

DAFTAR PUSTAKA

- Agbonifo, O. C., Sarumi, O. A., & Akinola, Y. M. (2020). A Chemistry laboratory platform enhanced with virtual reality for students' adaptive learning. *Research in Learning Technology*, 28. <https://doi.org/10.25304/rlt.v28.2419>
- Akbar, J. S., & Djakariah, D. (2023). Opportunities and challenges for using augmented reality-based learning media in learning chemistry in the era of society 5.0. *Cognitive Development Journal*, 1(2), 60-66. <https://doi.org/10.32585/cognitive.v1i2.9>
- Akbari, M., Khodayari, M., Danesh, M., Davari, A., & Padash, H. (2020). A bibliometric study of sustainable technology research. *Cogent Business & Management*, 7(1), 1751906. <https://doi.org/10.1080/23311975.2020.1751906>
- Al-Abyadh, M. H. A., & Abdel Azeem, H. A. H. (2022). Academic achievement: Influences of university students' self-management and perceived self-efficacy. *Journal of Intelligence*, 10(3), 55. <https://doi.org/10.3390/jintelligence10030055>
- Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011). Does discovery-based instruction enhance learning?. *Journal of Educational Psychology*, 103(1), 1. <https://doi.org/10.1037/a0021017>
- Aliyu, F., & Talib, C. A. (2019). Virtual reality technology: What benefits for nigerian pre-service chemistry teachers. *Asia Proceedings of Social Sciences*, 4(3), 66-68. <https://doi.org/10.31580/apss.v4i3.856>
- Alvarado, C., Garritz, A., & Mellado, V. (2015). Canonical pedagogical content knowledge by CoRes for teaching acid-base chemistry at high school. *Chemistry Education Research and Practice*, 16(3), 603-618. <https://doi.org/10.1039/C4RP00125G>
- Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*, 5(6), 66-70.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. In *Psychological Review*, 84(2) <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (2012). On the functional properties of perceived self-efficacy revisited. *Journal of Management*, 38(1), 9-44. <https://doi.org/10.1177/014920631141>
- Bandura, A., & Bandura, A. (2005). *Self-Efficacy Beliefs of Adolescents*.
- Baxter, G., & Hainey, T. (2019). Student perceptions of virtual reality use in higher education. *Journal of Applied Research in Higher Education*, 12(3), 413-424. <https://doi.org/10.1108/JARHE-06-2018-0106>

- Becker, N., Stanford, C., Towns, M., & Cole, R. (2015). Translating across macroscopic, submicroscopic, and symbolic levels: the role of instructor facilitation in an inquiry-oriented physical chemistry class. *Chemistry Education Research and Practice*, 16(4), 769-785. [10.1039/C5RP00064E](https://doi.org/10.1039/C5RP00064E)
- Birenboim, A., Dijst, M., Ettema, D., de Kruijf, J., de Leeuw, G., & Dogterom, N. (2019). The utilization of immersive virtual environments for the investigation of environmental preferences. *Landscape and Urban Planning*, 189, 129-138. <https://doi.org/10.1016/j.landurbplan.2019.04.011>
- Bonner, E., & Reinders, H. (2018). Augmented and virtual reality in the language classroom: Practical ideas. *Teaching English with Technology*, 18(3), 33-53. <http://www.tewtjournal.org>
- Bouterraka, S. (2024). Virtual reality innovations in higher education: Advancing teaching methods and student engagement. *The International Journal of Technology, Innovation, and Education*, 2(1), 35-56. <https://doi.org/10.5281/zenodo.14788374>
- Burr, V. (2015). *Social constructionism*. Routledge.
