogeneity Test Result

	Estimates	Lower bound	Upper Bound
τ^2	0.602	0.4778	1.023
τ	0.721	0.3610	0.972
I^2 (%)	96.019	93.912	98.250
H^2	48.209	28.734	64.115

Based on Tables 2 and 3 show heterogeneity test results from 18 heterogeneously distributed studies. This can be seen from the p value < 0.001; Q = 97.880; τ^2 or t > 0 and I^2 (%) = 87.250 is close to 100%. The next step is to check publication bias. Publication bias checking is essential to avoid bias in meta-analysis research (Chamdani et al., 2022; Tamur & Wijaya, 2021; Chen et al., 2022; Diah et al., 2022). In this meta-analysis research, publication bias can be identified using *funnel plots*. *The overall funnel flot effect size* of the study can be seen in Figure 2.
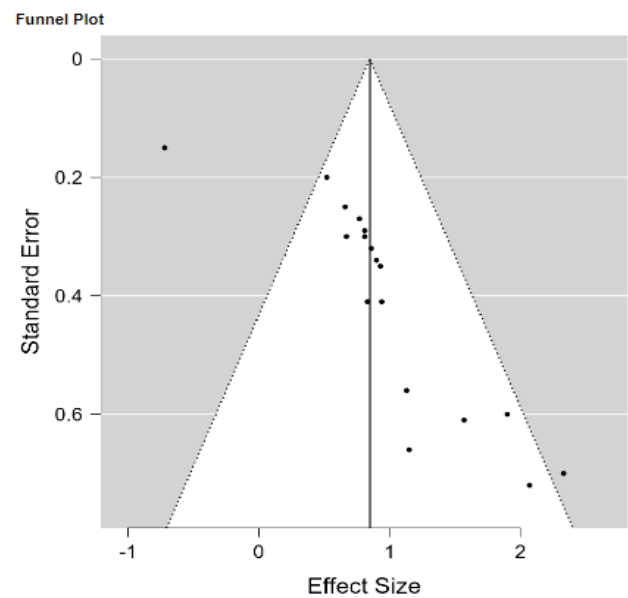
Figure 2. Funnel plot standard error

Figure 2 showing publication bias analysis with funnel plots, the overall effect size is not in a vertical curve, making it difficult to know whether the curve is symmetrical or not. Furthermore, Egger's test was carried out to determine the shape of the curve from 18 studies analyzed. Egger's test results are shown in Table 4.

Table 4. Egger's Test Results

	z	p
Sei	4. 843	< 0.001

Based on Table 5 value (p-value > 0.05; z = 4.843) then the distribution *of the funnel plot* issymmetrical. *The funnel plot* showed no publication bias in this study. Furthermore, to increase the validity of publication bias,

it is necessary to conduct *a Fasil Safe* N (FSN) test. The results of the *safe N file* test can be seen in Table 5.

Table 5. *Safe N File* Test Results

Safe N File Test Results	
z value	5.423
p-value	0.00
Alpha	0.05
Z for alpha	2.91
N	18
p>number of missing studies	546

Based on table 5, the *safe* N (FSN) file value is 546. Next, the value of the safe N file is compared to the value of k = (5.18) + 10 = 90. Therefore, *Rosenthal Fail Safe* N > k values mean that in meta-analysis studies there is no publication bias, so there is no need for research to be added or eliminated. Next, calculate the summary effect value or *mean effect size* of the 18 studies to be analyzed. The results of the summary effect size test are shown in Table 6.

Table 6. Summary Effect Size or Mean Effect Size Test Results

	Estimates	SE	z	p
Intercept	0.848	0.210	5.109	< 0.001

Based on Table 4. Indicates that the p value < 0.001. These results conclude that the SETS-based problem-based learning model has a significant influence on students' creative thinking skills. Furthermore, these results are categorized as high-effect based on the *estimates standard error* value, namely (0.848; Z = 8.109). The application of the SETS-based problem-based learning model is effective in improving students' creative thinking skills in learning Physical Education, Sports and Health (PJOK) at school.

This research is in line with Kardoyo et al. (2019) *the problem-based* learning model has a positive effect on students' creative thinking ability in learning. This finding is supported by Khairunnisa et al. (2022), Wenno et al. (2021), and Masek et al. (2011), said the *problem-based* learning model can develop students' critical and creative thinking skills in the learning process. Learning with a student-based problem-based learning model can train students to be more active and creative in learning (Kurniahtunnisa et al., 2016; Aini et al., 2022; Nurkhasanah et al., 2019). The problem-based learning model based on *Science Environment Technology and Society* (SETS) makes it easier for students to implement learning materials with the surrounding environment (Hasanah et al., 2019; Rahman et al., 2023; Ummah & Yuliati, 2020; Suharyat et al., 2022).

