

S2 Research Articles Selected for Systematic Review

Author and Year	Article Title	Source	Research Type	Doi
Thomas et al., 2010	Augmented reality for anatomical education	Journal of Visual Communication in Medicine	Empirical research	10.3109/17453050903557359
Martín-Gutiérrez et al., 2010	Design and validation of an augmented book for spatial abilities development in engineering students	Computers & Graphics	Empirical research	10.1016/j.cag.2009.11.003
Fiorentino et al., 2009	Interactive "touch and see" FEM Simulation using Augmented Reality	International Journal of Engineering Education	Design case	ijee.ie/articles/Vol25-6/08_ijee2236.pdf
Kaufmann, H., 2009	Dynamic Differential Geometry in Education	Journal for Geometry and Graphics	Design case	NA
Weghorst et al., 2008	Medical interface research at the HIT Lab	Virtual Reality	Synthesis	10.1007/s10055-008-0107-9
Klopfer & Squire, 2008	Environmental detectives—the development of an augmented reality platform for environmental simulations	Educational Technology Research and Development	Empirical research	10.1007/s11423-007-9037-6
Nomura et al., 2008	Can Interview Prior to Laparoscopic Simulator Training Predict a Trainee's Skills?	Journal of Surgical Education	Empirical research	10.1016/j.jsurg.2008.07.008
Squire & Klopfer, 2007	Augmented Reality Simulations on Handheld Computers	Journal of the Learning Sciences	Empirical research	10.1080/10508400701413435
Marín et al., 2005	A multimodal interface to control a robot arm via the web: A case study on remote programming	IEEE Transactions on Industrial Electronics	Design case	10.1109/TIE.2005.858733
Marín et al., 2003	The UJI Online Robot: An Education and Training Experience	Autonomous Robots	Design case	10.1023/A:1026220621431
Espejo-Trung et al., 2015	Development and Application of a New Learning Object for Teaching Operative Dentistry Using Augmented Reality	Journal of Dental Education	Empirical research	10.1002/j.0022-0337.2015.79.1.tb06033.x
Martín-Gutiérrez et al., 2015	Augmented reality to promote collaborative and autonomous learning in higher education	Computers in Human Behavior	Empirical research	10.1016/j.chb.2014.11.093
Sánchez Riera et al., 2015	Geo-located teaching using handheld augmented reality: good practices to improve the motivation and qualifications of architecture students	Universal Access in the Information Society	Empirical research	10.1007/s10209-014-0362-3
McMahon et al., 2015	Augmented reality as a navigation tool to employment opportunities for postsecondary education students with intellectual disabilities and Autism	Journal of Research on Technology in Education	Empirical research	10.1080/15391523.2015.1047698
Solak, 2015	Exploring the effect of materials designed with augmented reality on language learners' vocabulary learning	The Journal of Educators Online-JEO	Empirical research	10.9743/JEO.2015.2.5
Shirazi, 2015	Design and Assessment of a Mobile Augmented Reality-Based Information Delivery Tool for Construction and Civil Engineering Curriculum	Journal of Professional Issues in Engineering Education and Practice	Empirical research	10.1061/(asce)ei.1943-5541.0000229
Abhari, 2015	Training for planning tumour resection: Augmented reality and human factors	IEEE Transactions on Biomedical Engineering	Empirical research	10.1109/TBME.2014.2385874
Castillo, 2015	A pilot study on the Use of mobile augmented reality for interactive experimentation in quadratic equations	Mathematical Problems in Engineering	Empirical research	10.1155/2015/946034
