

DAFTAR PUSTAKA

- Ahad, N. A., & Yahaya, S. S. S. (2014). Sensitivity analysis of Welch's t -test. *AIP Conference Proceedings*, 1605(2014), 888–893. <https://doi.org/10.1063/1.4887707>
- Alansyah, P., Noviyana, H., & Kirana, A. R. (2025). Pengaruh Model Problem Based Learning Berbasis Artificial Intelegence (AI) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Kelas VIII SMP N 17 PESAWARAN Tahun Pelajaran 2025/2026. *Jurnal Ilmiah Mahasiswa Pendidikan Matematika STKIP PGRI Bandar Lampung*, 7(1), 13–21. <https://eskripsi.stkippgribl.ac.id/index.php/matematika/article/view/1123>
- Ali, D., Fatemi, Y., Boskabadi, E., Nikfar, M., Ugwuoke, J., & Ali, H. (2024). ChatGPT in Teaching and Learning: A Systematic Review. *Education Sciences*, 14(6). <https://doi.org/10.3390/educsci14060643>
- Alreshidi, N. A. K., & Lally, V. (2024). The effectiveness of training teachers in problem-based learning implementation on students' outcomes: a mixed-method study. *Humanities and Social Sciences Communications*, 11(1). <https://doi.org/10.1057/s41599-024-03638-6>
- Alzarea, A. I., Ishaqui, A. A., Maqsood, M. B., Alanazi, A. S., Alsaidan, A. A., Mallhi, T. H., Kumar, N., Imran, M., Alshahrani, S. M., Alhassan, H. H., Alzarea, S. I., & Alsaidan, O. A. (2025). Evaluating AI performance in infectious disease education: a comparative analysis of ChatGPT, Google Bard, Perplexity AI, Microsoft Copilot, and Meta AI. *Frontiers in Medicine*, 12(October), 1–14. <https://doi.org/10.3389/fmed.2025.1679153>
- Aqsa, M., Nurhaswinda, & Hidayat, A. (2021). Analisis Kemampuan Pemahaman Konsep Soal Cerita Matematika dalam Materi Perkalian pada Siswa Kelas III SD Negeri 019 Tanjung Sawit. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 2(2), 9–16. <https://doi.org/10.30998/formatif.v5i1.165>
- Aryashanti, N., & Yuli Witanto. (2025). Analisis Kesulitan Peserta Didik dalam Menyelesaikan Soal Cerita Matematika Ditinjau dari Kemampuan

- Pemahaman Konsep dan Keterampilan Matematika. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 7(2), 180–189. <https://doi.org/10.36232/jurnalpendidikandasar.v7i2.1899>
- As'ari, A., Tohir, M., Valentino, E., Imron, Z., & Taufiq, I. (2017). *Matematika* (2nd ed.). Pusat Kurikulum dan Perbukuan, Balitbang, Kemendikbud.
- Aykac, K., Cubuk, O., Demir, O. O., Choe, Y. J., & Aydin, M. (2025). Comparing ChatGPT-3 . 5 , Gemini pneumonia learning in medical students. *Scientific Reports*, 15(4032), 1–8. <https://doi.org/https://doi.org/10.1038/s41598-025-27722-2>
- Bhullar, P. S., Joshi, M., & Chugh, R. (2024). ChatGPT in higher education - a synthesis of the literature and a future research agenda. *Education and Information Technologies*, 29, 21501–21522. <https://doi.org/https://doi.org/10.1007/s10639-024-12723-x>
- Bo, L., Ding, X., & Wang, S. (2022). A Comparative Analysis of Traditional Teaching and PBL Model. *Proceedings of the 2022 8th International Conference on Humanities and Social Science Research (ICHSSR 2022)*, 664(Ichssr), 1686–1690. <https://doi.org/10.2991/assehr.k.220504.306>
- Christanto, H. J., Dewi, C., Sutresno, S. A., & Silalahi, A. D. K. (2024). Analyzing the Use of Chat Generative Pre-Trained Transformer and Artificial Intelligence. *Revue d'Intelligence Artificielle*, 38(4), 1297–1304. <https://doi.org/10.18280/ria.380423>
- Cohen, J. (1988). *Statistical Power Analysis For The Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Depitasari, R., Muchlis, E., & Irsal, N. (2021). Analisis Kemampuan Pemahaman Konsep Matematis Setelah Pembelajaran Menggunakan LKPD Dengan Model Inkuiri. *Jurnal Penelitian Pembelajaran Matematika Sekolah*, 5(1), 58–70. <https://doi.org/10.33369/jp2ms.5.1.58-70>
- Dewi, L. P. S., Giri, I. M. A., & Suparya, I. K. (2025). Pengaruh Pendekatan Pembelajaran Berdiferensiasi. *Widyajaya: Jurnal Mahasiswa Prodi PGSD*

