

DAFTAR PUSTAKA

- Abdurrahman, Ariyani, F., Achmad, A., & Nurulsari, N. (2019). Designing an Inquiry-based STEM Learning strategy as a Powerful Alternative Solution to Enhance Students' 21st -century Skills: A Preliminary Research. *Journal of Physics: Conference Series*, 1155, 012087. <https://doi.org/10.1088/1742-6596/1155/1/012087>
- Abidin, Y., Mulyati, T., & Yunansah, H. (2021). *Pembelajaran literasi: Strategi meningkatkan kemampuan literasi matematika, sains, membaca, dan menulis*. Bumi Aksara.
- Aiman, U., & Hasyda, S. (2020). The Influence of Process Oriented Guided Inquiry Learning (POGIL) Model Assisted by Realia Media to Improve Scientific Literacy and Critical Thinking Skill of Primary School Students. *European Journal of Educational Research*, 9(4), 1635–1647.
- Alifa, D. M., Azzahroh, F., & Pangestu, I. R. (2018). Penerapan metode STEM (Science, Technology, Engineering, Mathematic) berbasis proyek untuk meningkatkan kreativitas siswa sma kelas xi pada materi gas ideal. *Prosiding SNPS (Seminar Nasional Pendidikan Sains)*, 7(2), 88–109.
- Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives: complete edition*. Addison Wesley Longman, Inc.
- Apriyani, Y., Supriyati, Y., & Margono, G. (2021). The influence of learning models on scientific literacy in physics course: A meta-analysis research. *International Journal of Science and Society*, 3(4), 44–51.
- Ariel, R., & Moffat, S. D. (2018). Age-related similarities and differences in monitoring spatial cognition. *Aging, Neuropsychology, and Cognition*, 25(3), 351–377.
- Arikunto, S. (2006). *Prosedur Penelitian, Rineka Cipta*. Jakarta.
- Aryani, A. K., & Suwono, H. (2021). Parno.(2016). Profil kemampuan literasi sains siswa SMPN 3 Batu. *Prosiding Seminar Nasional Pendidikan IPA Pascasarjana UM*, 852.
- Astuti, F. N., Suranto, S., & Masykuri, M. (2019). Augmented reality for teaching science: Students' problem solving skill, motivation, and learning outcomes. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 5(2), 305–312.
- Aydin-Gunbatar, S., Tarkin-Celikkiran, A., Kutucu, E. S., & Ekiz-Kiran, B. (2018). The influence of a design-based elective STEM course on pre-service chemistry teachers' content knowledge, STEM conceptions, and engineering views. *Chemistry Education Research and Practice*, 19(3), 954–972.
- Azzajjad, M. F., Ahmar, D. S., & Syahrir, M. (2020). The effect of animation media in discovery learning model on students' representation ability on chemical equilibrium materials. *Journal of Applied Science, Engineering, Technology, and Education*, 2(2), 204–209.
- Bačnik, A., Slavič Kumer, S., Bah Brglez, E., Eršte, S., Golob, N., Gostinčar Blagotinšek, A., Hajdinjak, M., Hartman, S., & Ivančič, G. (n.d.). Kljajič, S., Majer Kovačič, J., Mohorič, A., Moravec, B., Novak, N., Pavlin, J., Repnik, R., Vičič.
- Banchi, H., & Bell, R. (2008). The many levels of inquiry. *Science & Children*, 46(2).
- Becker, K. H., & Park, K. (2011). Integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A meta-

- analysis. In *Journal of STEM education: Innovations and research* (Vol. 12, Issue 5).
- Bell, R. L., Smetana, L., & Binns, I. (2005). Simplifying inquiry instruction. *The Science Teacher*, 72(7), 30–33.
- Bethke Wendell, K., & Rogers, C. (2013). Engineering design-based science, science content performance, and science attitudes in elementary school. *Journal of Engineering Education*, 102(4), 513–540.
- Bloom, B. S. (1971). *Taxonomy of educational objectives: The classification of educational goals: By a committee of college and university examiners*. David McKay.
- Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science*, 25(1), 2–16.
- Braaten, M., & Windschitl, M. (2011). Working toward a stronger conceptualization of scientific explanation for science education. *Science Education*, 95(4), 639–669.