Ferrer-Torregrosa, 2015	ARBOOK: Development and Assessment of a Tool Based on Augmented Reality	Journal of Science Education and Technology	Empirical research	10.1007/s10956-014-9526-4

	mented Reality for Anatomy	Technology		
Sidhu, 2015	The effects of using learning-aided cues in an augmented reality environment for a multi-body mechanism	International Journal of Computer Applications in Technology	Empirical research	10.1504/ijcat.2015.073587
Okimoto, 2015	Learning with augmented reality: Effects toward student with different spatial abilities	Procedia Manufacturing	Empirical research	10.1166/ASL.2015.6307
Garrett, 2015	Augmented reality m-learning to enhance nursing skills acquisition in the clinical skills laboratory	Interactive Technology and Smart Education	Empirical research	10.1108/itse-05-2015-0013
Crandall, 2015	Development of an augmented reality game to teach abstract concepts in food chemistry	Journal of Food Science Education	Empirical research	10.1111/1541-4329.12048
Shirazi, 2015	Content delivery using augmented reality to enhance students' performance in a building design and assembly project	Advances in Engineering Education	Empirical research	NA
Rizov, 2015	Augmented reality as a teaching tool in higher education	International Journal of Cognitive Research in Science, Engineering and Education	Empirical research	10.23947/2334-8496-2015-3-1-7-15
Chang, 2015	Apply an augmented reality in a mobile guidance to increase sense of place for heritage places	Educational Technology and Society	Empirical research	NA
Chen, 2015	A pilot study exploring augmented reality to increase motivation of Chinese college students learning English	Computers in Education Journal	Empirical research	10.18260/1-2--19977
Odeh, 2015	Augmented reality internet labs versus its traditional and virtual equivalence	International Journal of Emerging Technologies in Learning	Empirical research	10.3991/ijet.v10i3.4354
Vera, 2014	Augmented reality telementoring (ART) platform: a randomized controlled trial to assess the efficacy of a new surgical education technology	Surgical Endoscopy	Empirical research	10.1007/s00464-014-3625-4
Wang, 2014	An investigation of university students' collaborative inquiry learning behaviors in an augmented reality simulation and a traditional simulation	Journal of Science Education and Technology	Empirical research	10.1007/s10956-014-9494-8
Fonseca, 2014	Relationship between student profile, tool use, participation, and academic performance with the use of Augmented Reality technology for visualized architecture models	Computers in Human Behavior	Empirical research	10.1016/j.chb.2013.03.006
Redondo, 2014	Mobile learning in the field of architecture and building construction. A case study analysis	RUSC Universities and Knowledge Society Journal	Empirical research	10.7238/rusc.v11i1.1844
Chao, 2014	Implementation of a mobile peer assessment system with augmented reality in a fundamental design course	Knowledge Management and E-Learning	Empirical research	10.34105/j.kmel.2014.06.009
Chang, 2014	Development and behavioral pattern analysis of a mobile guide system with augmented reality for painting appreciation instruction in an art museum	Computers and Education	Empirical research	10.1016/j.compedu.2013.09.022
Yang, 2014	Computer-assisted culture learning in an online augmented reality environment based on free-hand gesture interaction	IEEE Transactions on Learning Technologies	Empirical research	10.1109/tlt.2014.2307297
Chou, 2014	Location-based learning through	Journal of Education	Empirical research	10.2190/ec.51.3.