- STAHN Mpu Kuturan Singaraja, 5, 234–247.
<https://journal.mpukuturan.ac.id/index.php/widyajaya/article/view/1350>
- Diana, P., Marethi, I., & Pamungkas, A. (2020). Kemampuan Pemahaman Konsep Matematis Siswa: Ditinjau Dari Kategori Kecemasan Matematik. *SJME(Supremum Journal of Mathematics Education)*, 4(1), 24–32.
<http://journal.unsika.ac.id/index.php/supremum>
- Dodo, M., In, A., Zukhrufurrohmah, Z., & Ernawati, S. (2023). Implementasi Artificial Intelligence ChatGPT Melalui Pembelajaran Problem Based Learning Dengan Pendekatan TARL Dalam Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Profesi Guru*, 4(3), 97–107.
<https://doi.org/10.22219/jppg.v4i3.26175%0A>
- Edy, S. K., Novaliyosi, N., & Widodo, S. A. (2024). Systematic Literature Review: Implementation of Problem Based Learning (PBL) on Students' Mathematical Cognitive and Affective Aspects. *Prisma*, 13(1), 1.
<https://doi.org/10.35194/jp.v13i1.3278>
- Fadila, M. T., Untarti, R., Jazuli, A., & Jaelani, A. (2025). Mathematics in the AI Era: The Effectiveness of ChatGPT in Helping Students Solve HOTS Problems. *AlphaMath : Journal of Mathematics Education*, 11(2), 191–204.
<https://doi.org/10.30595/alphamath.v11i2.28261>
- Fadilah, N. A., & Hakim, D. (2022). Efektivitas Pembelajaran Realistic Mathematics Education (RME) terhadap Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Ilmiah Wahana Pendidikan*, 8(22), 565–574.
<https://doi.org/10.5281/zenodo.7357396>
- Fajra, R., Syachruraji, A., & Rokmanah, S. (2023). Metode Pembelajaran Aktif Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Dunia Pendidikan*, 4(1), 67–78.
<http://jurnal.stokbinaguna.ac.id/index.php/JURDIP/article/view/2083>
- Gouia-Zarrad, R., & Gunn, C. (2024). Enhancing Students' Learning Experience in Mathematics Class through ChatGPT. *International Electronic Journal of Mathematics Education*, 19(3). <https://doi.org/10.29333/iejme/14614>