- Brame, C. J. (2019). Metacognitive Practices. In *Science Teaching Essentials* (pp. 85–94). Elsevier. <https://doi.org/10.1016/B978-0-12-814702-3.00006-8>
- Brookhart, S. M. (2010). *How to assess higher-order thinking skills in your classroom*. Ascd.
- Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*.
- Bruning, R. H. (1999). *Cognitive psychology and instruction*. Merrill.
- Budiarti, I. S., & Tanta, T. (2021). Analysis on students' scientific literacy of Newton's law and motion system in living things. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 9(1), 36–51.
- Budsankom, P., Sawangboon, T., Damrongpanit, S., & Chuensirimongkol, J. (2015). Factors Affecting Higher Order Thinking Skills of Students: A Meta-Analytic Structural Equation Modeling Study. *Educational Research and Reviews*, 10(19), 2639–2652.
- Burrows, A. C., Breiner, J. M., Keiner, J., & Behm, C. (2014). Biodiesel and integrated STEM: Vertical alignment of high school biology/biochemistry and chemistry. *Journal of Chemical Education*, 91(9), 1379–1389.
- Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245–281.
- Butterworth, J., & Thwaites, G. (2013). *Thinking skills: Critical thinking and problem solving*. Cambridge University Press.
- Bybee, R. W. (2013). The case for STEM education: Challenges and opportunities. *National Science Teachers Association*.
- CAPRILE, M., PALMÉN, R., & DENTE, G. (2015). *Encouraging STEM studies for the labour market*.
- Carnevale, A. P., Smith, N., & Melton, M. (2011). STEM: Science Technology Engineering Mathematics. *Georgetown University Center on Education and the Workforce*.
- Chen, K., & Chen, C. (2021). Effects of STEM Inquiry Method on Learning Attitude and Creativity. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(11).
- Chen, J. (2022). The Effectiveness of Self-Regulated Learning (SRL) Interventions on L2 Learning Achievement, Strategy Employment and Self-Efficacy: A meta-

- Analytic Study. *Frontiers in Psychology*, <https://doi.org/10.3389/fpsyg.2022.1021101>.
- Chi, S., Liu, X., Wang, Z., & Won Han, S. (2018). Moderation of the effects of scientific inquiry activities on low SES students' PISA 2015 science achievement by school teacher support and disciplinary climate in science classroom across gender. *International Journal of Science Education*, 40(11), 1284–1304.
- Chin, C., & Osborne, J. (2008). Students' questions: a potential resource for teaching and learning science. *Studies in Science Education*, 44(1), 1–39.
- Chonkaew, P., Sukhummek, B., & Faikhamta, C. (2016). Development of analytical thinking ability and attitudes towards science learning of grade-11 students through science technology engineering and mathematics (STEM education) in the study of stoichiometry. *Chemistry Education Research and Practice*, 17(4), 842–861.
- Chonkaew, P., Sukhummek, B., & Faikhamta, C. (2019). STEM activities in determining stoichiometric mole ratios for secondary-school chemistry teaching. *Journal of Chemical Education*, 96(6), 1182–1186.
- Cooper, R., & Heaverlo, C. (2013). Problem Solving and Creativity and Design: What Influence Do They Have on Girls' Interest in STEM Subject Areas?. *American Journal of Engineering Education*, 4(1), 27–38.
- Council, N. R., Education, B. on S., Standards, N. C. on S. E., & Assessment. (1995). *National science education standards*. National Academies Press.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. *Handbook of Theories of Social Psychology*, 1(20), 416–436.
- Deci, E. L., & Ryan, R. M. (2013). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.
- Díaz, B., & Aizman, A. (2024). Design and impact of a stoichiometry voluntary online course for entering first-year STEM college students. *Chemistry Education Research and Practice*, 25(1), 11–24.
- Dick, W. (2005). The systematic design of instruction. *Scott Foresman*.
- Donald, R. C., Jenkins, D. B., & Metcalf, K. K. (2006). *The act of teaching*. New York: McGraw Hill.
- Dragoş, V., & Mih, V. (2015). Scientific literacy in school. *Procedia-Social and Behavioral Sciences*, 209, 167–172.
- Duran, M., & Dökme, I. (2016). The effect of the inquiry-based learning approach on student's critical-thinking skills. *Eurasia Journal of Mathematics Science and Technology Education*, 12(12).
- Fadilah, S., Jatmiko, B., & Prastowo, T. (2020). Validity and effectiveness of argument-driven inquiry model with contextual approaches to improve critical thinking skills in science learning. *Studies in Learning and Teaching*, 1(2), 66–75.