	Augmented Reality	tional Computing Research		e
Muñoz-Cristóbal, 2014	City Ads: Embedding virtual worlds and augmented reality in everyday educational practice	Journal of Universal Computer Science	Empirical research	NA
Keebler, 2014	Shifting the paradigm of music instruction: Implications of embodiment stemming from an augmented reality guitar learning system	Journal of Information Technology Research	Empirical research	10.3389/fpsyg.2014.00471
Keebler, 2014	Shifting the paradigm of music instruction: Implications of embodiment stemming from an augmented reality guitar learning system	Journal of Information Technology Research	Empirical research	10.3389/fpsyg.2014.00471
Wang, 2014	An investigation of university students' collaborative inquiry learning behaviors in an augmented reality simulation and a traditional simulation	Journal of Science Education and Technology	Empirical research	10.1007/s10956-014-9494-8
Sánchez Riera, 2013	Hand-held augmented reality: Usability and academic performance assessment in educational environments. Case study of an engineering degree course	Information (Japan)	Empirical research	NA
Hsiao, 2013	Using augmented reality for students health - Case of combining educational learning with standard fitness	Multimedia Tools and Applications	Empirical research	10.1007/s11042-011-0985-9
Liarokapis, 2012	Augmented reality interfaces for assisting computer games university students	Bulletin of the Technical Committee on Learning Technology	Design case	NA
Mejías Borrero, 2012	A Pilot Study of the Effectiveness of Augmented Reality to Enhance the Use of Remote Labs in Electrical Engineering Education	Journal of Science Education and Technology	Design case	10.2307/41674483
von Jan, 2012	MARble - Augmented reality in medical education	Biomedizinische Technik	Empirical research	10.1515/bmt-2012-4252
Delello, 2015	Integrating augmented reality in higher education: A multidisciplinary study of student perceptions	Journal of Educational Multimedia and Hypermedia	Empirical research	NA
Albrecht, 2013	Effects of mobile augmented reality learning compared to textbook learning on medical students: Randomized controlled pilot study	Journal of Medical Internet Research	Empirical research	10.2196/jmir.2497
Vargas, 2017	Exploring the virtuality continuum for complex rule-set education in the context of soccer rule comprehension	Multimodal Technologies and Interaction	Empirical research	10.3390/mti1040030
Mahmoudi, 2017	AR-based value-added visualization of infographic for enhancing learning performance	Computer Applications in Engineering Education	Empirical research	10.1002/cae.21853
Wang, 2017	Conceptual design of a mobile application for geography fieldwork learning	ISPRS International Journal of Geo-Information	Theoretical research	10.3390/ijgi6110355
Rai, 2017	Teaching binocular indirect ophthalmoscopy to novice residents using an augmented reality simulator	Canadian Journal of Ophthalmology	Empirical research	10.1016/j.jcjo.2017.02.015
Turkan, 2017	Mobile augmented reality for teaching structural analysis	Advanced Engineering Informatics	Empirical research	10.1016/j.aei.2017.09.005
Wang et al., 2017	Using augmented reality to support a software editing course for college students	Journal of Computer Assisted Learning	Empirical research	10.1111/jcal.12199
Noll, 2017	Mobile augmented reality as a feature for self-oriented, blended	JMIR mHealth and uHealth	Empirical research	10.2196/mhealth.7943

	d learning in medicine: Randomized controlled trial			
Frank, 2017	Mixed-reality learning environments: Integrating mobile interfaces with laboratory test-beds	Computers and Education	Empirical research	10.1016/j.compedu.2017.02.009
Bursztyn, 2017	Increasing undergraduate interest to learn geoscience with GPS-based augmented reality field trips on students' own smartphones	GSA Today	Empirical research	10.1130/GSATG304A.1
Bursztyn et al., 2017	Assessment of student learning using augmented reality Grand Canyon field trips for mobile smart devices	Geosphere	Empirical research	10.1130/ges01404.1
Abdullah, 2017	Go virtual: Exploring augmented reality application in representation of steel architectural construction for the enhancement of architecture education	Advanced Science Letters	Empirical research	10.1166/asl.2017.7449