- Cai, S., Liu, C., Wang, T., Liu, E., & Liang, J. C. (2021). Effects of learning physics using augmented reality on students' self-efficacy and conceptions of learning. *British Journal of Educational Technology*, 52(1), 235-251. <https://doi.org/10.1111/bjet.13020>
- Çakıroğlu, Ü., Güler, M., Dündar, M., & Coşkun, F. (2024). Virtual reality in realistic mathematics education to develop mathematical literacy skills. *International Journal of Human-Computer Interaction*, 40(17), 4661-4673. <https://doi.org/10.1080/10447318.2023.2219960>
- Calogiuri, G., Litleskare, S., Fagerheim, K. A., Rydgren, T. L., Brambilla, E., & Thurston, M. (2018). Experiencing nature through immersive virtual environments: Environmental perceptions, physical engagement, and affective responses during a simulated nature walk. *Frontiers in psychology*, 8, 2321. <https://doi.org/10.3389/fpsyg.2017.02321>
- Cao, S., Chu, J., Zhang, Z. C., & Liu, L. (2024). The effectiveness of VR environment on primary and secondary school students' learning performance in science courses. *Interactive Learning Environments*. <https://doi.org/10.1080/10494820.2024.2312921>
- Castells, M. (2010). Globalisation, networking, urbanisation: Reflections on the spatial dynamics of the information age. *Urban Studies*, 47(13), 2737-2745. <https://doi.org/10.1177/00420980103773>
- Chang, R. (1988). *Chemistry* (3rd ed.). New York: McGraw-Hill.
- Cieri, R. L., Turner, M. L., Carney, R. M., Falkingham, P. L., Kirk, A. M., Wang, T., ... & Farmer, C. G. (2021). Virtual and augmented reality: New tools for visualizing, analyzing, and communicating complex

- morphology. *Journal of morphology*, 282(12), 1785-1800.
<https://doi.org/10.1002/jmor.21421>
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed). Routledge.
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods In Education* (8th Ed.). Routledge.
- Dabic, M., Daim, T., Bayraktaroglu, E., Novak, I., & Basic, M. (2012). Exploring gender differences in attitudes of university students towards entrepreneurship: An international survey. *International Journal of Gender and Entrepreneurship*, 4(3), 316–336.
<https://doi.org/10.1108/17566261211264172>
- Dede, C., Salzman, M. C., & Loftin, R. B. (1996, March). ScienceSpace: Virtual realities for learning complex and abstract scientific concepts. In *Proceedings of the IEEE 1996 virtual reality annual international symposium* (pp. 246-252). IEEE. [10.1109/VRAIS.1996.490534](https://doi.org/10.1109/VRAIS.1996.490534)
- Dhanil, M., & Mufit, F. (2024). How virtual reality impacts science learning? a meta-analysis. *International Journal of Interactive Mobile Technologies (IJIM)*, 18(22), pp. 77–96. <https://doi.org/10.3991/ijim.v18i22.49989>
- Dou, R., Hazari, Z., Brewe, E., & Potvin, G. (2018). Beyond performance metrics: Examining a decrease in students' physics self-efficacy through a social network lens. *Physical Review Physics Education Research*, 14(2), 020107. <https://doi.org/10.1103/PhysRevPhysEducRes.14.020107>
- Efgivia, M. G., Rinanda, R. A., Hidayat, A., Maulana, I., & Budiarjo, A. (2021, October). Analysis of constructivism learning theory. In 1st UMGESHIC International Seminar on Health, Social Science and Humanities (UMGESHC-ISHSSH 2020) (pp. 208-212). Atlantis Press. [10.2991/assehr.k.211020.032](https://doi.org/10.2991/assehr.k.211020.032)
- Elaish, M.M., Yadegaridehkordi, E. & Ho, YS. Publication performance and trends in virtual reality research in education fields: a bibliometric analysis. *Multimed Tools Appl* 84, 6999–7026 (2025).
<https://doi.org/10.1007/s11042-024-19238-0>
- Falco, L. D., & Summers, J. J. (2019). Improving career decision self-efficacy and STEM self-efficacy in high school girls: Evaluation of an intervention. *Journal of Career Development*, 46(1), 62-76.