- Fakhriyah, F., Masfuah, S., Roysa, M., Rusilowati, A., & Rahayu, E. S. (2017). Student's science literacy in the aspect of content science? *Jurnal Pendidikan IPA Indonesia*, 6(1).
- Fan, S.-C., & Yu, K.-C. (2017). How an integrative STEM curriculum can benefit students in engineering design practices. *International Journal of Technology and Design Education*, 27, 107–129.

- Fanani, A., & Kusmaharti, D. (2018). Pengembangan pembelajaran berbasis HOTS (higher order thinking skill) di sekolah dasar kelas V. *Jurnal Pendidikan Dasar*, 9(1), 1–11.
- Febrianti, D., Suhery, T., & Suharman, A. (2018). Pengembangan Strategi Pembelajaran STEM--PBL (Science, Technology, Engineering, And Mathematic Problem Base Dlearning) Pada Materi Termokimia Di Kelas XI Sman 19 Palembang. *Penelitian Pendidikan Kimia*, 158–159.
- Fitrianto, T. Y. (2018). Pengembangan instrumen pengukuran nilai kerja sama siswa. *Wiyata Dharma: Jurnal Penelitian Dan Evaluasi Pendidikan*, 6(2), 157–164.
- Fitriyana, N., Wiyarsi, A., Pratomo, H., & Marfuatun, M. (2024). The Importance of Integrated STEM Learning in Chemistry Lesson: Perspectives from High School and Vocational School Chemistry Teachers. *Journal of Technology and Science Education*, 14(2), 418–437.
- Force, S. T. (2014). Innovate: A blueprint for science, technology, engineering, and mathematics in California public education. *Dublin, CA: Californians Dedicated to Education Foundation*.
- Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of Educational Research*, 82(3), 300–329.
- Gholam, A. P. (2019). Inquiry-based learning: Student teachers' challenges and perceptions. *Journal of Inquiry and Action in Education*, 10(2), 6.
- Gredler, M. E. (2009). Hiding in plain sight: The stages of mastery/self-regulation in Vygotsky's cultural-historical theory. *Educational Psychologist*, 44(1), 1–19.
- Gredler, M. E. (2012). Understanding Vygotsky for the classroom: Is it too late? *Educational Psychology Review*, 24, 113–131.
- Güçlüer, E., & Kesercioğlu, T. (2012). THE EFFECT OF USING ACTIVITIES IMPROVING SCIENTIFIC LITERACY ON STUDENTS'ACHIEVEMENT IN SCIENCE AND TECHNOLOGY LESSON. *International Online Journal of Primary Education*, 1(1), 8–13.
- Gulo, W. (2008). *Strategi Belajar Mengajar (Cover Baru)*. Grasindo.
- Hake, R. R. (1999). *Analyzing change/gain scores*.
- Harris, A., & De Bruin, L. R. (2018). Secondary school creativity, teacher practice and STEAM education: An international study. *Journal of Educational Change*, 19, 153–179.
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111–127.
- Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: a response to Kirschner, Sweller, and. *Educational Psychologist*, 42(2), 99–107.
- Hofstein, A., Eilks, I., & Bybee, R. (2011). Societal issues and their importance for contemporary science education—a pedagogical justification and the state-of-the-art in Israel, Germany, and the USA. *International Journal of Science and Mathematics Education*, 9, 1459–1483.
- Holbrook, J., & Rannikmae, M. (2009). The meaning of scientific literacy. *International Journal of Environmental and Science Education*, 4(3), 275–288.
- Honey, M., Pearson, G., & Schweingruber, H. A. (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research* (Vol. 500). National Academies Press Washington, DC.

- Ješková, Z., Lukáč, S., Šnajder, L., Guniš, J., Klein, D., & Kireš, M. (2022). Active Learning in STEM Education with Regard to the Development of Inquiry Skills. *Education Sciences*, 12(10), 686. <https://doi.org/10.3390/educsci12100686>
- Johnson, C. C. (2013). Conceptualizing integrated STEM education. *School Science & Mathematics*, 113(8).
- Johnstone, A. H. (2000). Teaching of chemistry-logical or psychological? *Chemistry Education Research and Practice*, 1(1), 9–15.
