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Virtual Reality for Learning Mathematics: A Systematics Literature Review
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Abstract

The use of virtual reality (VR) in learning is a manifestation of the rapid development of science and technology today. Even so, there are still not many studies that comprehensively discuss the use of VR in learning mathematics. This research aims to analyze studies related to this topic from 2018 to 2022 using the PRISMA protocol. Article searches in the Scopus and ERIC databases yielded 13 articles. Next, it will be divided into five themes: mathematical learning outcome types, VR types, research subject, research approach, VR role in affecting mathematics learning, and main topics in mathematics using VR-based learning. The results of this systematic literature review are expected to help develop further research by paying attention to important things that need to be improved when using VR while learning mathematics. © 2024 American Institute of Physics Inc.. All rights reserved.

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References

- Akman, E., Çakır, R.
(2020) *The effect of educational virtual reality game on primary school students' achievement and engagement in mathematics*,
- Bates, J.
Virtual Reality, Art, and Entertainment
(1992) *Presence: Teleoperators and Virtual Environments*, 1 (1), pp. 133-138.
- Biocca, F., Delaney, B.
Immersive virtual reality technology
(1995) *Communication in the age of virtual reality*,
Lawrence Erlbaum Associates, Inc
- Chirico, A., Lucidi, F., De Laurentiis, M., Milanese, C., Napoli, A., Giordano, A.
Virtual Reality in Health System: Beyond Entertainment. A Mini-Review on the Efficacy of VR During Cancer Treatment
(2016) *Journal of Cellular Physiology*, 231 (2), pp. 275-287.
- Clement, E., Guerrien, A.
Motivation and academic learning
(2022) *Emotional Processes in Learning Situations*, pp. 73-97.
- Dani, N.J.
Impact of Virtual Reality on Gaming
(2019) *International Research Journal of Engineering and Technology (IRJET)*, 6 (12).
- Davila Delgado, J.M., Oyedele, L., Demian, P., Beach, T.
A research agenda for augmented and virtual reality in architecture, engineering

and construction

(2020) *Advanced Engineering Informatics*, 45, p. 101122.

- Demitriadou, E., Stavroulia, K.-E., Lanitis, A.

Comparative evaluation of virtual and augmented reality for teaching mathematics in primary education

(2020) *Education and Information Technologies*, 25 (1), pp. 381-401.

- Driscoll, M.P.

(2000) *Psychology of Learning for Instruction (Second Edition)*, Allyn & Bacon

- Grossi, S., Cattoni, M., Rotolo, N., Imperatori, A.

Video-assisted thoracoscopic surgery simulation and training: a comprehensive literature review

(2023) *BMC Medical Education*, 23 (1), p. 535.

- Guo, X., Chen, X., Feng, X., Zheng, S.

The Enlightenment of “AR / VR” Technical University Course Education in Taiwan, China

(2020) *2020 4th International Conference on Artificial Intelligence and Virtual Reality*, pp. 22-28.

- Hock, P., Benedikter, S., Gugenheimer, J., Rukzio, E.

CarVR

(2017) *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, pp. 4034-4044.

- Host'ovecky, M., Huraj, L., Pribilova, K.

(2019) *Virtual reality in mathematics: Design of the serious game improves spatial imagination performance*, pp. 239-244.

- Hsu, Y.C.

Exploring the Effectiveness of Two Types of Virtual Reality

(2021) *Headsets for Teaching High School Mathematics*, 17 (8), pp. 1-12.

- Hsu, Y.-C.

(2020) *Exploring the learning motivation and effectiveness of applying virtual reality to high school mathematics*, 8 (2), pp. 438-444.

- Huang, T., Yang, C., Hsieh, Y., Wang, J., Hung, C.

Augmented reality (AR) and virtual reality (VR) applied in dentistry

(2018) *The Kaohsiung Journal of Medical Sciences*, 34 (4), pp. 243-248.

- Jensen, L., Konradsen, F.

A review of the use of virtual reality head-mounted displays in education and training

(2018) *Education and Information Technologies*, 23 (4), pp. 1515-1529.

- Keller, T., Hebeisen, A., Brucker-Kley, E.

(2018) *Integration of children with special needs in mathematics through virtual reality*, pp. 30-37.

- Kodvavi, M.S., Asghar, M.A., Ghaffar, R.A., Nadeem, I., Bhimani, S., Kumari, V., Rabbani, A., Ghazni, M.S.

Effectiveness of virtual reality in managing pain and anxiety in adults during periprocedural period: a systematic review and meta-analysis

(2023) *Langenbeck's Archives of Surgery*, 408 (1), p. 301.

- Lei, X., Chen, H.-H., Rau, P.-L.P., Dong, L., Liu, X.