- Gusteti, M. U., & Neviyarni. (2022). Pembelajaran berdiferensiasi pada pembelajaran matematika di kurikulum merdeka. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, 3(3), 636–646. <http://lebesgue.lppmbinabangsa.id/index.php/home>
- Hallinger, P. (2023). Bibliometric Review Methodology and State of the Science: Bibliometric Review of Research on Problem-based Learning, 2017–2021. *Interdisciplinary Journal of Problem-Based Learning*, 16(2), 2017–2022. <https://doi.org/https://doi.org/10.14434/ijpbl.v17i2.35761>
- Haris, A. (2022). Proses Kognitif Dalam Desain Pembelajaran Berbasis Masalah. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, 6(1), 2413–2421. <https://doi.org/10.58258/jisip.v6i1.2820>
- Humaira Handayani, R. (2020). Penerapan Model Problem Based Learning untuk Melatih Higher Order Thinking Skill Siswa Sekolah Dasar. *Jurnal Pendidikan Tambusai*, 4(2), 1494–1499. <https://doi.org/10.62775/edukasia.v5i1.714>
- Ihsani, U. A., Yuli, T., & Siswono, E. (2024). Student's Metacognition in Solving Mathematical Problem using ChatGPT. *Journal of Mathematical Pedagogy*, 5(2), 102–112. <https://doi.org/10.26740/jomp.v5n2.p102-112>
- Kafullillah, D. S., & Sartika, S. B. (2023). Concept Understanding Level of Junior High School Students on Substance Pressure Material. *Jurnal Pendidikan Dan Pengajaran*, 56(3), 581–591. <https://doi.org/10.23887/jpp.v56i3.60396>
- Kalsum, U., Tsanawiyah, M., & Islam, N. (2025). Penerapan Metode Pembelajaran Kooperatif untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Materi Sejarah Kebudayaan Islam di MTs Nurul Islam Pasengerahan. *Jurnal Edusiana : Jurnal Ilmu Pendidikan*, 3(1), 35–46. <https://doi.org/10.70437/edusiana.v3i1.1100>
- Kholid, M. N., Imawati, A., Swastika, A., Maharani, S., & Pradana, L. N. (2021). How are Students' Conceptual Understanding for Solving Mathematical Problem? *Journal of Physics: Conference Series*, 1776(1). <https://doi.org/10.1088/1742-6596/1776/1/012018>

- Killpatrick, J., Swafford, J., & Findell, B. (2001). Adding It Up Helping Children Learn Mathematics. In *October* (Issue October). National Academy Press.
- Kotmungkun, S., Chompurach, W., & Thaksanan, P. (2024). OpenAI ChatGPT vs Google Gemini: A study of AI chatbots' writing quality evaluation and plagiarism checking. *English Language Teaching Educational Journal*, 7(2), 90–108. <https://doi.org/10.12928/eltej.v7i2.11572>
- Kuncoro, K., Leuwol, F., Wijayanti, A., Hiasa, F., Susanto, E., Dacholfany, M., Sulistyowati, F., Kusuma, A., Erlangga, S., Widyawati, A., Kusumaningrum, B., Apdoludin, Rahmawati, F., Nasrullah, A., Islam, A., & Hanifah. (2023). *Model-model Pembelajaran Prinsio, Konsep, dan Aplikasi* (1st ed.). CV. Edupedia Publisher.
- Kurniawati, Y., & Ummah, S. (2023). Pengembangan Modul Ajar Kurikulum Merdeka Berbasis STEM-PBL Pada Materi Statistika Yeva Kurniawati 1 , Sholikatul Ummah 2 ,. *Penelitian Dan Pengabdian Masyarakat*, 1, 48–62.
- Linsida, L., Agustinsa, R., Utari, T., Siagian, T. A., & Yensy, N. A. (2022). Pengaruh Model Problem Based Learning Terhadap Kemampuan Pemahaman Konsep Matematis Peserta Didik Kelas VII. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, 6(2), 298–307. <https://doi.org/10.33369/jp2ms.6.2.298-307>
- Lo, C. K. (2023). What Is the Impact of ChatGPT on Education? A Rapid Review of the Literature. *Education Sciences*, 13(4). <https://doi.org/10.3390/educsci13040410>
- Macbeth, G. E., Razumiejczyk, E., & Ledesma, R. D. (2011). Cliff's delta calculator: A non-parametric effect size program for two groups of observations. *Universitas Psychologica*, 10(2), 545–555. <https://doi.org/10.11144/javeriana.upsy10-2.cdcp>
- Maharani, R. A., Sutirna, S., & Marlina, R. (2025). Pengaruh Model Pembelajaran IMPROVE terhadap Kemampuan Pemahaman Konsep Matematis Siswa Kelas VIII SMP. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, 5(3), 953–963. <https://doi.org/10.53299/jagomipa.v5i3.2076>