- Joyce, B., Weil, M., & Calhoun, E. (1996). *Models of teaching 5th edition*. Needham Heights. Mas.
- Joyce, B., Weil, M., & Calhoun, E. (2011). *Models of Teaching, Model-Model Pengajaran*, terj. Achmad Fawaid Dan Ateilla Mirza. Yogyakarta: Pustaka Pelajar.
- Kadir, (2015). *Statistika Terapan. Edisi ketiga*. Jakarta: Rajawali Pers
- Kosasih, E. (2021). *Pengembangan bahan ajar*. Bumi Aksara.
- Kozulin, A. (1986). The concept of activity in Soviet psychology: Vygotsky, his disciples and critics. *American Psychologist*, 41(3), 264–274. <https://doi.org/10.1037/0003-066X.41.3.264>
- Kuo, Y.-R., Tuan, H.-L., & Chin, C.-C. (2019). Examining low and non-low achievers' motivation towards science learning under inquiry-based instruction. *International Journal of Science and Mathematics Education*, 17, 845–862.
- Lafifa, F., Rosana, D., Suyanta, S., Nurohman, S., & Astuti, S. R. D. (2023). Integrated STEM approach to improve 21st century skills in Indonesia: A systematic review. *International Journal of STEM Education for Sustainability*, 3(2), 252–267.
- Lai, C.-S. (2018). Using Inquiry-Based Strategies for Enhancing Students' STEM Education Learning. *Journal of Education in Science, Environment and Health*, 4(1), 110–117.
- Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). STEM: Good Jobs Now and for the Future. ESA Issue Brief# 03-11. *US Department of Commerce*.
- Laugksch, R. C. (2000). Scientific literacy: A conceptual overview. *Science Education*, 84(1), 71–94.
- Leedy, P. D., & Ormrod, J. E. (2023). *Practical Research: Planning and Design*. Pearson.
- Leppävirta, J., Kettunen, H., & Sihvola, A. (2010). Complex problem exercises in developing engineering students' conceptual and procedural knowledge of electromagnetics. *IEEE Transactions on Education*, 54(1), 63–66.
- Levanova, E., Galustyan, O., Seryakova, S., Pushkareva, T., Serykh, A., & Yezhov, A. (2020). Students' project competency within the framework of stem education. *International Journal of Emerging Technologies in Learning (IJET)*, 15(21), 268–276.
- Lindawati, L., Wardani, S., & Sumarti, S. S. (2019). Development of inquiry materials based on chemical representation to improve students' critical thinking ability. *Journal of Innovative Science Education*, 8(3), 332–343.
- Linn, M. C., & Eylon, B.-S. (2011). *Science learning and instruction: Taking advantage of technology to promote knowledge integration*. Routledge.
- Lourenço, A. A., & Paiva, M. O. (2024). Academic performance of excellence: The impact of self-regulated learning and academic time management planning. *Knowledge*, 4(2), 289-301.

- Lou, S.-J., Shih, R.-C., Ray Diez, C., & Tseng, K.-H. (2011). The impact of problem-based learning strategies on STEM knowledge integration and attitudes: an exploratory study among female Taiwanese senior high school students. *International Journal of Technology and Design Education*, 21, 195–215.
- Lupi3n-Cobos, T., Gir3n-Gambero, J. R., & Garc3a-Ruiz, C. (2022). *Building STEM inquiry-based teaching proposal through collaborations between schools and research centres: students' and teachers' perceptions*.
- Mahanani, I., Rahayu, S., & Fajaroh, F. (2019). The effect of inquiry based learning with socioscientific issues context on critical thinking skills and scientific explanation. *Jurnal Kependidikan Penelitian Inovasi Pembelajaran*, 3(1), 53–68.
- Mandina, S., & Ochonogor, E. C. (2017). Using problem-solving instruction to overcome high school chemistry students' difficulties with stoichiometric problems. *African Journal of Educational Studies in Mathematics and Sciences*, 13, 33–39.
- McClure, E. R., Guernsey, L., Clements, D. H., Bales, S. N., Nichols, J., Kendall-Taylor, N., & Levine, M. H. (2017). STEM starts early: Grounding science, technology, engineering, and math education in early childhood. *Joan Ganz Cooney Center at Sesame Workshop*.
- McCormick, R. (2004). Issues of learning and knowledge in technology education. *International Journal of Technology and Design Education*, 14, 21–44.
- Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible “hidden variable” in diagnostic pretest scores. *American Journal of Physics*, 70(12), 1259–1268.
- Miles, M. B., Huberman, A. M., & Salda3a, J. (2014). *Qualitative data analysis: A methods sourcebook*. 3rd. Thousand Oaks, CA: Sage.
- Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 47(4), 474–496.
- Mohamad Hasim, S., Rosli, R., Halim, L., Capraro, M. M., & Capraro, R. M. (2022). STEM professional development activities and their impact on teacher knowledge and instructional practices. *Mathematics*, 10(7), 1109.
- Mulyani, T. (2019). Pendekatan pembelajaran STEM untuk menghadapi revolusi industri 4.0. *Prosiding Seminar Nasional Pascasarjana*, 2(1), 453–460.
- Mulyatiningsih, E. (2015). *Metode penelitian terapan bidang pendidikan*. Uny Press.
- Nguyen, H. & Wolters, C.A. (2023). *Practical Strategies for Promoting Students' Self-Regulated Learning (SRL) in Classroom*. Division 15 of the American Psychological Association.
- Nguyen, A. Lamsa, J. Dwiarie, A. Jarvela, S. (2024). Lifelong Learner Needs for Human-Centered Self-Regulated Learning Analytics. *International and Learning Sciences*. 125 (1): 68-108
- Nieveen, N. (1999). Prototyping to reach product quality. *Design Approaches and Tools in Education and Training*, 125–135.
- Novitra, F. (2021). Development of Online-Based Inquiry Learning Model to Improve 21st-Century Skills of Physics Students in Senior High School. *Eurasia Journal of Mathematics, Science and Technology Education*, 17(9).
- OECD. (2018). Promoting innovation in established SMEs. *Policy Note, SME Ministerial Conference*.

- OECD. (2019). An OECD Learning Framework 2030. *The Future of Education and Labor*, 23–35.
- OECD, P. (2017). Enhancing the contributions of SMEs in a global and digitalised economy. *Paris*. Retrieved Feb, 25, 2019.
- Oğuz Ünver, A., & Arabacıoğlu, S. (2011). *Overviews on inquiry based and problem based learning methods*.
- Oktaviana, I. A., Saputro, A. N. C., & Utami, B. (2016). Upaya Peningkatkan Kemampuan Berpikir Kritis Dan Prestasi Belajar Siswa Melalui Penerapan Model Pembelajaran Problem Based Learning (Pbl) Dilengkapi Modul Pada Materi Kelarutan Dan Hasil Kali Kelarutan Kelas Xi Sma Negeri 1 Gondang. *Jurnal Pendidikan Kimia Universitas Sebelas Maret*, 5(1), 143–152.
- Owens, A. D., & Hite, R. L. (2022). Enhancing student communication competencies in STEM using virtual global collaboration project based learning. *Research in Science & Technological Education*, 40(1), 76–102. <https://doi.org/10.1080/02635143.2020.1778663>
- Paris, S. G., & Paris, A. H. (2003). Classroom applications of research on self-regulated learning. In *Educational Psychology* (pp. 89–101). Routledge.
- Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A. N., Kamp, E. T., Manoli, C. C., Zacharia, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61.
- Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, 36(1), 36–48.
- Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, 37(2), 91–105.
- Peterson, E. G. (2020). Supporting curiosity in schools and classrooms. *Current Opinion in Behavioral Sciences*, 35, 7–13. <https://doi.org/10.1016/j.cobeha.2020.05.006>
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33.
- Pisa, O. (2013). assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy. *Paris: Organisation for Economic Cooperation and Development*.
- Ploj Vrtič, M. (2022). Teaching science & technology: components of scientific literacy and insight into the steps of research. *International Journal of Science Education*, 44(12), 1916–1931.
- Priansa, D. J. (2017). *Pengembangan strategi dan model pembelajaran: inovatif, kreatif, dan prestatif dalam memahami peserta didik*.
- Purnomo, S., Rahayu, Y. S., & Agustini, R. (2023). Effectiveness of adi-stem to improve student's science literacy skill. *IJORER: International Journal of Recent Educational Research*, 4(5), 632–647.
- Purwanto, M. N. (2019). *Prinsip-prinsip dan teknik evaluasi pengajaran*.
- Purzer, Ş., Goldstein, M. H., Adams, R. S., Xie, C., & Nourian, S. (2015). An exploratory study of informed engineering design behaviors associated with scientific explanations. *International Journal of STEM Education*, 2, 1–12.

