DAFTAR PUSTAKA

Adams, C., & Nash, J. (2016). Exploring design thinking practices in evaluation. *Journal of Multi Disciplinary Evaluation*, *12*(26), 12–17. https://doi.org/10.56645/jmde.v12i26.434

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*(1), 1-9 http://dx.doi.org/10.25304/rlt.v28.2419

Ahn, S. J., Bostick, J., Ogle, E., Nowak, K. L., McGillicuddy, K. T., & Bailenson, J. N. (2016). Experiencing nature: Embodying animals in immersive virtual environments increases inclusion of nature in self and involvement with nature. *Journal of Computer-Mediated Communication*, *21*(6), 399-419. https://doi.org/10.1111/jcc4.12173

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement*, *45*(1), 131-142. https://doi.org/10.1177/0013164485451012

Al-Amri, A., Osman, M., & Musawi, A. A. (2020). The effectiveness of a 3D-virtual reality learning environment (3D-VRLE) on the Omani eighth grade students' achievement and motivation towards physics learning. *International Journal of Emerging Technologies in Learning*, *15*(5), 4–16. https://doi.org/10.3991/ijet.v15i05.11890

Allison, D. E. (1984). The effect of item-difficulty sequence, intelligence, and sex on test performance, reliability, and item difficulty and discrimination. *Measurement and Evalution in Guidance*, *16*(4), 211-217. https://doi.org/10.1080/00256307.1984.12022359

Al-Labadi, L., & Sant, S. (2021). Enhance learning experience using technology in class. *Journal of Technology and Science Education*, *11*(1), 44-52. https://doi.org/10.3926/jotse.1050

Arici, F., Yildirim, P., Caliklar, Ş., & Yilmaz, R. M. (2019). Research trends in the use of augmented reality in science education: Content and bibliometric mapping analysis. *Computer Education*, *142*(1), 103-647. https://doi.org/10.1016/j.compedu.2019.103647

Ary, D., Jacobs, L. C., Razavieh, A., & Ary, D. (2010). *Introduction to research in education* (8th Ed.). WARDSWORTH Cengage Learning.

Artun, H., Durukan, A., & Temur, A. (2020). Effects of virtual reality enriched science laboratory activities on pre-service science teachers' science process skills. *Education and Information Technologies*, *25*(6), 5477-5498. https://doi.org/10.1007/s10639-020-10220-5

August, S. E., Hammers, M. L., Murphy, D. B., Neyer, A., Gueye, P., and Thames, R. Q. (2016). Virtual engineering sciences learning lab: Giving STEM education a second life. *Learning Technol*ogies, *9*(1), 18–30. https://doi.org/10.1109/TLT.2015.2419253

Barton, E. A., & Dexter, S. (2020). Sources of teachers' self-efficacy for technology integration from formal, informal, and independent professional learning. *Educational Technology Research and*

Development, *68*(1), 89–108. https://doi.org/10. 1007/ s11423- 019-09671-6

Bereiter, C., & Scardamalia, M. (2006). Education for the knowledge age: Aesign-centered models of teaching and instruction. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of Educational Psychology* (pp. 695–713). Lawrence Erlbaum Associates Publishers.

Blikstein, P., Fuhrmann, T., & Salehi, S. (2016). Using the bifocal modeling framework to resolve "Discrepant Events" between physical experiments and virtual models in biology. *Journal of Science Education and Technology*, *25*(4), 513-526. https://doi.org/10.1007/s10956-016-9623-7

Birss, V. I., & Truax, D. R. (1990). An effective approach to teaching electrochemistry. *Journal of Chemical Education*, *67*(5), 403-456. https://doi.org/10.1021/ed067p403

Bogusevschi, D., Muntean, C., & Muntean, G. M. (2020). Teaching and learning physics using 3D virtual learning environment: A case study of combined virtual reality and virtual laboratory in secondary school. *Journal of Computers in Mathematics and Science Teaching*, *39*(1), 5-18.