- Mangaraja, A., Ammy, P. M., & Sinulingga, H. M. T. (2025). Peningkatan Pemahaman Konsep Matematika Siswa Melalui Model PBL (Problem Based Learning) Di UPT SMP N 16 Medan. *JMES (Journal Mathematics Education Sigma)*, 6(1), 1–10. <https://doi.org/10.30596/jmes.v6i1.19748>
- Meissel, K., & Yao, E. S. (2024). Using Cliff's Delta as a Non-Parametric Effect Size Measure: An Accessible Web App and R Tutorial. *Practical Assessment, Research and Evaluation*, 29(2), 1–12. <https://doi.org/10.7275/pare.1977>
- Muhammad, I., & Juandi, D. (2023). Discovery Learning Research in Mathematics Learning (1968-2023): A Bibliometric Review. *Hipotenusa: Journal of Mathematical Society*, 05(02), 197–214. <https://doi.org/10.18326/hipotenusa.v5i2.396>
- Mulyadi, K., & Ratnaningsih, N. (2022). Analisis Pencapaian Dan Kendala Penerapan Problem Based Learning Pada Pembelajaran Tatap Muka Terbatas (PTMT). *J-KIP (Jurnal Keguruan Dan Ilmu Pendidikan)*, 3(1), 37–46. <http://dx.doi.org/10.25157/j-kip.v3i1.7023>
- Navisa, E. T., Mustafa, A. N., Keguruan, F., Sultan, U., & Tirtayasa, A. (2026). Integrasi ChatGPT dalam Model Problem Based Learning (PBL): Pengaruhnya terhadap Pemahaman Konsep Matematis Peserta didik pada Materi SPLDV. *10(March)*, 371–377. <https://doi.org/10.31004/cendekia.v10i1.4731>
- Ningsih, E. P., Rismen, S., & Haryono, Y. (2025). Efektivitas Problem Based Learning (PBL) dalam Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa. *Journal of Education Research*, 6(3), 670–676. <https://doi.org/10.37985/jer.v6i3.1635>
- Nuraeni, R., & Munandar, D. R. (2023). Kemampuan Pemahaman Konsep Matematis Siswa SMPPada Materi Segitiga dan Segiempat. *Jurnal Didactical Mathematics*, 5(2), 361–368. <https://ejournal.unma.ac.id/index.php/dm>
- Nuraini, I., & Imami, A. I. (2025). Analysis of the Students' Mathematical Conceptual Understanding Ability on Sequences and Series Material in Senior High School. *EMTEKA: Jurnal Pendidikan Matematika*, 6(1), 226–238.

<https://doi.org/10.24127/emteka.v6i1.7661>

Nuris, N. D., Anam, K., & Narasati, R. (2024). Pendidikan di Era Digital: Implikasi Teknologi CHATGPT Bagi Institusi dan Peserta Didik. *Jurnal Ilmiah Kajian Ilmu Sosial Dan Budaya*, 26(2), 115–132. <http://jurnalsosiologi.fisip.unila.ac.id/index.php/jurnal>

OECD. (2023). PISA 2022 Results. In *Journal Pendidikan: Vol. I*.

P. Balacuit, I. C., B. Nabua, E., & G. Saludares, J. R. (2025). Examining Conceptual Understanding and Engagement in Mathematics Students. *Indonesian Journal of Mathematics Education*, 8(1), 1–17. <https://doi.org/10.31002/ijome.v8i1.2535>

Pamuji, Kristanto, W., Tri Achmad, E., & Khotimah, N. (2025). Integrating project-based learning and video exposé to enhance English language teaching in higher education: a case study of student empowerment. *Cogent Education*, 12(1). <https://doi.org/10.1080/2331186X.2025.2578371>

Pratiwi, S. I., Lusiana, & Fuadiah, N. F. (2019). Peningkatan kemampuan pemahaman konsep matematis siswa SMPN 30 Palembang melalui pembelajaran core. *Jurnal Pendidikan Matematika Raflesia*, 04(02), 15–28. <https://doi.org/10.33369/jpmr.v4i2.9749>