- Purzer, S., & Shelley, M. (2018). The rise of engineering in STEM education: The “E” in STEM. *Research Highlights in STEM Education*, 38–56.
- Qamariyah, S. N., Rahayu, S., Fajaroh, F., & Alsulami, N. M. (2021). The Effect of Implementation of Inquiry-Based Learning with Socio-Scientific Issues on Students’ Higher-Order Thinking Skills. *Journal of Science Learning*, 4(3), 210–218.
- Quigley, C. F., Herro, D., & Jamil, F. M. (2017). Developing a conceptual model of STEAM teaching practices. *School Science and Mathematics*, 117(1–2), 1–12.
- Rahayu, S. (2017). Mengoptimalkan aspek literasi dalam pembelajaran kimia abad 21. *Prosiding Seminar Nasional Kimia UNY*, 21(4), 183–188.
- Rahayuni, G. (2016). Hubungan keterampilan berpikir kritis dan literasi sains pada pembelajaran IPA terpadu dengan model PBM dan STM. *Jurnal Penelitian Dan Pembelajaran IPA*, 2(2), 131–146.
- Riduwan, A. (2010). *Metode Penelitian untuk Guru-Karyawan dan Peneliti Pemula*. Alfabeta.
- Ristiyan, E., & Bahriah, E. S. (2016). Analisis kesulitan belajar kimia siswa di SMAN X Kota Tangerang Selatan. *Jurnal Penelitian Dan Pembelajaran IPA*, 2(1), 18–29.
- Rivera, H., & Li, J.-T. (2020). Potential factors to enhance students’ STEM college learning and career orientation. *Frontiers in Education*, 5, 25.
- Roberts, D. A. (2013). Scientific literacy/science literacy. In *Handbook of research on science education* (pp. 729–780). Routledge.
- Roberts, T., Jackson, C., Mohr-Schroeder, M. J., Bush, S. B., Maiorca, C., Cavalcanti, M., Craig Schroeder, D., Delaney, A., Putnam, L., & Cremeans, C. (2018). Students’ perceptions of STEM learning after participating in a summer informal learning experience. *International Journal of STEM Education*, 5, 1–14.
- Roth, M. J. S., & Elrod, S. (2015). Framing Leadership for Sustainable Interdisciplinary Programs. *Peer Review*, 17(2).
- Rusman. (2011). *Model-model pembelajaran: Mengembangkan profesionalisme guru*. Rajawali Pers/PT Raja Grafindo Persada.
- Salado, A., Chowdhury, A. H., & Norton, A. (2019). Systems thinking and mathematical problem solving. *School Science and Mathematics*, 119(1), 49–58.
- Sanders, M. E. (2008). *Stem, stem education, stemmania*.
- Sani, R. A. (2013). *Inovasi Pembelajaran*, Jakarta: PT. Bumi Aksara.
- Sani, R. A. (2021). *Pembelajaran berorientasi akm: asesmen kompetensi minimum*. Bumi Aksara.
- Sanjaya, W. (2013). *Penelitian pendidikan: jenis, metode dan prosedur*.
- Schneider, M., Rittle-Johnson, B., & Star, J. R. (2011). Relations among conceptual knowledge, procedural knowledge, and procedural flexibility in two samples differing in prior knowledge. *Developmental Psychology*, 47(6), 1525.
- Schraw, G., & Robinson, D. H. (2011). *Assessment of higher order thinking skills*. IAP.
- Schunk, D. H. (2012). *Learning theories an educational perspective*. Pearson Education, Inc.
- Schunk, D. H., & Zimmerman, B. J. (2012). Self-regulation and learning. *Handbook of Psychology, Second Edition*, 7.
- Schwarz, C. V., Reiser, B. J., Davis, E. A., Kenyon, L., Achér, A., Fortus, D., Shwartz, Y., Hug, B., & Krajcik, J. (2009). Developing a learning progression for scientific modeling: Making scientific modeling accessible and meaningful for learners.

- Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, 46(6), 632–654.
- Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Tor/Forge.
- Şentürk, C., & Sari, H. (2018). Investigation of the contribution of differentiated instruction into science literacy. *Qualitative Research in Education*, 7(2), 197–237.