<https://doi.org/10.1177/08948453177216>
- Fernando, S. Y., & Marikar, F. M. (2017). Constructivist teaching/learning theory and participatory teaching methods. *Journal of Curriculum and Teaching*, 6(1), 110-122.
- Freeman, A., Becker, S. A., & Cummins, M. (2017). *NMC/CoSN horizon report: 2017 K*. The New Media Consortium.

- Fusco, A., & Tieri, G. (2022). Challenges and perspectives for clinical applications of immersive and non-immersive virtual reality. *Journal of Clinical Medicine*, 11(15), 4540. <https://doi.org/10.3390/jcm11154540>
- Gholam, A. P. (2019). Inquiry-based learning: Student teachers' challenges and perceptions. *Journal of Inquiry and Action in Education*, 10(2), 6.
- Gungor, Almer, *et al.* "The use of virtual reality in a chemistry lab and its impact on students' self-efficacy, interest, self-concept and laboratory anxiety." *Eurasia Journal of Mathematics, Science and Technology Education* 18.3 (2022): em2090. <https://doi.org/10.29333/ejmste/11814>
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). (3th Ed.). Thousand Oaks, CA: Sage. A primer on partial least squares structural equation modeling (PLS-SEM)
- Hasanatin, M. A., & Rohaeti, E. (2022). Analysis of feasibility of integrated assessment instruments to measure critical thinking skills and scientific attitudes of high school students on acid-base titration materials. *European Journal of Education Studies*, 9(1). <http://dx.doi.org/10.46827/ejes.v9i1.4169>
- Honick, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational research review*, 17, 63-84. <https://doi.org/10.1016/j.edurev.2015.11.002>
- Huh, M. B., & Miri, M. (2025). The effects of using VR to promote student motivation in architectural design studio course. *International Journal of Design Creativity and Innovation*, 1-24. <https://doi.org/10.1080/21650349.2025.2471973>
- Hussein, M., & Nätterdal, C. (2015). The benefits of virtual reality in education- A comparison Study. <http://hdl.handle.net/2077/39977>
- Hwang, M. H., Choi, H. C., Lee, A., Culver, J. D., & Hutchison, B. (2016). The relationship between self-efficacy and academic achievement: A 5-year panel analysis. *The Asia-Pacific Education Researcher*, 25, 89-98. <https://doi.org/10.1016/j.sbspro.2011.03.180>
- Ibiyemi, A., Mohd Adnan, Y., Daud, M. N., Olanrele, S., & Jogunola, A. (2019). A content validity study of the test of valuers' support for capturing sustainability in the valuation process in Nigeria. *Pacific Rim Property Research Journal*, 25(3), 177-193. <https://doi.org/10.1080/14445921.2019.1703700>
- Iksal, I., Hayani, R. A., & Aslan, A. (2024). Strengthening character education as a response to the challenges of the times. *Indonesian Journal of Education (INJOE)*, 4(3), 761-774. <https://injoe.org/index.php/INJOE/article/view/116>
- Jamieson, J. (2004). Analysis of covariance (ANCOVA) with difference scores. *International Journal of Psychophysiology*, 52(3), 277-283.

- Kamińska, D., Sapiński, T., Wiak, S., Tikk, T., Haamer, R. E., Avots, E., ... & Anbarjafari, G. (2019). Virtual reality and its applications in education: Survey. *Information*, 10(10), 318. <https://doi.org/10.3390/info10100318>
- Khalaf, B. K., & Mohammed Zin, Z. B. (2018). Traditional and inquiry-based learning pedagogy: A systematic critical review. *International Journal of Instruction*, 11(4), 545-564. <https://doi.org/10.12973/iji.2018.11434a>
- Kim, S., Lee, H., Park, Y. R., & Hwang, H. (2021). Examining the effectiveness of 3D virtual reality training on self-efficacy and problem-solving skills: A randomized controlled trial. *Journal of Medical Internet Research*, 23(11), e29862. <https://doi.org/10.2196/29862>
- King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & management*, 43(6), 740-755.