Carbonell, 2017	Landscape interpretation with augmented reality and maps to improve spatial orientation skill	Journal of Geography in Higher Education	Empirical research	10.1080/03098265.2016.1260530
Cheng, 2017	Reading an augmented reality book: An exploration of learners' cognitive load, motivation, and attitudes	Australasian Journal of Educational Technology	Empirical research	10.14742/ajet.2820
Woods, 2016	Pilot study using the augmented reality sandbox to teach topographic maps and surficial processes in introductory geology labs	JOURNAL OF GEOSCIENCE EDUCATION	Design case	10.5408/15-135.1
Akçayır et al., 2016	Augmented reality in science laboratories: The effects of augmented reality on university students' laboratory skills and attitudes toward science laboratories	Computers in Human Behavior	Empirical research	10.1016/j.chb.2015.12.054
Juan et al., 2016	A mobile augmented reality system for the learning of dental morphology	Digital Education Review	Design case	10.1344/DER.2016.30.234-247
Küçük et al., 2016	Learning anatomy via mobile augmented reality: Effects on achievement and cognitive load	Anatomical sciences education	Empirical research	10.1002/ase.1603
Martin-Gonzalez et al., 2016	Usability evaluation of an augmented reality system for teaching Euclidean vectors	Innovations in Education and Teaching International	Empirical research	10.1080/14703297.2015.1108856
Monroy Reyes et al., 2016	A mobile augmented reality system to support machinery operations in scholar environments	Computer Applications in Engineering Education	Empirical research	10.1002/cae.21772
Wong et al., 2018	Learning on mobile augmented reality trails of integrity and ethics	Research and Practice in Technology Enhanced Learning	Empirical research	10.1186/s41039-018-0088-6
Ibrahim et al., 2018	ARbis Pictus: A study of vocabulary learning with augmented reality	IEEE Transactions on Visualization and Computer Graphics	Empirical research	10.1109/tvcg.2018.2868568
Zhu et al., 2018	Increasing Enthusiasm and Enhancing Learning for Biochemistry-Laboratory Safety with an Augmented-Reality Program	Journal of Chemical Education	Empirical research	10.1021/acs.jchemed.8b00116
Wang et al., 2018	Augmented reality in education and training: pedagogical approaches and illustrative case studies	Journal of Ambient Intelligence and Humanized Computing	Synthesis	10.1007/s12652-017-0547-8
Sural, 2018	Augmented reality experience: Initial perceptions of higher education students	International Journal of Instruction	Empirical research	10.12973/iji.2018.11435a
Goff et al., 2018	Applications of Augmented Reality in Informal Science Learning	Journal of Science Education and	Synthesis	10.1007/s10956-018-9734-4

	Sites: a Review	Technology		
Wang et al., 2018	Enhancing mechanisms education through interaction with augmented reality simulation	Computer Applications in Engineering Education	Empirical research	10.1002/cae.21951
Turan et al., 2018	The impact of mobile augmented reality in geography education: achievements, cognitive loads and views of university students	Journal of Geography in Higher Education	Empirical research	10.1080/03098265.2018.1455174
Chanlin & Chan, 2018	Augmented reality applied in dietary monitoring	Libri	Empirical research	10.1515/libri-2017-0024
Teng et al., 2018	Impact of Augmented Reality on Programming Language Learning: Efficiency and Perception	Journal of Educational Computing Research	Empirical research	10.1177/0735633117706109
Aebersold et al., 2018	Interactive Anatomy-Augmented Virtual Simulation Training	Clinical Simulation in Nursing	Empirical research	10.1016/j.ecns.2017.09.008
Llena et al., 2018	Implementation of augmented reality in operative dentistry learning	European Journal of Dental Education	Empirical research	10.1111/eje.12269
Carrera et al., 2018	Teaching with AR as a tool for relief visualization: usability and motivation study	International Research in Geographical and Environmental Education	Empirical research	10.1080/10382046.2017.1285135
Molnár et al., 2018	Use of augmented reality in learning	Acta Polytechnica Hungarica	Empirical research	10.12700/aph.15.5.2018.5.12
Richardson et al., 2018	Augmented affordances support learning: Comparing the instructional effects of the Augmented Reality Sandbox and conventional maps to teach topographic map skills	Journal of Interactive Learning Research	Empirical research	NA