Bouta, H., Retalis, S., & Paraskeva, F. (2012). Utilising a collaborative macro-script to enhance student engagement: A mixed method study in a 3D virtual environment. *Computers & Education*, *58*(1), 501-517. https://doi.org/10.1016/j.compedu.2011.08.031

Broisin, J., Venant, R., and Vidal, P. (2017). Lab4CE: A remote laboratory for computer education. *Internasional Journal of Artificial Intelligence in Education*, *27*(1), 154–180. https://doi.org/10.1007/s40593-015-0079-3

Brown, T. J. (2008). Design thinking. *Harvard Business Review*, *86*(1)*,* 84–92.

Brown, T. J., & Wyatt, J. (2010). Design thinking for social innovation. *Stanford Social Innovation Review*, *8*, 30–35.

Buentello-Montoya, D. A., Lomelí-Plascencia, M. G., & Medina-Herrera, L. M. (2021). The role of reality enhancing technologies in teaching and learning of mathematics. *Compuers and ElectricalEngineering*, *94*, 107-287. https://doi.org/10.1016/j.compeleceng.2021.107287

Bujdosó, G., Novac, O. C., & Szimkovics, T. (2017). Developing cognitive processes for improving inventive thinking in system development using a collaborative virtual reality system. In *2017 8th IEEE international conference on cognitive infocommunications (coginfocom)* (pp. 79-84). IEEE. https://doi.org/10.1109/CogInfoCom.2017.8268220

Cabrero-Almenara, J., Guillen-Gamez, F.D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2021). Class sifcation models in the digital competence of higher education teachers based on the DigCompEdu Framework: Logistic regression and segment tree. *Journal of E-Learning and Knowledge Society*, *17*(1), 49–61. https://doi.org/10.20368/1971-8829/1135472

Caine, R. N., & Caine, G. (1998). Education on the edge of possibility. *National Association of Secondary School Principals. NASSP Bulletin*, *82*(598), 119-125.

Campos, E., Hidrogo, I., & Zavala, G. (2022). Impact of virtual reality use on the teaching and learning of vectors. *Frontiers in Education,7*, 702-717. https://doi.org/10.3389/feduc.2022.965640

Cardoso, A., Prado, P. R., Lima, G. F., & Lamounier, E. (2017). A virtual reality based approach to improve human performance and to minimize safety risks when operating power electric systems. In S. Cetiner, P. Fechtelkotter, M. Legatt (Eds.), *Advances in Human Factors in Energy: Oil, Gas, Nuclear and Electric Power Industries* (pp. 171-182). Springer International Publishing. https://doi.org/10.1007/978-3-319-41950-3_15

Chang, R. (2010). *Chemistry* (10th Ed.). McGraw-Hill.

Chang, Y. S., Chou, C. H., Chuang, M. J., Li, W. H., & Tsai, I. F. (2023). Effects of virtual reality on creative design performance and creative experiential learning. *Interactive Learning Environments*, *31*(2), 1142-1157. https://doi.org/10.1080/10494820.2020.1821717

Chang, Y. S., Kao, J. Y., & Wang, Y. Y. (2022). Influences of virtual reality on design creativity and design thinking. *Thinking Skills and Creativity*, *46*, 101127. https://doi.org/10.1016/j.tsc.2022.101127

Chen, C. J. (2006). The design, development and evaluation of a virtual reality based learning environment. *Australasian Journal of Educational Technology*, *22*(1), 39-63. https://doi.org/10.14742/ajet.1306

Cheng, K., and Tsai, C. (2020). Students' motivational beliefs and strategies, perceived immersion and attitudes towards science learning with immersive virtual reality: A partial least squares analysis. *British Journal of Education Technoogy, 51*(6), 2139–2158. https://doi.org/10.1111/bjet.12956

Cigdemoglu, C., & Geban, O. (2015). Improving students' chemical literacy levels on thermochemical and thermodynamics concepts through a context-based approach. *Chemistry Education Research and Practice*, *16*(2), 302-317. https://doi.org/10.1039/C5RP00007F

Cindioglu, H. C., Gursel Dino, I., & Surer, E. (2022). Proposing a novel mixed-reality framework for basic design and its hybrid evaluation using linkography and interviews. *International Journal of Technology and Design Education*, *32*(5), 2775-2800. https://doi.org/10.1007/s10798-021-09707-0

Cohen, L., Manion, L., & Morrison, K. (20018). *Research methods in education* (8th Ed.). Routledge. https://doi.org/10.4324/9780203029053

Cook, K. L., & Bush, S. B. (2018). Design thinking in integrated STEAM learning: Surveying the landscape and exploring exemplars in elementary grades. *School Science and Mathematics*, *118*(3-4), 93–103. https://doi.org/10.1111/ssm.12268

Cresswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th Ed.). Pearson.