Rahma, A., & Kurniawati, Y. (2024). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Terhadap Pemahaman Konsep Matematika Siswa. *Jurnal Pendidikan Matematika*, 8(2), 301–308. <https://doi.org/10.30998/jkpm.v11i1.3812>

Ritonga, N. W., Manik, E., & Simanjuntak, R. M. (2025). Analysis of The Ability to Understand Mathematics Concepts Reviewed From Students' Anxiety Level On Integer Material For Class VII SMP Negeri 4 Pangaribuan District Analisis Kemampuan Pemahaman Konsep Matematika Ditinjau Dari Tingkat Kecemasan Siswa Pada . *JKIP : Jurnal Kajian Ilmu Pendidikan*, 5(4), 838–850. <http://journal.al-matani.com/index.php/jkip/index>

Riyani, R., Maizora, S., & Hanifah. (2017). Uji Validitas Pengembangan Tes Untuk

- Mengukur Kemampuan Pemahaman Relasional Pada Materi Persamaan Kuadrat Siswa Kelas VIII SMP. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, 1(1), 212.
- Robiah, S., & Rahmawati, D. (2021). Analisis Kemampuan Berpikir Kritis dan Kreatif Matematis Siswa SMP Pada Materi Segiempat dan Segitiga. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, 4(1), 105. <https://doi.org/10.22460/jpmi.v1i5.p1015-1024>
- Rosmawati, R. R., & Sritresna, T. (2021). Kemampuan Pemahaman Konsep Matematis ditinjau dari Self-Confidence Siswa pada Materi Aljabar dengan Menggunakan Pembelajaran Daring. *Plusminus: Jurnal Pendidikan Matematika*, 1(2), 275–290. <https://doi.org/10.31980/plusminus.v1i2.901>
- Rossettini, G., Rodeghiero, L., Corradi, F., Cook, C., Pillastrini, P., Turolla, A., Castellini, G., Chiappinotto, S., Gianola, S., & Palese, A. (2024). Comparative accuracy of ChatGPT-4, Microsoft Copilot and Google Gemini in the Italian entrance test for healthcare sciences degrees: a cross-sectional study. *BMC Medical Education*, 24(1), 1–9. <https://doi.org/10.1186/s12909-024-05630-9>
- Sahir, S. H. (2021). *Metodologi Penelitian* (T. Koryati (ed.); Cetakan 1). Penerbit KBM Indonesia.
- Sasmita, R. S., & Harjono, N. (2021). Efektivitas Model Problem Based Learning dan Problem Posing dalam Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Basicedu*, 5(5), 3472–3481. <https://doi.org/10.31004/basicedu.v5i5.1313>
- Shin, N., Bowers, J., Krajcik, J., & Damelin, D. (2021). Promoting Computational Thinking Through Project-Based Learning. *Disciplinary and Interdisciplinary Science Education Research*, 3(7). <https://doi.org/https://doi.org/10.1186/s43031-021-00033-y>
- Silalahi, R. A., Siahaan, T. M., & Tambunan, L. O. (2023). Pengaruh Model Pembelajaran Problem Based Learning (PBL) terhadap Kemampuan Pemahaman Konsep Matematis Siswa Kelas XI SMA Swasta Kampus Nommensen Pematangsiantar. *Journal on Education*, 5(4), 14264–14275.