- Sergis, S., Sampson, D. G., Rodríguez-Triana, M. J., Gillet, D., Pelliccione, L., & de Jong, T. (2019). Using educational data from teaching and learning to inform teachers' reflective educational design in inquiry-based STEM education. *Computers in Human Behavior*, 92, 724–738.
- Shadreck, M., & Enunuwe, O. C. (2018). Recurrent difficulties: Stoichiometry problem-solving. *African Journal of Educational Studies in Mathematics and Sciences*, 14, 25–31.
- Shao, J., Chen, Y., Wei, X., Li, X., & Li, Y. (2023). Effects of Regulated Learning Scaffolding on Regulation Strategies and Academic Performance: A meta-analysis. *Frontiers in Psychology*, 14, 1110086.
- Shelley, M., & Kiray, S. A. (2018). Research Highlights in STEM Education. *Online Submission*.
- Shen, Q. (2023). *From theory to practice: Research and trends in STEM education*. In Y. Chen et al. (Eds.), *Proceedings of ICMETSS 2022* (pp. 876–887). Atlantis Press. https://doi.org/10.2991/978-2-494069-45-9_106
- Shwartz, Y., Ben-Zvi, R., & Hofstein, A. (2005). The importance of involving high-school chemistry teachers in the process of defining the operational meaning of 'chemical literacy.' *International Journal of Science Education*, 27(3), 323–344.
- Škoda, J., Doulik, P., Bílek, M., & Šimonová, I. (2015). The Effectiveness of Inquiry Based Science Education in Relation to the Learners' Motivation Types. *Journal of Baltic Science Education*, 14(6), 791–803.
- States, N. L. (2013). *Next generation science standards: For states, by states*. National Academies Press.
- Stohlmann, M. S., Moore, T. J., & Cramer, K. (2013). Pre-service elementary teachers' mathematical content knowledge from an integrated STEM modelling activity. *Journal of Mathematical Modelling and Application*, 1(8), 18–31.
- Sugiyono, S. (2016). Metode penelitian kuantitatif, kualitatif, R&D. *Bandung: Alfabeta*, 1–11.
- Sukmadinata, N. S. (2019). *Metode penelitian pendidikan*.
- Sulaeman, N. F., Putra, P. D. A., Mineta, I., Hakamada, H., Takahashi, M., Ide, Y., & Kumano, Y. (2021). Exploring student engagement in STEM education through the engineering design process. *Jurnal Penelitian Dan Pembelajaran IPA*, 7(1), 1–16.
- Sunyono, S., Yuanita, L., & Ibrahim, M. (2015). Mental models of students on stoichiometry concept in learning by method based on multiple representation. *The Online Journal of New Horizons in Education (TOJNED)*, 5(2), 30–45.
- Sutiani, A., Situmorang, M., & Silalahi, A. (2021). Implementation of an inquiry learning model with science literacy to improve student critical thinking skills. *International Journal of Instruction*, 14(2), 117–138.
- Sutikno, S. (2014). Metode dan model-model pembelajaran. *Lombok: Holistica*.
- Sutoyo, S., Azizah, U., & Allamin, S. (2019). Effectiveness of the guided inquiry model integrated with STEM to improve the student critical thinking skills in chemistry

- learning. *International Journal of Innovative Science and Research Technology*, 4(12), 349–353.
- Taber, K. S. (2014). *Student Thinking and Learning in Science: Perspectives on the nature and development of learners' ideas*. Routledge.
- Takeuchi, M. A., Sengupta, P., Shanahan, M.-C., Adams, J. D., & Hachem, M. (2020). Transdisciplinarity in STEM education: A critical review. *Studies in Science Education*, 56(2), 213–253.
- Talanquer, V. (2011). Macro, submicro, and symbolic: The many faces of the chemistry “triplet.” *International Journal of Science Education*, 33(2), 179–195.
- Thomas, A., & Thorne, G. (2009). How to increase higher order thinking. *Metarie, LA: Center for Development and Learning*, 264.
- Toharudin, U., Hendrawati, S., & Rustaman, A. (2011). Membangun literasi sains peserta didik. *Bandung: Humaniora*, 1.
- Townley, A. (2018). Teaching and Learning Science in the 21st Century: Challenging Critical Assumptions in Post-Secondary Science. *Education Sciences*, 8(1), 12. <https://doi.org/10.3390/educsci8010012>
- Treagust, D., Chittleborough, G., & Mamiala, T. (2003). The role of submicroscopic and symbolic representations in chemical explanations. *International Journal of Science Education*, 25(11), 1353–1368.