Daza Pérez, E. P., Gras-Marti, A., Gras-Velázquez, Á., Guerrero Guevara, N., Gurrola Togasi, A., Joyce, A., Mora-Tores, E., Pedraza, Y., Ripoll E & Santos, J. (2009). Experiences in the teaching of chemistry with the aid of ICT. *Educación Química*, *20*(3), 320-329.

Dodevska, Z. A., and Mihic, M. M. (2018). Augmented reality and virtual reality technologies in project management: What can we expect?. *European Project Management Journal*, *8*(1), 17–24. http://dx.doi.org/10.18485/epmj.2018.8.1.3

Drew, J. H., Glen, A. G., & Leemis, L. M. (2000). Computing the cumulative distribution function of the Kolmogorov–Smirnov statistic. *Computational Statistics & Data Analysis*, *34*(1), 1-15. https://doi.org/10.1016/S0167-9473(99)00069-9

Frost, M., Goates, M. C., Cheng, S., & Johnston, J. (2020). Virtual reality. *Information Technology Libraries*, *39*(1), 1–12. https://doi.org/10.6017/ital.v39i1.11369

Garnett, P. J., & Treagust, D. F. (1992). Conceptual difficulties experienced by senior high school students of electrochemistry: Electrochemical (galvanic) and electrolytic cells. *Journal of Research in Science Teaching*, *29*(10), 1079-1099. https://doi.org/10.1002/tea.3660291006

Georgiev, G. V., Yamada, K., Taura, T., Kostakos, V., Pouke, M., Yung, S. T., & Ojala, T. (2017, March). Augmenting creative design thinking using networks of concepts. In *2017 IEEE Virtual Reality (VR)* (pp. 243-244). IEEE. https://doi.org/10.1109/VR.2017.7892267

Gong, Z., Lee, L. H., Soomro, S. A., Nanjappan, V., & Georgiev, G. V. (2022). A systematic review of virtual brainstorming from the perspective of creativity: Affordances, framework, and outlook. *Digital Creativity*, *33*(2), 96-127. https://doi.org/10.1080/14626268.2022.2064879

Guaman-Quintanilla, S., Everaert, P., Chiluiza, K., & Valcke, M. (2022). Impact of design thinking in higher education: A multi-actor perspective on problem solving and creativity. *International Journal of Technology and Design Educatio,* 33(1), 217-240. https://doi.org/10.1007/s10798-021-09724-z

Güney, Z. (2019). Visual literacy and visualization in instructional design and technology for learning environments. *European Journal of Contemporary Education,* *8*(1), 103–117. http://dx.doi.org/10.13187/ejced.2019.1.103

Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2010) *Multivariate data analysis* (7th Ed.). Pearson.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) (3th Ed.). Thousand Oaks, CA: Sage.

Hamzah, M. L., Rizal, F., & Simatupang, W. (2021). Development of augmented reality application for learning computer network device. *International Journal of Interactive Mobile Technologies*, *15*(12), 47-64. https://doi.org/10.3991/ijim.v15i12.21993

Hanandeh, A. E. (2016). Can experiential learning help students' learning and improve course satisfaction. In *27th Annual Conference of the Australasian Association for Engineering Education: at At Coffs Harbour, NSW* (p. 243).

