DATA EXTRACTION OF AUGMENTED REALITY AND VIRTUAL REALITY ARTICLES

Classification	No	Author	Title	Identity and url
Augmented Reality	1	(S. Yang et al., 2018)	*Mobile Augmented Reality (MAR) Assisted Chemical Education: Insights from Elements 4D*	*Journal of Chemical Education*, *95*(6), 1060–1062. https://doi.org/10.1021/acs.jchemed.8b00017
	2	(Tee et al., 2018)	*Demonstrating an Augmented Reality Colorimetric Titration Tool.*	*Journal of Chemical Education*, *95*(3), 393–399. https://doi.org/10.1021/acs.jchemed.7b00618
	3	(Plunkett, 2019)	*A Simple and Practical Method for Incorporating Augmented Reality into the Classroom and Laboratory*	*Journal of Chemical Education*, *96*(11), 2628–2631. https://doi.org/10.1021/acs.jchemed.9b00607
	4	(Lee & Tucker-Kellogg, 2020)	*An accessible, open-source mobile application for macromolecular visualization using augmented reality*	*Biochemistry and Molecular Biology Education*, *48*(3), 297–303. https://doi.org/10.1002/bmb.21335
	5	(Schmid et al., 2020)	*Structural Chemistry 2.0: Combining Augmented Reality and 3D Online Models.*	*Journal of Chemical Education*, *97*(12), 4515–4519. https://doi.org/10.1021/acs.jchemed.0c00823
	6	(Eriksen et al., 2020)	*Visualizing 3D Molecular Structures Using an Augmented Reality*	*Journal of Chemical Education*, *97*(5), 1487–1490. https://doi.org/10.1021/acs.jchemed.9b01033
	7	(Sung et al., 2020)	*BiochemAR: An Augmented Reality Educational Tool for Teaching Macromolecular Structure and Function*	*Journal of Chemical Education*, *97*(1), 147–153. https://doi.org/10.1021/acs.jchemed.8b00691

	8	(An et al., 2020)	*Usability Testing and the Development of 10an Augmented Reality Application for Laboratory Learning*	*Journal of Chemical Education*, *97*(1), 97–105. https://doi.org/10.1021/acs.jchemed.9b00453
	9	(F. Yang et al., 2021)	*Augmented Titration Setup for Future Teaching Laboratories.*	*Journal of Chemical Education*, *98*(3), 876–881. https://doi.org/10.1021/acs.jchemed.0c01394
	10	(Kuit & Osman, 2021)	*CHEMBOND3D e-Module Effectiveness in Enhancing Students' Knowledge of Chemical Bonding Concept and Visual-spatial Skills*	*European Journal of Science and Mathematics Education*, *9*(4), 252–264. https://doi.org/10.30935/SCIMATH/11263
	11	(Rahmawati et al., 2021)	*Analysing Students' Spatial Abilities in Chemistry Learning Using 3D Virtual Representation*	*Education Sciences*, *11*(4). https://doi.org/10.3390/educsci11040185
	12	(Aristov et al., 2021)	*Library of 3D Visual Teaching Tools for the Chemistry Classroom Accessible via Sketchfab and Viewable in Augmented Reality*	*Journal of Chemical Education*, *98*(9), 3032–3037. https://doi.org/10.1021/acs.jchemed.1c00460
	13	(Fernandes et al., 2021)	*Developing and Using BioSIMAR, an Augmented Reality Program to Visualize and Learn about Chemical Structures in a Virtual Environment on Any Internet-Connected Device Henrique*	*Journal of Chemical Education*, *98*(5), 1789–1794. https://doi.org/10.1021/acs.jchemed.0c01317
Virtual Reality	1	(Fernandes et al., 2021)	*The effect of virtual reality*	*Journal of Chemical Education*, *98*(5), 1789–