Kugelman et al., 2018	An Augmented Reality magic mirror as additive teaching device for gross anatomy	Annals of Anatomy	Empirical research	10.1016/j.aanat.2017.09.011
Lytridis et al., 2018	ARTutor—An augmented reality platform for interactive distance learning	Education Sciences	Design case	10.3390/educsci8010006
Chang & Yu, 2018	Using augmented reality technologies to enhance students' engagement and achievement in science laboratories	International Journal of Distance Education Technologies	Empirical research	10.4018/ijdet.2018100104
Del Rio-Guerra et al., 2019	AR Graphic representation of musical notes for self-learning on guitar	Applied Sciences (Switzerland)	Empirical research	10.3390/app9214527
Bork et al., 2019	The Benefits of an Augmented Reality Magic Mirror System for Integrated Radiology Teaching in Gross Anatomy	Anatomical Sciences Education	Empirical research	10.1002/ase.1864
Alahmari et al., 2019	Faculty awareness of the economic and environmental benefits of augmented reality for sustainability in Saudi Arabian universities	Journal of Cleaner Production	Empirical research	10.1016/j.jclepro.2019.04.090
Cabero-Almenara & Roig-Vila, 2019	The motivation of technological scenarios in Augmented Reality (AR): Results of different experiments	Applied Sciences (Switzerland)	Empirical research	10.3390/app9142907
Cabero-Almenara et al., 2019	Adoption of augmented reality technology by university students	Heliyon	Empirical research	10.1016/j.heliyon.2019.e01597
Bodensiek et al., 2019	Augmenting the fine beam tube: From hybrid measurements to magnetic field visualization	Physics Teacher	Design case	10.1119/1.5095388
ChanLin et al., 2019	An epistemological assessment of learning nutritional information with augmented reality	Electronic Library	Empirical research	10.1108/EL-06-2018-0128
Bacca et al., 2019	Framework for designing motivational augmented reality applications in vocational education and training	Australasian Journal of Educational Technology	Empirical research	10.14742/ajet.4182

Chin et al., 2019	Effects of an augmented reality-based mobile system on students' learning achievements and motivation for a liberal arts course	Interactive Learning Environments	Empirical research	10.1080/10494820.2018.1504308
Bos et al., 2019	Educational Technology and Its Contributions in Students' Focus and Attention Regarding Augmented Reality Environments and the Use of Sensors	Journal of Educational Computing Research	Empirical research	10.1177/0735633119854033
Boonbrahm et al., 2019	Teaching fundamental programming using augmented reality	International Journal of Interactive Mobile Technologies	Empirical research	10.3991/ijim.v13i07.10738
Cabero-Almenara et al., 2019	Educational uses of augmented reality (AR): Experiences in educational science	Sustainability (Switzerland)	Empirical research	10.3390/su11184990
Carbonell-Carrera & Hess-Medler, 2019	Interactive Visualization Software to Improve Relief Interpretation Skills: Spatial Data Infrastructure Geoportal versus Augmented Reality	Professional Geographer	Empirical research	10.1080/00330124.2019.1595064
Tzima et al., 2019	Augmented reality applications in education: Teachers point of view	Education Sciences	Empirical research	10.3390/educsci9020099
Kim-Berman et al., 2019	Validity and User Experience in an Augmented Reality Virtual Tooth Identification Test	Journal of Dental Education	Empirical research	10.21815/JDE.019.139
Lin et al., 2019	Research into the e-learning model of agriculture technology companies: Analysis by deep learning	Agronomy	Empirical research	10.3390/agronomy9020083
Liu et al., 2019	Comparison of AR and physical experiential learning environment in supporting product innovation	International Journal of Engineering Business Management	Empirical research	10.1177/1847979019839578
Logishetty et al., 2019	Can an Augmented Reality Headset Improve Accuracy of Acetabular Cup Orientation in Simulated THA? A Randomized Trial	Clinical Orthopaedics and Related Research	Empirical research	10.1097/CORR.0000000000000542
Mei & Yang, 2019	Nurturing environmental education at the tertiary education level in China: Can mobile augmented reality and gamification help?	Sustainability (Switzerland)	Empirical research	10.3390/su11164292