Heeg, J., Hundertmark, S., & Schanze, S. (2020). The interplay between individual reflection and collaborative learning–seven essential features for designing fruitful classroom practices that develop students'

individual conceptions. *Chemistry Education Research and Practice*, *21*(3), 765-788. https://doi.org/10.1039/C9RP00175A

Henriksen, D., Richardson, C., & Mehta, R. (2017). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity*, *26*, 140–153. https://doi.org/10.1016/j.tsc.2017.10.001

Hidrogo, I., Zambrano, D., Hernandez-de-Menendez, M., & Morales-Menendez, R. (2020). Mostla for engineering education: Part 1 initial results. *International Journal on Interactive Design and Manufacturing*, *14*, 1429–1441. https://doi.org/10.1007/s12008-020-00730-4

Hill, A., Arford, T., Lubitow, A., & Smollin, L. M. (2012). ''I'm ambivalent about it'': The dilemmas of PowerPoint. *Teaching Sociology*, *40*(3), 242–256. https://doi.org/10.1177/0092055X12444071

Hite, R. L., Jones, M. G., Childers, G. M., Ennes, M., Chesnutt, K., Pereyra, M., et al. (2019). Investigating potential relationships between adolescents' cognitive development and perceptions of presence in 3-D, haptic-enabled, virtual reality science instruction. *Journal of Science Education and Technology*, *28*, 265–284. https://doi.org/10.1007/s10956-018-9764-y

Huang, G. Q., Yang, T. H., & Xu, S. (2014). Application of virtual reality technology in teaching. *Applied Mechanics and Materials*, *475*, 1230-1234. https://doi.org/10.4028/www.scientific.net/AMM.475-476.1230

Hung, J. F., & Tsai, C. Y. (2020). The effects of a virtual laboratory and metacognitive scaffolding on students' data modeling competences. *Journal of Baltic Science Education*, *19*(6), 923-939. http://dx.doi.org/10.33225/jbse/20.19.923

Idris, U. P. S. (2022). Virtual laboratory-based game application: The quality and its effects towards students' motivation and self-regulated learning. *International Journal of Interactive Mobile Technologies*, *16*(18), 114-132. https://doi.org/10.3991/ijim.v16i18.32875

Jensen, C. G. (2017). Collaboration and dialogue in virtual reality. *Journal of Problem Based Learning in Higher Education*, *5*(1), 85-110. https://doi.org/10.5278/ojs.jpblhe.v0i0.1542

Johnson-Glenberg, M. C., and Megowan-Romanowicz, C. (2017). Embodied science and mixed reality: How gesture and motion capture affect physics education. *Cognitive Research: Principles Implication*, *2*(24), 1-28. https://doi.org/10.1186/s41235-017-0060-9

Johnstone, A. H. (1991). Why is science difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning*, *7*(2), 75-83. https://doi.org/10.1111/j.1365-2729.1991.tb00230.x

Jordan, L. A., & Papp, R. (2014). PowerPointÒ: It's not ''yes'' or ''no'': It's ''when'' and ''how''. *Research in Higher Education Journal*, *22*, 1–11.

Juan, J., Sánchez, C., & Alemán, E. C. (2011). Teachers' opinion survey on the use of ICT tools to support attendance-based teaching. *Computers & Education*, *56*(3), 911–915. https://doi.org/10.1016/j.compedu. 2010. 11. 005

Kalolo, J.F. (2019). Digital revolution and its impact on education systems in developing countries. *Education and Information Technologies*, *24*, 345–358. https://doi.org/10.1007/s10639-018-9778-3

Kaputa, V., Loučanová, E., & Tejerina-Gaite, F. A. (2022). Digital transformation in higher education institutions as a driver of social oriented innovations. *Social Innovation in Higher Education*, *61*, 81-85. https://doi.org/10.1007/978-3-030-84044-0_4#DOI

Kavanagh, S., Luxton-Reilly, A., Wuensche, B., & Plimmer, B. (2017). A systematic review of virtual reality in education. *Themes in science and technology education*, *10*(2), 85-119.