			laboratory on conceptual understanding in electrolytes and non-electrolytes	1794. https://doi.org/10.1021/acs.jchemed.0c01317
	2	(Penn & Ramnarain, 2019)	*South African university students' attitudes towards chemistry learning in a virtually simulated learning environment*	*Chemistry Education Research and Practice*, *20*(4), 699–709. https://doi.org/10.1039/c9rp00014c
	3	(Dai et al., 2020)	*Developing a Virtual Reality Approach toward a Better Understanding of Coordination Chemistry and Molecular Orbitals*	*Journal of Chemical Education*, *97*(10), 3647–3651. https://doi.org/10.1021/acs.jchemed.0c00469
	4	(Dunnagan et al., 2020)	*Production and Evaluation of a Realistic Immersive Virtual Reality Organic Chemistry Laboratory Experience: Infrared Spectroscopy*	*Journal of Chemical Education*, *97*(1), 258–262. https://doi.org/10.1021/acs.jchemed.9b00705
	5	(Maksimenko et al., 2021)	*Introducing Atomic Structure to First-Year Undergraduate Chemistry Students with an Immersive Virtual Reality Experience*	*Journal of Chemical Education*, *98*(6), 2104–2108. https://doi.org/10.1021/acs.jchemed.0c01441
	6	(Broyer et al., 2021)	*Using Virtual Reality to Demonstrate Glove Hygiene in Introductory Chemistry Laboratories*	*Journal of Chemical Education*, *98*(1), 224–229. https://doi.org/10.1021/acs.jchemed.0c00137
	7	(Gungor et al., 2022)	*The Use of Virtual Reality in A Chemistry Lab and Its Impact on Students'*	*Eurasia Journal of Mathematics, Science and Technology Education*, *18*(3). https://doi.org/10.29333/ejmste/11814

			SelfEfficacy, *Interest*, *Self-Concept and Laboratory Anxiety*.	

Referensi:

An, J., Poly, L. P., & Holme, T. A. (2020). Usability Testing and the Development of an Augmented Reality Application for Laboratory Learning. *Journal of Chemical Education*, *97*(1), 97–105. https://doi.org/10.1021/acs.jchemed.9b00453

Aristov, M. M., Moore, J. W., & Berry, J. F. (2021). Library of 3D Visual Teaching Tools for the Chemistry Classroom Accessible via Sketchfab and Viewable in Augmented Reality. *Journal of Chemical Education*, *98*(9), 3032–3037. https://doi.org/10.1021/acs.jchemed.1c00460

Broyer, R. M., Miller, K., Ramachandran, S., Fu, S., Howell, K., & Cutchin, S. (2021). Using Virtual Reality to Demonstrate Glove Hygiene in Introductory Chemistry Laboratories. *Journal of Chemical Education*, *98*(1), 224–229. https://doi.org/10.1021/acs.jchemed.0c00137

Dai, R., Laureanti, J. A., Kopelevich, M., & Diaconescu, P. L. (2020). Developing a Virtual Reality Approach toward a Better Understanding of Coordination Chemistry and Molecular Orbitals. *Journal of Chemical Education*, *97*(10), 3647–3651. https://doi.org/10.1021/acs.jchemed.0c00469

Dunnagan, C. L., Dannenberg, D. A., Cuales, M. P., Earnest, A. D., Gurnsey, R. M., & Gallardo-Williams, M. T. (2020). Production and Evaluation of a Realistic Immersive Virtual Reality Organic Chemistry Laboratory Experience: Infrared Spectroscopy. *Journal of Chemical Education*, *97*(1), 258–262. https://doi.org/10.1021/acs.jchemed.9b00705

Eriksen, K., Nielsen, B. E., & Pittelkow, M. (2020). Visualizing 3D Molecular Structures Using an Augmented Reality App. *Journal of Chemical Education*, *97*(5), 1487–1490. https://doi.org/10.1021/acs.jchemed.9b01033

Fernandes, H. S., Cerqueira, N. M. F. S. A., & Sousa, S. F. (2021). Developing and Using BioSIMAR, an Augmented Reality Program to Visualize and Learn about Chemical Structures in a Virtual Environment on Any Internet-Connected Device. *Journal of Chemical Education*, *98*(5), 1789–1794. https://doi.org/10.1021/acs.jchemed.0c01317