Pellas & Kazanidis, 2019	Developing and assessing augmented reality applications for mathematics with trainee instructional media designers: An exploratory study on user experience	Journal of Universal Computer Science	Empirical research	10.3217/JUCS-025-05-0489
Kaur et al., 2019	Design implications for adaptive augmented reality based interactive learning environment for improved concept comprehension in engineering paradigms	Interactive Learning Environments	Empirical research	10.1080/10494820.2019.1674885
Redzuan et al., 2019	Emotional augmented reality-based mobile learning design elements: A kansei engineering approach	Indonesian Journal of Electrical Engineering and Computer Science	Empirical research	10.11591/ijeecs.v14.i1.pp413-420
Rusli et al., 2019	A study of students' motivation in using the mobile arc welding learning app	International Journal of Interactive Mobile Technologies	Empirical research	10.3991/IJIM.V13i10.11305
Singh et al., 2019	Evaluating the impact of the augmented reality learning environment on electronics laboratory skills of engineering students	Computer Applications in Engineering Education	Empirical research	10.1002/cae.22156
Sung et al., 2019	Real-time augmented reality physics simulator for education	Applied Sciences (Switzerland)	Empirical research	10.3390/app9194019

Yip et al., 2019	Improving quality of teaching and learning in classes by using augmented reality video	Computers and Education	Empirical research	10.1016/j.compedu.2018.09.014
Yu et al., 2019	Effect of AR-based online wearable guides on university students' situational interest and learning performance	Universal Access in the Information Society	Empirical research	10.1007/s10209-017-0591-3
Zarraonandia et al., 2019	Using a Google Glass-Based Classroom Feedback System to Improve Students to Teacher Communication	IEEE Access	Empirical research	10.1109/ACCESS.2019.2893971
Nordin et al., 2020	Mobile augmented reality using 3d ruler in a robotic educational module to promote stem learning	Bulletin of Electrical Engineering and Informatics	Empirical research	10.11591/EEI.V9I6.2235
Fernandes et al., 2020	An augmented reality-based mobile application facilitates the learning about the spinal cord	Education Sciences	Empirical research	10.3390/educsci10120376
AlNajdi et al., 2020	The effectiveness of using augmented reality (AR) on assembling and exploring educational mobile robot in pedagogical virtual machine (PVM)	Interactive Learning Environments	Empirical research	10.1080/10494820.2018.1552873
Gómez-Galán et al., 2020	Socio-educational impact of augmented reality (AR) in sustainable learning ecologies: A semantic modeling approach	Sustainability (Switzerland)	Empirical research	10.3390/su12219116
Nadeem et al., 2020	AR-LaBOR: Design and assessment of an augmented reality application for lab orientation	Education Sciences	Empirical research	10.3390/educsci10110316
Lee, 2020	Using augmented reality to train students to visualize three-dimensional drawings of mortise-tenon joints in furniture carpentry	Interactive Learning Environments	Empirical research	10.1080/10494820.2019.1572629
Soltis et al., 2020	A novel approach to measuring student engagement while using an augmented reality sandbox	Journal of Geography in Higher Education	Empirical research	10.1080/03098265.2020.1771547
Pombo & Marques, 2020	The potential educational value of mobile augmented reality games: The case of edupark app	Education Sciences	Empirical research	10.3390/educsci10100287
Urbano et al., 2020	Evaluating an online augmented reality puzzle for DC circuits: Students' feedback and conceptual knowledge gain	Computer Applications in Engineering Education	Empirical research	10.1002/cae.22306
Gonzalez et al., 2020	Augmented reality-based learning for the comprehension of cardiac physiology in undergraduate biomedical students	Advances in Physiology Education	Empirical research	10.1152/advan.00137.2019
Bogomolova et al., 2020	The Effect of Stereoscopic Augmented Reality Visualization on Learning Anatomy and the Modifying Effect of Visual-Spatial Abilities: A Double-Center Randomized Controlled Trial	Anatomical Sciences Education	Empirical research	10.1002/ase.1941