- Klassen, R. M., & Klassen, J. R. L. (2018). Self-efficacy beliefs of medical students: A critical review. In *Perspectives on Medical Education*, 7(2), pp. 76–82). <https://doi.org/10.1007/s40037-018-0411-3>
- Klomegah, R. Y. (2007). Predictors of academic performance of university students: an application of the goal efficacy model. *College Student Journal*, 41(2),
- Lämsä, J., Hämäläinen, R., Koskinen, P., & Viiri, J. (2018). Visualising the temporal aspects of collaborative inquiry-based learning processes in technology-enhanced physics learning. *International Journal of Science Education*, 40(14), 1697-1717. <https://doi.org/10.1080/09500693.2018.1506594>
- Laricheva, E. N., & Ilikchyan, A. (2023). Exploring the effect of virtual reality on learning in general chemistry students with low visual-spatial skills. *Journal of Chemical Education*, 100(2), 589-596. <https://doi.org/10.1021/acs.jchemed.2c00732>
- Latip, M. S. A., Noh, I., Tamrin, M., & Latip, S. N. N. A. (2020). Students' acceptance for e-learning and the effects of self-efficacy in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 10(5), 658-674. <http://dx.doi.org/10.6007/IJARBSS/v10-i5/7239>
- Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. *Review of educational research*, 86(3), 681-718. <https://doi.org/10.1016/j.im.2006.05.003>
- Lege, R., & Bonner, E. (2020). Virtual reality in education: The promise, progress, and challenge. *The Jalt Call Journal*, 16(3), 167-180. <https://doi.org/10.29140/jaltcall.v16n3.388>
- Liu, R., Wang, L., Lei, J., Wang, Q., & Ren, Y. (2020). Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons. *British Journal of Educational Technology*, 51(6), 2034-2049. <https://doi.org/10.1111/bjet.13028>

- Liu, Z., Yu, P., Liu, J., Pi, Z., & Cui, W. (2023). How do students' self-regulation skills affect learning satisfaction and continuous intention within desktop-based virtual reality? A structural equation modelling approach. *British Journal of Educational Technology*, 54(3). <https://doi.org/10.1111/bjet.13278>
- Lofgran, B. B., Smith, L. K., & Whiting, E. F. (2015). Science self-efficacy and school transitions: Elementary school to middle school, middle school to high school. *School Science and Mathematics*, 115(7), 366-376. <https://doi.org/10.1111/ssm.12139>
- Luckin, R., & Cukurova, M. (2019). Designing educational technologies in the age of AI: A learning sciences-driven approach. *British Journal of Educational Technology*, 50(6), 2824-2838. <https://doi.org/10.1111/bjet.12861>
- Maglio, C., Williams, M., & Camponeschi, A. (2025). Biology wet lab e-learning during and after the COVID-19 pandemic: A review of student learning and experiences. *Biochemistry and Molecular Biology Education*. <https://doi.org/10.1002/bmb.21897>
- Makransky, G., & Lilleholt, L. (2018). A structural equation modeling investigation of the emotional value of immersive virtual reality in education. *Educational Technology Research and Development*, 66, 1141–1164. <https://doi.org/10.1007/s11423-018-9581-2>
- Makransky, G., Terkildsen, T. S., & Mayer, R. E. (2019). Adding immersive virtual reality to a science lab simulation causes more presence but less learning. *Learning and Instruction*, 60, 225-236. <https://doi.org/10.1016/j.learninstruc.2017.12.007>
- Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual reality in education: A review of learning theories, approaches and methodologies for the last decade. *Electronics*, 12(13), 2832. <https://doi.org/10.3390/electronics12132832>
- Michel, N., Cater III, J. J., & Varela, O. (2009). Active versus passive teaching styles: An empirical study of student learning outcomes. *Human Resource Development Quarterly*, 20(4), 397-418. [10.1002/hrdq.20025](https://doi.org/10.1002/hrdq.20025)