Learning in virtual reality: Effects of instruction type and emotional arousal on

learning performance

(2022) *Learning and Motivation*, 80, p. 101846.

- Lin, C., Ren, Y., Lu, A.
The effectiveness of virtual reality games in improving cognition, mobility, and emotion in elderly post-stroke patients: a systematic review and meta-analysis
(2023) *Neurosurgical Review*, 46 (1), p. 167.
- Liu, R., Liu, C., Ren, Y.
(2018) *A Virtual Reality Application for Primary School Mathematics Class*, pp. 138-141.
- Markowitz, D.M., Laha, R., Perone, B.P., Pea, R.D., Bailenson, J.N.
Immersive Virtual Reality Field Trips Facilitate Learning About Climate Change
(2018) *Frontiers in Psychology*, 9.
- Merchant, Z., Goetz, E.T., Cifuentes, L., Keeney-Kennicutt, W., Davis, T.J.
Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis
(2014) *Computers & Education*, 70, pp. 29-40.
- Monaghesh, E., Negahdari, R., Samad-Soltani, T.
Application of virtual reality in dental implants: a systematic review
(2023) *BMC Oral Health*, 23 (1), p. 603.
- Moro, C., Štromberga, Z., Stirling, A.
Virtualisation devices for student learning: Comparison between desktop-based (Oculus Rift) and mobile-based (Gear VR) virtual reality in medical and health science education
(2017) *Australasian Journal of Educational Technology*, 33 (6).
- Musa, M., Rahman, P., Buhalis, D.
Virtual Reality (VR) Types
(2022) *Encyclopedia of Tourism Management and Marketing*,
Edward Elgar Publishing, Inc
- Mystakidis, S., Lympouridis, V.
Immersive Learning
(2023) *Encyclopedia*, 3 (2), pp. 396-405.
- Pan, Z., Cheok, A.D., Yang, H., Zhu, J., Shi, J.
Virtual reality and mixed reality for virtual learning environments
(2006) *Computers & Graphics*, 30 (1), pp. 20-28.
- Pearl, H., Horn, M., Swanson, H.
(2019) *Coordi: A virtual reality application for reasoning about mathematics in three dimensions*,
- Pillai, A.S., Mathew, P.S.
(2019) *Impact of Virtual Reality in Healthcare*, pp. 17-31.
- Portman, M.E., Natapov, A., Fisher-Gewirtzman, D.
To go where no man has gone before: Virtual reality in architecture, landscape architecture and environmental planning
(2015) *Computers, Environment and Urban Systems*, 54, pp. 376-384.
- Radianti, J., Majchrzak, T.A., Fromm, J., Wohlgenannt, I.
A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda
(2020) *Computers & Education*, 147, p. 103778.
- Rahmawati, N.D., Buchori, A., Ghoffar, M.H.A.
(2022) *Design of virtual reality-based mathematics learning media on trigonometry*

material in senior high school, p. 2577.

- Ryan, M.-L.
(2015) *Narrative as Virtual Reality 2*,
Johns Hopkins University Press
- Su, Y.-S., Cheng, H.-W., Lai, C.-F.
(2022) *Study of Virtual Reality Immersive Technology Enhanced Mathematics Geometry Learning*, p. 13.
- Takac, M.
(2020) *Application of Web-based Immersive Virtual Reality in Mathematics Education*,
- van Ginkel, S., Gulikers, J., Biemans, H., Noroozi, O., Roozen, M., Bos, T., van Tilborg, R., Mulder, M.
Fostering oral presentation competence through a virtual reality-based task for delivering feedback
(2019) *Computers & Education*, 134, pp. 78-97.
- Vargas González, A.N., Kapalo, K., Koh, S., LaViola, J.
Exploring the Virtuality Continuum for Complex Rule-Set Education in the Context of Soccer Rule Comprehension
(2017) *Multimodal Technologies and Interaction*, 1 (4), p. 30.
- Westmattelmann, D., Grotenhermen, J.-G., Sprenger, M., Rand, W., Schewe, G.
Apart we ride together: The motivations behind users of mixed-reality sports
(2021) *Journal of Business Research*, 134, pp. 316-328.
- Won, M., UNGU, D.A.K., Matovu, H., Treagust, D.F., Tsai, C.-C., Park, J., Mocerino, M., Tasker, R.
Diverse approaches to learning with immersive Virtual Reality identified from a systematic review
(2023) *Computers & Education*, 195, p. 104701.
- Xie, Y., Hong, Y., Fang, Y.
(2022) *Virtual Reality Primary School Mathematics Teaching System Based on GIS Data Fusion*, p. 2022.
- Yeh, H.-C., Tseng, S.-S., Heng, L.
Enhancing EFL students' intracultural learning through virtual reality
(2022) *Interactive Learning Environments*, 30 (9), pp. 1609-1618.

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