Khanna, M., Parasher, R., & Tripathi, S. (2022). From Chalk and Talk to Twenty-First Century Readiness for Teaching–Learning. In H.B. Kaushik, U.S. Dixit, J. Jose, B.G. Jaganathan (Eds.), *Trends in Teaching-Learning Technologies* (pp. 23-38). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-4874-1_3

Kingsley, L. J., Brunet, V., Lelais, G., McCloskey, S., Milliken, K., Leija, E., & Spraggon, G. (2019). Development of a virtual reality platform for effective communication of structural data in drug discovery. *Journal of Molecular Graphics and Modelling*, *89*, 234-241. https://doi.org/10.1016/j.jmgm.2019.03.010

Koh, J. H. L., Chi, C. S., Wong, B., & Hong, H-Y. (2015). *Design thinking for education: Conceptions and applications in teaching and learning*. Springer. https://doi.org/10.1007/978-981-287-444-3

Kolko, J. (2010). Abductive thinking and sensemaking: The drivers of design synthesis. *Design Issues*, *26*(1), 15-28. https://doi.org/10.1162/desi.2010.26.1.15

Kurniawan, B., Shrestha, R. P., Astina, I. K., Hadi, N., Irawan, L. Y., Kurniawati, E., & Wiradimadja, A. (2022). Developing a virtual Nature laboratory of faculty social science (LAV-FIS) to assists field-based learning during pandemic: A need analysis review. *International Journal of Interactive Mobile Technologies*, *16*(7), 22-37. https://doi.org/10.3991/ijim.v16i07.28481

Lande, M., & Leifer, L. (2010). Difficulties student engineers face designing the future. *International Journal of Engineering Education*, *26*(2), 271-288.

Lau, K. W. (2007). Establishing creative-friendly space for design thinking in shared virtual reality in tertiary design education. *International Association of Societies of Design Research, Hong Kong*, 12-15.

Lee, J. H., Yang, E., & Sun, Z. Y. (2021). Using an immersive virtual reality design tool to support cognitive action and creativity: Educational insights from fashion designers. *The Design Journal*, *24*(4), 503-524. https://doi.org/10.1080/14606925.2021.1912902

Leeds-Hurwitz W. (2009). Social construction of reality. *Encyclopedia of Communication Theory*, 892-895.

Levine, D. (2014). *Even you can learn statistics and analytics: An easy to understand guide to statistics and analytics* (3rd ed.). Pearson FT Press.

Lin, H. C., Chang, Y. S., & Li, W. H. (2020). Effects of a virtual reality teaching application on engineering design creativity of boys and girls.

Thinking Skills and Creativity, *37*, 100705. https://doi.org/10.1016/j.tsc.2020.100705

Lind, J., Pelger, S., & Jakobsson, A. (2020). Students' knowledge of emerging technology and sustainability through a design activity in technology education. *International Journal of Technology and Design Education*, 1-24. https://doi.org/10.1007/s10798-020-09604-y

Liu, R., Wang, L., Lei, J., Wang, Q., and Ren, Y. (2020). Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons. *British Journal Education Technology*, *51*, 2034–2049. https://doi.org/10.1111/bjet.13028

Lyu, Q., Watanabe, K., Umemura, H., & Murai, A. (2023). Design-thinking skill enhancement in virtual reality: A literature study. *Frontiers in Virtual Reality*, *4*, 1137293. https://doi.org/10.3389/frvir.2023.1137293

Maloy, J. T. (1985). Goals in teaching electrochemistry. *Journal of Chemical Education*, *62*(11), 10-18. https://doi.org/10.1021/ed062p1018.2

Mandler, D., Mamlok-Naaman, R., Blonder, R., Yayon, M., & Hofstein, A. (2012). High-school chemistry teaching through environmentally oriented curricula. *Chemistry Education Research and Practice*, *13*(2), 80-92. https://doi.org/10.1039/C1RP90071D

Marks, J. (2017). *The impact of a brief design thinking intervention on students' design knowledge, iterative dispositions, and attitudes towards failure*. Columbia University.

Marshall, J. (2005). Connecting art, learning, and creativity: A case for curriculum integration. *Studies in Art Education*, *46*(3), 227-241. https://doi.org/10.1080/00393541.2005.11650076

McElhaney, K. W., and Linn, M. C. (2011). Investigations of a complex, realistic task: Intentional, unsystematic, and exhaustive experimenters. *Journal of Research in Science Teaching, 48*(7), 745–770. https://doi.org/10.1002/tea.20423

Mercader, C., & Gairín, J. (2020). University teachers' perception of barriers to the use of digital technologies: The importance of the academic discipline. *International Journal of Educational Technology in Higher Education*, *17*(1), 4. https://doi.org/10.1186/s41239-020-0182-x

Micheli, P., Wilner, S. J. S., Bhatti, S. H., Mura, M., & Beverland, M. B. (2019). Doing design thinking: Conceptual review, synthesis, and research agenda. *Journal of Product Innovation Management*, *36*(2), 124–148. https://doi.org/10.1111/jpim.12466

Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems*, *77*(12), 1321-1329.