- Mpho, O. Teacher centered dominated approaches: Their implications for today's inclusive classrooms. 2018; 10 (February): 11–21. Publisher Full Text. <https://doi.org/10.5897/IJPC2016.0393>
- Mubarokah, F. D., Mulyani, S., & Indriyanti, N. Y. (2018). Identifying students' misconceptions of acid-base concepts using a three-tier diagnostic test: A case of indonesia and thailand. *Journal of Turkish Science Education*, 15(STEM Special Issue), 51-58. <https://doi.org/10.12973/tused.10256a>
- Ng, D. S., Yip, B. H., Young, A. L., Yip, W. W., Lam, N. M., Li, K. K., ... & Tham, C. C. (2023). Cost-effectiveness of virtual reality and wet laboratory

- cataract surgery simulation. *Medicine*, 102(40), e35067. <https://doi.org/10.1097/MD.00000000000035067>
- Nurhuda, A., Al Khoiron, M. F., Azami, Y. S. I., & Ni'mah, S. J. (2023). Constructivism learning theory in education: Characteristics, steps and learning models. *Research in Education and Rehabilitation*, 6(2), 234-242. <https://doi.org/10.51558/2744-1555.2023.6.2.234>
- Obilor, E. I., & Amadi, E. C. (2018). Test for significance of pearson's correlation coefficient. *International Journal of Innovative Mathematics, Statistics & Energy Policies*, 6(1), 11-23.
- Oigara, J. N. (2018). Integrating virtual reality tools into classroom instruction. *Handbook of Research on Mobile Technology, Constructivism, and Meaningful Learning*, 147-159. IGI Global.
- Öqvist, A., & Malmström, M. (2018). What motivates students? A study on the effects of teacher leadership and students' self-efficacy. *International Journal of Leadership in Education*, 21(2), 155–175. <https://doi.org/10.1080/13603124.2017.1355480>
- Park, D. S., Lee, D. G., Lee, G., & Kim, H. (2020). Effects of virtual reality training on occupational performance and self-efficacy of patients with stroke. *Journal of NeuroEngineering and Rehabilitation*, 17(1), 1–8. <https://doi.org/10.1186/s12984-020-00783-2>
- Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47-61.
- Polit, D. F., & Beck, C. T. (2006). The content validity index: are you sure you know what's being reported? critique and recommendations. *Research in nursing & health*, 29(5), 489-497. <https://doi.org/10.1002/nur.20147>
- Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778. <https://doi.org/10.1016/j.compedu.2019.103778>
- Ripsam, M., & Nerdel, C. (2024, January). Teachers' attitudes and self-efficacy toward augmented reality in chemistry education. *Frontiers in Education*, 8(2). Frontiers Media SA.
- Rojas-Sánchez, M. A., Palos-Sánchez, P. R., & Folgado-Fernández, J. A. (2023). Systematic literature review and bibliometric analysis on virtual reality and education. *Education and Information Technologies*, 28(1), 155–192. <https://doi.org/10.1007/s10639-022-11167-5>
- Salame, I. I., Montero, A., & Eschweiler, D. (2022). Examining some of the students' challenges and alternative conceptions in learning about acid-base titrations. *IJCER (International Journal of Chemistry Education Research)*, 1-10.

- Sanchez-Vives, M. V., & Slater, M. (2005). From presence to consciousness through virtual reality. *Nature Reviews Neuroscience*, 6(4), 332-339.
- Sanfilippo, F., Blazauskas, T., Salvietti, G., Ramos, I., Vert, S., Radianti, J., ... & Oliveira, D. (2022). A perspective review on integrating VR/AR with haptics into STEM education for multi-sensory learning. *Robotics*, 11(2), 41. <https://doi.org/10.3390/robotics11020041>
- Sari, I., Sinaga, P., Hernani, H., Mudzakir, A., & Santria, A. (2023). Using virtual reality as learning tools on chemistry: Advantages and challenges. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah*, 8(1), 49-60. <https://orcid.org/0000-0002-4926-4061>
- Sheppard, K. (2006). High school students' understanding of titrations and related acid-base phenomena. *Chemistry Education Research and Practice*, 7(1), 32-45.