Gómez-Tone et al., 2020	International comparative pilot study of spatial skill development in engineering students through autonomous augmented reality-based training	Symmetry	Empirical research	10.3390/SYM12091401
Gómez-Tone et al., 2020	International comparative pilot study of spatial skill development in engineering students through autonomous augmented reality-based training	Symmetry	Empirical research	10.3390/SYM12091401
Conley et al., 2020	MantarayAR: Leveraging augmented reality to teach probability and sampling	Computers and Education	Empirical research	10.1016/j.compedu.2020.103895
Mladenovic et al., 2020	Effect of augmented reality simulation on administration of local anesthesia	European Journal of Dental Education	Empirical research	10.1111/eje.12529

	al anaesthesia in paediatric patients	tion		
Lee & Tucker-Kellogg, 2020	An accessible, open-source mobile application for macromolecular visualization using augmented reality	Biochemistry and Molecular Biology Education	Design case	10.1002/bmb.21335
Peterson et al., 2020	An idea to explore: Use of augmented reality for teaching three-dimensional biomolecular structures	Biochemistry and Molecular Biology Education	Empirical research	10.1002/bmb.21341
Henssen et al., 2020	Neuroanatomy Learning: Augmented Reality vs. Cross-Sections	Anatomical Sciences Education	Empirical research	10.1002/ase.1912
Altmeyer et al., 2020	The use of augmented reality to foster conceptual knowledge acquisition in STEM laboratory courses—Theoretical background and empirical results	British Journal of Educational Technology	Empirical research	10.1111/bjet.12900
Lim & Lim, 2020	Semiotics, memory and augmented reality: History education with learner-generated augmentation	British Journal of Educational Technology	Empirical research	10.1111/bjet.12904
Salar et al., 2020	A Model for Augmented Reality Immersion Experiences of University Students Studying in Science Education	Journal of Science Education and Technology	Empirical research	10.1007/s10956-019-09810-x
Kerr & Lawson, 2020	Augmented Reality in Design Education: Landscape Architecture Studies as AR Experience	International Journal of Art and Design Education	Design case	10.1111/jade.12227
Moore et al., 2020	Comparative usability of an augmented reality sandtable and 3D GIS for education	International Journal of Geographical Information Science	Empirical research	10.1080/13658816.2019.1656810
An et al., 2020	Usability Testing and the Development of an Augmented Reality Application for Laboratory Learning	Journal of Chemical Education	Empirical research	10.1021/acs.jchemed.9b00453
DÍAZ-NOGUERA et al., 2020	Professional Action Competences Through Experiences with Augmented Reality	Journal of Turkish Science Education	Empirical research	10.36681/tused.2020.7
McNeal et al., 2020	A multi-institutional study of inquiry-based lab activities using the Augmented Reality Sandbox: impacts on undergraduate student learning	Journal of Geography in Higher Education	Empirical research	10.1080/03098265.2019.1694875
McNeal et al., 2020	A multi-institutional study of inquiry-based lab activities using the Augmented Reality Sandbox: impacts on undergraduate student learning	Journal of Geography in Higher Education	Empirical research	10.1080/03098265.2019.1694875
Stojić et al., 2020	Students' attitudes toward the application of mobile augmented reality in higher education	Drustvena Istrazivanja	Empirical research	10.5559/DI.29.4.02
Yüzüak & Yiğit, 2020	Augmented reality application in engineering education: N-Type MOSFET	International Journal of Electrical Engineering Education	Empirical research	10.1177/0020720920954150
Bork et al., 2020	The Effectiveness of Collaborative Augmented Reality in Gross Anatomy Teaching: A Quantitative and Qualitative Pilot Study	Anatomical Sciences Education	Empirical research	10.1002/ase.2016
Lee, J., 2020	Problem-based gaming via an augmented reality mobile game and a printed game in foreign language education	Education and Information Technologies	Empirical research	10.1007/s10639-020-10391-1
Sharmin & Chow, 2020	Augmented reality application to develop a learning tool for students: Transforming cellphones into flashcards	Healthcare Informatics Research	Design case	10.4258/hir.2020.26.3.238
Lin et al., 2020	The effects of an augmented-reality ubiquitous writing application	Computer Assisted Language Learning	Empirical research	10.1080/09588221.2020.177029