Mulligan, K., Calder, A., & Mulligan, H. (2018). Inclusive design in architectural practice: Experiential learning of disability in architectural education. *Disability and Health Journal*, *11*(2), 237-242. https://doi.org/10.1016/j.dhjo.2017.08.009

Nah, F. F. H., Siau, K., Mennecke, B. E., & Schiller, S. Z. (2010). Co-creation and collaboration in a virtual world: A 3D visualization design project in second life. *Journal of Database Management*, *21*(4), 1-13. https://doi.org/10.4018/jdm.2010100101

National Research Council. (2013). *Next generation science standards: For states, by states*. The National Academies Press. https://doi.org/10.17226/18290

Neges, M., Adwernat, S., & Abramovici, M. (2018). Augmented Virtuality for maintenance training simulation under various stress conditions. *Procedia Manufacturing*, *19*, 171-178. https://doi.org/10.1016/j.promfg.2018.01.024

Obeid, S., & Demirkan, H. (2020). The influence of virtual reality on design process creativity in basic design studios. *Interactive Learning Environments*, *31*(4), 1841-1859. https://doi.org/10.1080/10494820.2020.1858116

O'Connor, M., Deeks, H. M., Dawn, E., Metatla, O., Roudaut, A., Sutton, M.,Thomas, L.M., Sage, R., Tew, P., Wonnacott, M., Bates, P., Mulholland, A.J & Glowacki, D. R. (2018). Sampling molecular conformations and dynamics in a multiuser virtual reality framework. *Science Advances*, *4*(6), 27-31. https://doi.org/10.1126/sciadv.aat2731

Ogude, A. N., & Bradley, J. D. (1994). Ionic conduction and electrical neutrality in operating electrochemical cells: Pre-college and college student interpretations. *Journal of Chemical Education*, *71*(1), 29. https://doi.org/10.1021/ed071p29

Oh, E. (2021). Levels of Students' Problem-solving skills and creative attitudes in project-based learning. *Asia-pacific Journal of Convergent Research Interchange*, *7*(6), 63-72. http://dx.doi.org/10.47116/apjcri.2021.06.06

Okoye, K., Rodriguez-Tort, J. A., Escamilla, J., & Hosseini, S. (2021). Technology-mediated teaching and learning process: A conceptual study of Educators' response amidst the Covid-19 pandemic. *Education and Information Technologies*, *26*(6), 7225–7257. https://doi.org/10.1007/s10639-021-10527-x

Özkaya, A. R. (2002). Conceptual difficulties experienced by prospective teachers in electrochemistry: Half-cell potential, cell potential, and chemical and electrochemical equilibrium in galvanic cells. *Journal of Chemical Education*, *79*(6), 735. https://doi.org/10.1021/ed079p735

Paxinou, E., Panagiotakopoulos, C. T., Karatrantou, A., Kalles, D., & Sgourou, A. (2020). Implementation and evaluation of a three-dimensional virtual reality biology lab versus conventional didactic practices in lab experimenting with the photonic microscope. *Biochemistry and Molecular Biology Educucation*, *48*(1), 21–27. https://doi.org/10.1002/bmb.21307

Potkonjak, V., Gardner, M., Callaghan, V., Mattila, P., Guetl, C., Petrović, V. M., & Jovanović, K. (2016). Virtual laboratories for education in science, technology, and engineering: A review. *Computers & Education*, *95*, 309-327. https://doi.org/10.1016/j.compedu.2016.02.002

Poyade, M., Eaglesham, C., Trench, J., & Reid, M. (2021). A transferable psychological evaluation of virtual reality applied to safety training in chemical manufacturing. *ACS Chemical Health & Safety*, *28*(1), 55-65. https://doi.org/10.1021/acs.chas.0c00105

Pratomo, L. C., & Wardani, D. K. (2021). The effectiveness of design thinking in improving student creativity skills and entrepreneurial alertness.