Furthermore, the SETS-based problem-based learning model can foster student motivation and interest in learning (Munawaroh, 2020; Mustofa & Hidayah, 2020; Suryawan et al., 2023) thus encouraging the ability to think creatively in learning Physical Education, Sports and Health (PJOK). The *problem-based learning* model allows students to think at a higher level in solving a problem in life (Hatipoğlu, 2023). Furthermore, Hairida (2017) students' SETS-based learning is able to encourage students' comprehension abilities in learning. Therefore, the SETS-based problem-based learning model contributes to teachers in improving students' creative thinking skills at school.

Conclusion

From this study, it can be concluded that there is a positive influence of the SETS-based Problem Based Learning model on students' creative thinking ability (rE = 0.848; Z = 5.109 ; p < 0.001). This finding explains that the SETS-based Problem Based Learning model has a high influence on students' creative thinking skills in learning Physical Education, Sports and Health. The SETS-based problem-based learning model of students can foster interest and higher-order thinking in solving a problem in life

Author Contributions
In this research, all researchers consisting of Ahmad Adil, Syahrianti Syam, Muhammad Safar, Christanso Syam, Tri Satriawansyah and Rusmawan have contributed both directly and indirectly in carrying out the process of data collection, selection, interpretation and data analysis.

References

Aini, W., Rachmadiarti, F., Prabowo, P., Hariyono, E., & Prahani, B. K. (2022, January). The Study of Implementation SETS Approach to Improve Students' Critical Thinking Skills. In *Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)* (pp. 219-228). Atlantis Press. https://doi.org/10.2991/assehr.k.211229.035

Amin, S., Utaya, S., Bachri, S., & Susilo, S. (2020). Effect

of problem-based learning on critical thinking skills and environmental attitude. *Journal for the Education of Gifted Young Scientists*, 8(2), 743–755. https://doi.org/10.17478/jegys.650344

Ammaralikit, A., & Chattiwat, W. (2020). Effects of Business Reading Model on Thai Learners' Reading and Creative Thinking Abilities. *English Language Teaching*, 13(5), 191–208. https://doi.org/10.5539/elt.v13n5p191

Anazifa, R. D. (2017). Project-Based Learning and Problem-Based Learning: Are They Effective to Improve Student 'S Thinking Skills? *Indonesian Journal of Science Education*, 6(2), 346–355. https://doi.org/10.15294/jpii.v6i2.11100

Artayasa, I. P. (2020). Students' creative thinking skills in science learning use an open inquiry model. *Indonesian Journal of Science Education*, 8(1), 1–9. https://doi.org/10.24815/jpsi.v8i1.15394

Aspiranti, K. B., & Larwin, K. H. (2021). Investigating the Effects of Tablet-Based Math Interventions: A Meta-Analysis. *International Journal of Technology in Education and Science*, 5(4), 629–647. https://doi.org/10.46328/ijtes.266

Atthachakara, S. (2021). Developing Practical Skills Through Blended Learning Model Using Creativity-Based Learning Activites that Enhances Creative Thinking for Education Students Majoring in Social Studies at Mahasarakham University. *Journal of Education and Learning*, 10(6), 126. https://doi.org/10.5539/jel.v10n6p126

Aybirdi, N. (2023). The Impact of Flipped Learning on L2 Learners' Achievements: A Meta- Analysis. *International Journal of Education*, 11(1), 41–60. https://doi.org/10.34293/

Birgili, B. (2015). Creative and Critical Thinking Skills in Problem-based Learning Environments. *Journal of Gifted Education and Creativity*, 2(2), 71–80. https://doi.org/10.18200/JGEDC.2015214253

Çevik, M., & Bakioglu, B. (2022). The Effect of STEM Education Integrated into Teaching-Learning Approaches (SEITLA) on Learning Outcomes: A Meta-Analysis Study. *International Journal of Progressive Education*, 18(2), 119-135. https://doi.org/10.29329/ijpe.2022.431.8

Chamdani, M., Yusuf, F. A., Salimi, M., & Fajari, L. E. W. (2022). Meta-Analysis Study: The Relationship between Reflective Thinking and Learning Achievement. *Journal on Efficiency and Responsibility in Education and Science, 15*(3), 181-188. Retrieved from http://files.eric.ed.gov/fulltext/EJ1364586.pdf

Chen, S., Zhang, C., & Li, W. (2022). The effects of competency-based training model in the training of new nurses : A meta- analysis and systematic review. *PLos ONE, 17*(11), 1–14. https://doi.org/10.1371/journal.pone.0277484

Cohen, L., Manion, L., Lecturer, P., Morrison, K., &; Lecturer, S. (2007). *Research Methods in Education*. Routledge is an imprint of the Taylor &; Francis Group, an informa business.