<https://doi.org/10.31004/joe.v5i4.2453>

- Sinaga, D. Y., Hutagalung, N. A. Z., Purba, A. C. Y., Simatupang, N. A., Harianja, Z. G., Sinaga, M. V., & Gultom, E. (2025). Peningkatan Pemahaman Konsep Bangun Ruang Sisi Datar melalui Pendekatan Konkret dalam Pembelajaran Matematika. *Jurnal PKM Manajemen Bisnis*, 5(1), 324–331. <https://doi.org/10.37481/pkmb.v5i1.1265>
- Sipayung, T., Manurung, H. M., & Pane, E. P. (2025). Pengaruh Model Pembelajaran Guided Discovery Learning Terhadap Keterampilan Berpikir Kreatif Siswa Kelas X Pada Materi Struktur Atom Sma Negeri 6 Pematangsiantar. *PENDIPA Journal of Science Education*, 9(3), 650–656. <https://doi.org/10.33369/pendipa.9.3.650-656>
- Skemp, R. R. (2020). Relational Understanding and Instrumental Understanding. *Mathematics Teaching in the Middle School*, 12(2), 88–95. <https://doi.org/10.5951/mtms.12.2.0088>
- Sotiriou, S. A., Lazoudis, A., & Bogner, F. X. (2020). Inquiry-based learning and E-learning: how to serve high and low achievers. *Smart Learning Environments*, 7(29). <https://doi.org/10.1186/s40561-020-00130-x>
- Suganda, A. (2023). Memilih AI Yang Tepat Untuk Guru: Perbandingan Fitur Gemini, ChatGPT, dan Claude AI. *Jurnal Inovasi Teknologi Dan Edukasi Teknik*, 3(11), 2023. <https://doi.org/10.17977/um084.v3.i11.2023.2>
- Sugiyono. (2007). *Statistika untuk Penelitian* (E. Mulyatiningsih (ed.); kesebelas). CV ALFABETA.
- Sugiyono. (2023). *Metode Penelitian Kuantitatif, Kualitatif, dan RND* (Sutopo (ed.); 5th ed.). ALFABETA.
- Syamsidah, & Suryani, H. (2018). Buku Model Problem Based Learning (PBL). Yogyakarta: Penerbit Deepublish. *Buku*, 1–92.
- Usmadi. (2020). Pengujian Persyaratan Analisis (Uji Homogenitas Dan Uji Normalitas). *Inovasi Pendidikan*, 7(1), 50–62.

- Utami, D. N., & Sugiman. (2025). Fostering Mathematical Conceptual Understanding through ChatGPT-Assisted Discovery Learning. *International Journal of Multicultural and Multireligious Understanding (IJMMU)*, 12, 40–48. <https://doi.org/http://dx.doi.org/10.18415/ijmmu.v12i12.7200>
- Vygotsky, L. S. (1978). *Mind in Society The Development of Higher Mental Processes*. EBSCHO Publishing.
- Wibawa, T. P., Eliyarti, W., & Saputra, J. (2023). Pengaruh Model Problem Based Learning Terhadap Kemampuan Pemahaman Konsep Matematis Berbantuan Geogebra. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education*, 8(1), 109–118. <https://doi.org/10.23969/symmetry.v8i1.8851>
- Yatri, A. E., Suradi, & Danial. (2025). Faktor Penyebab Kesulitan dalam Pemahaman Konse Matematis pada Siswa. *Journal of Mathematics Education and Applied*, 5 No. 2(2), 146–159.
- Yunitasari, I., Tyas, A., & Hardini, A. (2021). Penerapan Model PBL untuk Meningkatkan Keaktifan Peserta Didik dalam Pembelajaran Daring di Sekolah Dasar. *Jurnal Basicedu*, 5(4), 1700–1708. <https://doi.org/10.31004/basicedu.v5i4.983>
- Zhu, L., Lai, Y., Mou, W., Zhang, H., Lin, A., Qi, C., Yang, T., Xu, L., Zhang, J., & Luo, P. (2024). ChatGPT's ability to generate realistic experimental images poses a new challenge to academic integrity. *Journal of Hematology and Oncology*, 17(1), 1–3. <https://doi.org/10.1186/s13045-024-01543-8>
- Zogara, J., Surata, S., & Paraniti, A. (2025). Pengaruh Model Pembelajaran Berbasis Masalah Dengan Bantuan Animasi Terhadap Hasil Belajar Siswa. *Jurnal Ikatan Alumni Fisika*, 2(4), 91. <https://doi.org/10.24114/jiaf.v2i4.7826>
- Zulkarnain, M. A., Syaiful, S., & Suratno, S. (2023). Using learning models problem based learning to improve students' mathematical critical thinking skills. *Desimal: Jurnal Matematika*, 6(2), 153. <https://doi.org/10.24042/djm.v6i2.18087>