International Journal of Instruction, *14*(4), 695–712. https://doi.org/10.29333/iji.2021.14440a

Qin, T., Cook, M., & Courtney, M. (2020). Exploring chemistry with wireless, PC-less portable virtual reality laboratories. *Journal of Chemical Education*, *98*(2), 521-529. https://doi.org/10.1021/acs.jchemed.0c00954

Ragan, E. D., Bowman, D. A., Kopper, R., Stinson, C., Scerbo, S., & McMahan, R. (2015). Effects of field of view and visual complexity on virtual reality training effectiveness for a visual scanning task. *IEEE Transactions on Visualization Computer Graphics*, *21*(7), 794–807. https://doi.org/10.1109/TVCG.2015.2403312

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important?. *Review of Educational Research*, *82*(3), 330–348. https://doi.org/10.3102/0034654312457429

Rieuf, V., Bouchard, C., Meyrueis, V., & Omhover, J. F. (2017). Emotional activity in early immersive design: Sketches and moodboards in virtual reality. *Design Studies*, *48*, 43-75. https://doi.org/10.1016/j.destud.2016.11.001

Rive, P., & Karmokar, S. (2016, September). Design thinking methods and creative technologies in virtual worlds. In *European Conference on Innovation and Entrepreneurship* (p. 635). Academic Conferences International Limited.

Rosegard, E., & Wilson, J. (2013). Capturing students' attention: An empirical student. *Journal of the Scholarship of Teaching and Learning*, 1-20.

Roth, W. M. (1999). Authentic school science: Intellectual traditions. *Learning and Knowledge*, 6-20.

Roupé, M., Johansson, M., Maftei, L., Lundstedt, R., & Viklund-Tallgren, M. (2020). Virtual collaborative design environment: supporting seamless integration of multitouch table and immersive VR. *Journal of Construction Engineering and Management*, *146*(12), 04020132. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001935

Sahin, D., & Yilmaz, R. M. (2020). The effect of augmented reality technology on middle school students' achievements and attitudes towards science education. *Computers & Educa*tion, *144*, 103-710. https://doi.org/10.1016/j.compedu.2019.103710

Saputri, M. D., Pramudya, I., & Slamet, I. (2020). Analysis of mathematic creative thinking ability of 10th grade high school students about solution mathematics problems. *International Journal of Multicultural and Multireligious Understanding*, *7*(3), 314-320. http://dx.doi.org/10.18415/ijmmu.v7i3.1553

Sarÿoglu, S., & Girgin, S. (2020). The effect of using virtual reality in 6th grade science course the cell topic on students' academic achievements and attitudes towards the course. *Journal of Turkish Science Education*, *17*(1), 109–125. https://doi.org/10.36681/tused.2020.16

Scherer, R., and Tiemann, R. (2012). Factors of problem-solving competency in a virtual chemistry environment: The role of metacognitive knowledge about strategies. *Computers & Education*, *59*(4), 1199–1214. https://doi.org/10.1016/j.compedu.2012.05.020

Schönborn, K. J., Bivall, P., and Tibell, L. A. E. (2011). Exploring relationships between students' interaction and learning with a haptic virtual biomolecular model. *Computers & Education, 57*(3), 2095–2105. https://doi.org/10.1016/j.compedu.2011.05.013

Schønheyder, J. F., & Nordby, K. (2018). The use and evolution of design methods in professional design practice. *Design Studies*, *58*, 36-62. https://doi.org/10.1016/j.destud.2018.04.001

Serin, H. (2018). A comparison of teacher-centered and student-centered approaches in educational settings. *International Journal of Social Sciences & Educational Studies*, *5*(1), 164-167. https://doi.org/10.23918/ijsses.v5i1p164

Serrano-Ausejo, E., & Mårell-Olsson, E. (2023). Opportunities and challenges of using immersive technologies to support students' spatial ability and 21st-century skills in K-12 education. *Education and Information Technologies*, 1-27. https://doi.org/10.1007/s10639-023-11981-5

Singh, Y. K. (2006). *Fundamental of research methodology and statistics*. New Age International.