- Shin, M.-H. (2018). Effects of project-based learning on students' motivation and Self-efficacy. *English Teaching*, 73(1), 95-114. <https://doi.org/10.15858/engtea.73.1.201803.95>
- Sindu, I. G. P., & Kertiasih, N. K. (2024). The influence of self-effucacy and self-regulation on learning motivation in simulation of immersive virtual reality-based laptop assembly practicum. *Conhecimento & Diversidade*, 16(43), 153-175. <https://doi.org/10.18316/rcd.v16i43.11808>
- Srinivasa, A. R., Jha, R., Ozkan, T., & Wang, Z. (2021). Virtual reality and its role in improving student knowledge, self-efficacy, and attitude in the materials testing laboratory. *International Journal of Mechanical Engineering Education*, 49(4), 382-409. <https://doi.org/10.1177/0306419019898824>
- Sun, K. T., Lin, C. L., & Wang, S. M. (2010). A 3-D virtual reality model of the sun and the moon for e-learning at elementary schools. *International Journal of Science and Mathematics Education*, 8, 689-710. <https://doi.org/10.1007/s10763-009-9181-z>
- Supatmi, S., Setiawan, A., & Rahmawati, Y. (2019). Students' misconceptions of acid-base titration assessments using a two-tier multiple-choice diagnostic test. *African Journal of Chemical Education*, 9(1).
- Tarng, W., Pan, I. C., & Ou, K. L. (2022). Effectiveness of virtual reality on attention training for elementary school students. *Systems*, 10(4), 104. <https://doi.org/10.3390/systems10040104>
- Taylor, S. P. (2018). Critical realism vs social constructionism & social constructivism: Application to a social housing research study. *International Journal of Sciences: Basic and Applied Research*, 37(2), 216-222. <https://insight.cumbria.ac.uk/id/eprint/3596>
- Timmer, M. C., Steendijk, P., Arend, S. M., & Versteeg, M. (2020). Making a lecture stick: The effect of spaced instruction on knowledge retention in

- medical education. *Medical Science Educator*, 30, 1211-1219. <https://doi.org/10.1007/s40670-020-00995-0>
- Tondeur, J., Scherer, R., Baran, E., Siddiq, F., Valtonen, T., & Sointu, E. (2019). Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. *British Journal of Educational Technology*, 50(3), 1189-1209. <https://doi.org/10.1111/bjet.12748>
- Turner, J. L. (2014). Using statistics in small-scale language education research: Focus on non-parametric data. Routledge.
- Velev, D., & Zlateva, P. (2017). Virtual reality challenges in education and training. *International Journal of Learning and Teaching*, 3(1), 33-37.
- Waddington, J. (2023). Self-efficacy. *ELT Journal*, 77(2), 237–240. <https://doi.org/10.1093/elt/ccac046>
- Wale, B. D., & Bishaw, K. S. (2020). Effects of using inquiry-based learning on EFL students' critical thinking skills. *Asian-Pacific Journal of Second and Foreign Language Education*, 5, 1-14. <https://doi.org/10.1186/s40862-020-00090-2>
- Xie, T., Li, Y., & Tang, Y. (2023). Effects of using immersive virtual reality for science education on learning outcomes: A randomized controlled pilot study. *IEEE Transactions on Learning Technologies*, 16(6). <https://doi.org/10.1109/TLT.2023.3263587>
- Žammit, J. (2023). Exploring the effectiveness of virtual reality in teaching maltese. *Computers & Education: X Reality*, 3, 100035. <https://doi.org/10.1016/j.cexr.2023.100035>
- Zhang, Y., Lin, H., & Xu, J. (2025). The impact of virtual reality on learner self-efficacy: A meta-analysis of randomized controlled trials. *Journal of Medical Internet Research*, 27, e58384. <https://doi.org/10.2196/58384>