Goddess, 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

Duman, B. (2023). The effect of problem-based learning on problem- solving skills in English language teaching. *Journal of Pedagogical Research*, 7(1), 154–173. https://doi.org/10.33902/JPR.202318642

Dwi, M., Ernawati, W., Jambi, U., Rusdi, M., Jambi, U., Asrial, A., Jambi, U., Muhaimin, M., Jambi, U., Wulandari, M., Jambi, U., Maryani, S., & Jambi, U. (2022). Analysis of problem based learning in the scaffolding design: Students' creative-thinking skills. *Cypriot Journal of Educational Sciences*, 17(7), 2333–2348. Retrieved from http://files.eric.ed.gov/fulltext/EJ1350312.pdf

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

Hairida. (2017a). Using Learning Science, Environment, Technology and Society (SETS) Local Wisdom and based Colloids Teaching Material. *Journal of Education, Teaching and Learning, 2*(1), 84–89. Retrieved from https://www.learntechlib.org/d/209154

Hairida, H. (2017b). Using Learning Science, Environment, Technology and Society (SETS) Local Wisdom and based Colloids Teaching Material. *JETL (Journal Of Education, Teaching And Learning)*, 2(1), 143. https://doi.org/10.26737/jetl.v2i1.146

Hasanah, A. F., Raharjo, & Rachmadiarti, F. (2019). Practicality and effectiveness of SETS based learning materials to trained students' higher-order thinking skills. *Journal of Physics: Conference Series*, 1417(1). https://doi.org/10.1088/1742-6596/1417/1/012079

Hatipoğlu, C. (2023). The effect of a problem-based learning model on high school students' human values. *African Educational Research Journal*, 11(2), 157–169. https://doi.org/10.30918/aerj.112.23.020

Hayati, A., Fadzil, P., &; Education, F. (2022). Factors influencing t eachers' creative teaching: A systematic review. *Cypriot Journal of Educational Sciences*, 17(1), 240–254. Retrieved from http://files.eric.ed.gov/fulltext/EJ1332465.pdf

Hidayati, N., Zubaidah, S., & Amnah, S. (2022). The PBL vs. Digital Mind Maps Integrated PBL: Choosing

Between the two with a view to Enhance Learners' Critical Thinking. *Participatory Educational Research, 9*(3), 330-343. https://doi.org/10.17275/per.22.69.9.3

Jumadi, J., Perdana, R., Rosana, D., Yogyakarta, U. N., Ata, U. A., & Info, A. (2021). The impact of problem-based learning with argument mapping and online laboratory on scientific argumentation skill. *International Journal of Evaluation and Research in Education (IJERE, 10*(1), 16–23. https://doi.org/10.11591/ijere.v10i1.20593

Kaçar, T., Terzi, R., Arıkan, İ., & Kırıkçi, A. C. (2021). The Effect of Inquiry-Based Learning on Academic Success: A Meta-Analysis Study. *International Journal of Education & Literacy Studies, 9*(2), 15–23. https://doi.org/10.7575/aiac.ijels.v.9n.2p.15

Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-based learning strategy: Its impact on students' critical and creative thinking skills. *European Journal of Educational Research, 9*(3), 1141–1150. https://doi.org/10.12973/EU-JER.9.3.1141

Khairunnisa, Abdullah, Kharil, Hasanuddin, & Rahmatan, H. (2022). The Influence of Problem Based Learning Models combined with Flashcard Media on Creative Thinking Skills of Students. *Journal of Science Education Research, 8*(1), 247–251. https://doi.org/10.29303/jppipa.v8i1.1154

Khuana, K., Khuana, T., & Santiboon, T. (2017). An instructional design model with the cultivating research-based learning strategies for fostering teacher students' creative thinking abilities. *Educational Research and Reviews, 12*(15), 712–724. https://doi.org/10.5897/ERR2017.3239

Kurniahtunnisa, K., Dewi, N. K., & Utami, N. R. (2016). Pengaruh model problem based learning terhadap kemampuan berpikir kritis siswa materi sistem ekskresi. *Journal of Biology Education, 5*(3), 310-318. https://doi.org/10.15294/jbe.v5i3.14865