Skrupskaya, Y., Skibina, V., Taratukhin, V., & Kozlova, E. (2021). The Use of Virtual Reality to Drive Innovations. VRE-IP Experiment. In *International Conference for Information Systems and Design* (pp. 336-345). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-95494-9_28

Stanford d.School. (2010). *An introduction to design thinking process guide*. Institute of Design at Stanford.

Tang, Y. M., Au, K. M., Lau, H. C., Ho, G. T., and Wu, C. H. (2020). Evaluating the effectiveness of learning design with mixed reality (MR) in higher education. *Virtual Real*, *24*, 797–807. https://doi.org/10.1007/s10055-020-00427-9

Topalsan, A. K. (2020). Development of scientific inquiry skills of science teaching through argument-focused virtual laboratory applications. *Journal of Baltic Science Education*, *19*(4), 628-646. http://dx.doi.org/10.33225/jbse/20.19.628

Tsai, M. J., & Wang, C. Y. (2021). Assessing young students' design thinking disposition and its relationship with computer programming self-efficacy. *Journal of Educational Computing Research*, *59*(3), 410-428. http://dx.doi.org/10.1177/0735633120967326

Turner, J. L. (2014). *Using statistics in small-scale language education research: Focus on non-parametric data*. Routledge.

Tüysüz, C. (2010). The effect of the virtual laboratory on students' achievement and attitude in chemistry. *International Online Journal of Educational Sciences*, *2*(1), 37-53.

Vanada, D. I. (2010). Practically creative: the role of design thinking as an improved paradigm for 21st century art education. *Techne Series A*, *21*(2), 21–33. https://doi.org/10.21606/learnxdesign.2013.071

Vanada, D. I. (2011). *Designing thinking: Developing dynamic learners in the arts*. Lap Lambert Academic Pub.

Vygotsky LS. (1978). *Mind in society*. Harvard University Press.

Walker, J. P., Sampson, V., Southerland, S., & Enderle, P. J. (2016). Using the laboratory to engage all students in science practices. *Chemistry Education Research and Practice*, *17*(4), 1098–1113. https://doi.org/10.1039/c6rp00093b

Wang, C.-Y., & Tsai, C.-C. (2018). Understanding students' conceptions of and approaches to learning in design. *The International Journal of Design Education*, *12*(3), 31–45. https://doi.org/10.18848/2325-128X/CGP/v12i03/31-45

Wei, X., & Huangfu, R. (2022). An empirical study on the improvement of design thinking ability based on virtual reality technology. In R.C. Li, S.K.S. Cheung, P.H.F. Ng, LP. Wong, F.L. Wang. (Eds.), *Blended Learning: Engaging Students in the New Normal Era* (pp. 62-73). Springer International Publishing. https://doi.org/10.1007/978-3-031-08939-8_6

Wu, J., Guo, R., Wang, Z., & Zeng, R. (2019). Integrating spherical video-based virtual reality into elementary school students' scientific inquiry instruction: effects on their problem-solving performance. *Interactive Learning Environments*, *29*(3), 496-509. https://doi.org/10.1080/10494820.2019.1587469

Zhavoronkov, A., Zagribelnyy, B., Zhebrak, A., Aladinskiy, V., Terentiev, V., Vanhaelen, Q., Bezrukov, DS., Polykovskiy, D., Shayakhmetov, R., Filimonov A., Bishop, M., McCloskey, S., Leija, E., Bright, D., Funakawa, K., Lin, Y., Huang, S.H., Liao, H., Aliper, A & Ivanenkov, Y. (2020). Potential non-covalent SARS-CoV-2 3C-like protease inhibitors designed using generative deep learning approaches and reviewed by human medicinal chemist in virtual reality. *ChemRxiv*, *5*(1), 1-18. https://doi.org/10.26434/chemrxiv.12301457.v1

Zydney, J. M., Hai-Jew, S., Renninger, K. A., List, A., Hardy, I., Koerber, S., Farrell, J. M. (2012). Socio-constructivist models of learning. *Encyclopedia of the Sciences of Learning*, 3128–3131. https://doi.org/10.1007/978-1-4419-1428-6_882