Gungor, A., Kool, D., Lee, M., Avraamidou, L., Eisink, N., Albada, B., van der Kolk, K., Tromp, M., & Bitter, J. H. (2022). The Use of Virtual Reality in A Chemistry Lab and Its Impact on Students' SelfEfficacy, Interest, Self-Concept and Laboratory Anxiety. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(3). https://doi.org/10.29333/ejmste/11814

Kuit, V. K., & Osman, K. (2021). Chembond3d e-module effectiveness in enhancing students' knowledge of chemical bonding concept and visual-spatial skills. *European Journal of Science and Mathematics Education*, *9*(4), 252–264. https://doi.org/10.30935/SCIMATH/11263

Lee, N. Y., & Tucker-Kellogg, G. (2020). An accessible, open-source mobile application for macromolecular visualization using augmented reality. *Biochemistry and Molecular Biology Education*, *48*(3), 297–303. https://doi.org/10.1002/bmb.21335

Maksimenko, N., Okolzina, A., Vlasova, A., Tracey, C., & Kurushkin, M. (2021). Introducing Atomic Structure to First-Year Undergraduate Chemistry Students with an Immersive Virtual Reality Experience. *Journal of Chemical Education*, *98*(6), 2104–2108. https://doi.org/10.1021/acs.jchemed.0c01441

Penn, M., & Ramnarain, U. (2019). South African university students' attitudes towards chemistry learning in a virtually simulated learning environment. *Chemistry Education Research and Practice*, *20*(4), 699–709. https://doi.org/10.1039/c9rp00014c

Plunkett, K. N. (2019). A Simple and Practical Method for Incorporating Augmented Reality into the Classroom and Laboratory. *Journal of Chemical Education*, *96*(11), 2628–2631. https://doi.org/10.1021/acs.jchemed.9b00607

Rahmawati, Y., Dianhar, H., & Arifin, F. (2021). Analysing students' spatial abilities in chemistry learning using 3d virtual representation. *Education Sciences*, *11*(4). https://doi.org/10.3390/educsci11040185

Schmid, J. R., Ernst, M. J., & Thiele, G. (2020). Structural Chemistry 2.0: Combining Augmented Reality and 3D Online Models. *Journal of Chemical Education*, *97*(12), 4515–4519. https://doi.org/10.1021/acs.jchemed.0c00823

Sung, R. J., Wilson, A. T., Lo, S. M., Crowl, L. M., Nardi, J., St. Clair, K., & Liu, J. M. (2020). BiochemAR: An Augmented Reality Educational Tool for Teaching Macromolecular Structure and Function. *Journal of Chemical Education*, *97*(1), 147–153. https://doi.org/10.1021/acs.jchemed.8b00691

Tee, N. Y. K., Gan, H. S., Li, J., Cheong, B. H. P., Tan, H. Y., Liew, O. W., & Ng, T. W. (2018). Developing and Demonstrating an Augmented Reality Colorimetric Titration Tool. *Journal of Chemical Education*, *95*(3), 393–399. https://doi.org/10.1021/acs.jchemed.7b00618

Yang, F., Lai, V., Legard, K., Kozdras, S., Prieto, P. L., Grunert, S., & Hein, J. E. (2021). Augmented Titration Setup for Future Teaching Laboratories. *Journal of Chemical Education*, *98*(3), 876–881. https://doi.org/10.1021/acs.jchemed.0c01394

Yang, S., Mei, B., & Yue, X. (2018). Mobile Augmented Reality Assisted Chemical Education: Insights from Elements 4D. *Journal of Chemical Education*, *95*(6), 1060–1062. https://doi.org/10.1021/acs.jchemed.8b00017

YILDIRIM, F. S. (2020). The Effect Of The Augmented Reality Applications In Science Class On Students' Cognitive And Emotional Learning. *Journal of Education in Science, Environment and Health*. https://doi.org/10.21891/jeseh.751023