Lee, Y., Lin, C., Hwang, G., Fu, Q., Tseng, W., Lin, C., Hwang, G., Fu, Q., Tseng, W., Lee, Y., & Lin, C. (2021). Effects of a mobile-based progressive peer-feedback scaffolding strategy on students' creative thinking performance , metacognitive awareness, and learning attitude metacognitive awareness, and learning attitude. *Interactive Learning Environments,* 0(0), 1–17. https://doi.org/10.1080/10494820.2021.1916763

Martiani, M. (2021). Kemandirian Belajar Melalui Metode Pembelajaran Project Based Learning Pada Mata Kuliah Media Pembelajaran Pendidikan Jasmani. *Edukatif: Jurnal Ilmu Pendidikan, 3*(2), 480-486. https://doi.org/10.31004/edukatif.v3i2.337

Masek, A., & Yamin, S. (2011). The Effect of Problem Based Learning on Critical Thinking Ability: A Theoretical and Empirical Review. *International Review of Social Sciences and Humanities, 2*(1), 215–221. Retrieved from https://rb.gy/lvyvuf

Maskur, R., Rahmawati, Y., Pradana, K., Syazali, M., Septian, A., & Kinarya Palupi, E. (2013). The Effectiveness of Problem Based Learning and Aptitude Treatment Interaction in Improving Mathematical Creative Thinking Skills on Curriculum 2013. *European Journal of Educational Research, 9*(1), 375–383. https://doi.org/10.12973/eu-jer.9.1.375

Munawaroh. (2020). The influence of problem-based learning model as learning method, and learning motivation on entrepreneurial attitude. *International Journal of Instruction, 13*(2), 431–444. https://doi.org/10.29333/iji.2020.13230a

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

Mustofa, R. F., & Hidayah, Y. R. (2020). The effect of problem-based learning on lateral thinking skills. *International Journal of Instruction, 13*(1), 463–474. https://doi.org/10.29333/iji.2020.13130a

Nufus, H., & Duskri, M. (2018). Mathematical Creative Thinking and Student Self-Confidence in the Challenge-Based Learning Approach. *Journal of Research and Advances in Mathematics Education, 3*(2), 57-68. Retrieved from http://files.eric.ed.gov/fulltext/EJ1283917.pdf

Nurkhasanah, A., Ibrahim, M., & Widodo, W. (2019). Use of SETS (Science , Environment , Technology and Society) Approach for Practice the Problem Solving Ability of Elementary School Students in Surabaya. *International Journal of Innovative Science and Research Technology ISSN, 4*(12), 515–520. Retrieved from https://ijisrt.com/assets/upload/files/IJISRT19DEC461.pdf

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: Journal of Education, 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

Permatasari, B. D., & Info, A. (2019). The influence of problem based learning towards social science learning outcomes viewed from learning interest. *International Journal of Evaluation and Research in Education (IJERE)*, *8*(1), 39–46. https://doi.org/10.11591/ijere.v8.i1.pp39-46

Puspita, S., & Irfandi, I. (2022). Meta-Analysis of Focusky Learning Media on Student Learning Outcomes. *Jurnal Ilmu Pendidikan Muhammadiyah Kramat Jati, 3*(2), 20-22. https://doi.org/10.55943/jipmukjt.v3i2.34

Rahman, A., Ilwandri, I., Santosa, T. A., Gunawan, R. G., Suharyat, Y., Putra, R., & Sofianora, A. (2023). Effectiveness of Problem-Based Learning Model in Science Learning: A Meta-Analysis Study. *JUARA: Jurnal Olahraga, 8*(2), 713-726. https://doi.org/10.33222/juara.v8i2.3128

Razak, A., Santosa, T. A., Lufri, L., & Zulyusri, Z. (2021). Meta-analisis: 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: Jurnal Pendidikan Biologi, 6*(1), 79-87. Retrieved from http://103.123.236.7/index.php/bioed/article/view/2930

Saptenno, A. E., Tuaputty, H., & Papilaya, P. M. (2019). The Improvement of Learning Motivation and Creative Thinking Skills of Senior High School Students Through Modified Problem Based Learning Model. *Journal for the Education of Gifted Young Scientists*, *7*(4), 1175–1194. https://doi.org/10.17478/jegys.597519

Saregar, A., Cahyanti, U. N., Misbah, Susilowati, N. E., Anugrah, A., & Muhammad, N. (2021). Core learning model: Its effectiveness towards students' creative thinking. *International Journal of Evaluation and Research in Education*, *10*(1), 35–41. https://doi.org/10.11591/ijere.v10i1.20813