- Trianto, M. P. (2009). Mendesain model pembelajaran inovatif-progresif. *Jakarta: Kencana*.
- Tudge, J., & Scrimsher, S. (2014). Lev S. Vygotsky on education: A cultural-historical, interpersonal, and individual approach to development. In *Educational psychology* (pp. 207–228). Routledge.
- Tytler, R., Williams, G., Hobbs, L., & Anderson, J. (2019). Challenges and opportunities for a STEM interdisciplinary agenda. *Interdisciplinary Mathematics Education: The State of the Art and Beyond*, 51–81.
- van Brederode, M. E., Zoon, S. A., & Meeter, M. (2020). Examining the effect of lab instructions on students' critical thinking during a chemical inquiry practical. *Chemistry Education Research and Practice*, 21(4), 1173–1182.
- Vieira, R. M., & Tenreiro-Vieira, C. (2016). Fostering scientific literacy and critical thinking in elementary science education. *International Journal of Science and Mathematics Education*, 14(4), 659–680.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (Vol. 86). Harvard university press.
- Wahab, G., & Rosnawati, R. (2011). Teori-teori belajar dan pembelajaran. *Erlangga, Bandung*.
- Wang, H.-H., Lin, H., Chen, Y.-C., Pan, Y.-T., & Hong, Z.-R. (2021). Modelling relationships among students' inquiry-related learning activities, enjoyment of learning, and their intended choice of a future STEM career. *International Journal of Science Education*, 43(1), 157–178.
- Wang, H.-H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM integration: Teacher perceptions and practice. *Journal of Pre-College Engineering Education Research (J-PEER)*, 1(2), 2.
- Widowati, A., Widodo, E., & Anjarsari, P. (2017). The Development of Scientific Literacy through Nature of Science (NoS) within Inquiry Based Learning Approach. *Journal of Physics: Conference Series*, 909(1), 012067.
- Widoyoko, E. P. (2012). *Teknik penyusunan instrumen penelitian*.

- Wilson, B. G. (1996). *Constructivist learning environments: Case studies in instructional design*. Educational Technology.
- Winarti, A. (2017). *Strategi Belajar Mengajar Kimia*. Program Studi Pendidikan Kimia FKIP ULM.
- Winata, A., Cacik, S., & RW, I. S. (2016). Analisis kemampuan awal literasi sains mahasiswa pada konsep IPA. *Education and Human Development Journal*, 1(1).
- Windschitl, M., Thompson, J., & Braaten, M. (2008). Beyond the scientific method: Model-based inquiry as a new paradigm of preference for school science investigations. *Science Education*, 92(5), 941–967.
- Yaki, A. A. (2022). Fostering Critical Thinking Skills Using Integrated STEM Approach among Secondary School Biology Students. *European Journal of STEM Education*, 7(1), 6.
- Yakman, G., & Lee, H. (2012). Exploring the exemplary STEAM education in the US as a practical educational framework for Korea. *Journal of the Korean Association for Science Education*, 32(6), 1072–1086.
- Yeh, Y. C. (2003). Critical thinking test-Level I guidebook. *Taipei, Taiwan: Psychological Publishing Co.*
- Yin, R. K. (2018). *Case study research and applications*. Sage Thousand Oaks, CA.
- Yıldız-Feyzioğlu, E., & Demirci, N. (2021). The effects of inquiry-based learning on students' learner autonomy and conceptions of learning. *Journal of Turkish Science Education*, 18(3), 401–420.
- Yu, B. (2023). Self-regulated learning: A key factor in the effectiveness of online learning for second language learners. *Frontiers in Psychology*, 13, 1051349.
- Yunus. (2016). Pengembangan Model Pembelajaran Teknik Pengelasan Berbantuan Komputer di SMK. (Disertasi Doktor Pendidikan). Universitas Negeri Yogyakarta
- Zhai, L. (2019). A inquiry teaching mode based on STEM education. *International Journal of Emerging Technologies in Learning (Online)*, 14(17), 44.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41(2), 64–70.
- Zeidner, M. & Stoeger, H. (2019). Self-Regulated Learning (SRL): A guide for the perplexed. *High Ability Studies*. <https://doi.org/10.1080/13598139.2019.1>