Savitri, E. N. (2020). The Influence of Science, Environment, Technology, and Society in Creative Industries on Scientific Based Business Designing Skills of Pre-Service Science Teachers. *Indonesian Journal of Science Education*, *8*, 27–38. https://doi.org/10.24815/jpsi.v8i1.15362

Setyawan, M., & Koeswanti, H. D. (2021). Pembelajaran Problem based learning Terhadap Berpikir Kritis Peserta Didik Sekolah Dasar. *Mimbar PGSD Undiksha, 9*(3), 489-496. https://doi.org/10.23887/jjpgsd.v9i3.41099

Suharyat, Y., Santosa, T. A., Aprilisia, S., & Yulianti, S. (2022). Meta-Analysis Study: The Effectiveness of Problem Solving Learning in Science Learning in Indonesia. *International Journal of Education and Literature (IJEL) Amik Veteran Porwokerto*, *1*(3), 6–13.

https://doi.org/10.55606/ijel.v1i3.36

Suryawan, I. P. P., Jana, P., Pujawan, I. G. N., Hartawan, I. G. N. Y., & Putri, P. E. W. (2023). Ethnomathematically Controversial Problem-Based Multimodal Approach in Terms of Students' Critical Thinking Ability. *Pegem Journal of Education and Instruction*, *13*(3), 323–336. https://doi.org/10.47750/pegegog.1

Sutipnyo, B. (2018). The Use of Numbered Heads Together (NHT) Learning Model With Science, Environment, Technology, Society (SETS) Approach to Improve Student Learning Motivation of Senior High. *Indonesian Journal of Physics Education*, *14*(January), 26–31. https://doi.org/10.15294/jpfi.v14i1.13929

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, M., & Wijaya, T. T. (2021). Using Problem-Based Learning to Enhance Mathematical Abilities of Primary School Students: A Systematic Review and Meta-Analysis. *JTAM (Journal of Mathematical Theory and Applications)*, *5*(1), 144–161. https://doi.org/10.31764/jtam.v5i1.3806

Ulger, K. (2018). The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education The Effect of Problem-Based Learning on the Creative Thinking and Critical. *Interdisciplinary Journal of Problem-Based Learning*, *12*(1), 3–6. https://doi.org/10.7771/1541-5015.1649

Uluçına, U. (2022). The Effect of Problem-Based Learning in Science Education on Academic Achievement: A Meta-Analytical Study. *Science Education Internat*, *34*(2), 72–85. Retrieved from https://icaseonline.net/journal/index.php/sei/article/view/505

Ummah, I. K., & Yuliati, N. (2020). The Effect of Jumping Task Based on Creative Problem Solving on Students' Problem Solving Ability. *International Journal of Instruction*, *13*(1), 387–406. Retrieved from http://files.eric.ed.gov/fulltext/EJ1239202.pdf

Wahyudi, Waluya, S. B., & Suyitno, H. (2018). Mathematical Creative Thinking Ability and Scaffolding Process According with Learning Styles for Pre-Service. *Anatolian Journal of Education*, *3*(1), 39–50. Retrieved from https://files.eric.ed.gov/fulltext/EJ1244497.pdf

Wenno, I. H., Jamaludin, J., & Batlolona, J. R. (2021). The Effect of Problem Based Learning Model on Creative and Critical Thinking Skills in Static Fluid Topics. *Indonesian Journal of Science Education*, *9*(3),

498–511. https://doi.org/10.24815/jpsi.v9i3.20829

Widiantini, N. N. A. S., Putra, M., & Wiarta, I. W. (2017). The learning model sets (Science, Environment, Technology, Society) assisted by virtual labs affect IPA knowledge competence. *Journal of Education Technology*, *1*(2), 141. https://doi.org/10.23887/jet.v1i2.11776

Wulandari, F. A., Mawardi, M., & Wardani, K. W. (2019). Peningkatan Keterampilan Berpikir Kreatif Siswa Kelas 5 Menggunakan Model Mind Mapping. J*urnal Ilmiah Sekolah Dasar*, *3*(1), 10-16. https://doi.org/10.23887/jisd.v3i1.17174

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

Joseph, 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), 237–247. Retrieved from http://files.eric.ed.gov/fulltext/EJ1378720.pdf

Zulkifli, Z., Satria, E., Supriyadi, A., & Santosa, T. A. (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,* *5*(1), 32-42. https://doi.org/10.55606/ijel.v1i2.32