	on: a comparative pilot project for enhancing EFL writing instruction	ning		1
Baran et al., 2020	Reproductive System Augmented Reality Application for Sexual Health Classes	International Journal of Sexual Health	Empirical research	10.1080/19317611.2020.1825028
Turan et al., 2020	A mixed-methods study exploring the effect of augmented learning for paramedic students in ECG training	Innovations in Education and Teaching International	Empirical research	10.1080/14703297.2020.175228
Liu et al., 2022	Augmented reality technology based on school physical education training	COMPUTERS & ELECTRICAL ENGINEERING	Empirical research	10.1016/j.compeleceng.2022.107807
McCafferty et al., 2021	Using Augmented Reality to Foster Clinical Readiness and Critical Thinking in Nursing Education	NURSING EDUCATION PERSPECTIVES	Empirical research	10.1097/01.NEP.0000000000000860
Mystakidis et al., 2021	A systematic mapping review of augmented reality applications to support STEM learning in higher education	EDUCATION AND INFORMATION TECHNOLOGIES	Synthesis	10.1007/s10639-021-10682-1
Rodriguez-Abad et al., 2021	A Systematic Review of Augmented Reality in Health Sciences: A Guide to Decision-Making in Higher Education	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	Synthesis	10.3390/ijerph18084262
Lim, 2022	Expanding Multimodal Artistic Expression and Appreciation Methods through Integrating Augmented Reality	INTERNATIONAL JOURNAL OF ART & DESIGN EDUCATION	Empirical research	10.1111/jade.12434
Yoon & Kang, 2021	Interactive learning in the classroom: A mobile augmented reality assistance application for learning	COMPUTER ANIMATION AND VIRTUAL WORLDS	Empirical research	10.1002/cav.1989
Bolek et al., 2022	Mixed-methods exploration of students' motivation in using augmented reality in neuroanatomy education with prosected specimens	ANATOMICAL SCIENCES EDUCATION	Empirical research	10.1002/ase.2116
Alvarez-Marín & Velázquez-Iturbide, 2021	Augmented Reality and Engineering Education: A Systematic Review	IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES	Synthesis	10.1109/tlt.2022.3144356
Mendez-Lopez et al., 2021	Evaluation of an Augmented Reality Application for Learning Neuroanatomy in Psychology	ANATOMICAL SCIENCES EDUCATION	Empirical research	10.1002/ase.2089
Christopoulos et al., 2021	The effects of augmented reality-supported instruction in tertiary-level medical education	BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY	Empirical research	10.1111/bjet.13167
Boboc et al., 2021	How Augmented Reality Could Improve the Student's Attraction to Learn Mechanisms	ELECTRONICS	Empirical research	10.3390/electronics10020175
Campos-Mesa et al., 2022	Augmented Reality and the Flipped Classroom-A Comparative Analysis of University Student Motivation in Semi-Presence-Based Education Due to COVID-19: A Pilot Study	SUSTAINABILITY	Empirical research	10.3390/su14042319
Kounlaxay et al., 2021	Learning Media on Mathematical Education based on Augmented Reality	KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS	Empirical research	10.3837/tiis.2021.03.011
Alvarez-Marín et al., 2021	Technology Acceptance of an Interactive Augmented Reality App on Resistive Circuits for Engineering Students	ELECTRONICS	Empirical research	10.3390/electronics10111286
Wong et al., 2021	Using Augmented Reality as a Powerful and Innovative Technology to Increase Enthusiasm and Enhance Student Learning in Higher Education Chemistry Courses	JOURNAL OF CHEMICAL EDUCATION	Empirical research	10.1021/acs.jchemed.0c01029

Uymaz & Uymaz, 2022	Assessing acceptance of augmented reality in nursing education	PLOS ONE	Empirical research	10.1371/journal.pone.0263937
Chung et al., 2021	Collaborative programming problem-solving in augmented reality: Multimodal analysis of effectiveness and group collaboration	AUSTRALASIAN JOURNAL OF EDUCATIONAL TECHNOLOGY	Empirical research	10.14742/ajet.7059
Cui, 2022	Artificial intelligence and creativity: piano teaching with augmented reality applications	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2022.2059520
Wolf et al., 2021	Comparing the effectiveness of augmented reality-based and conventional instructions during single ECMO cannulation training	INTERNATIONAL JOURNAL OF COMPUTERS ASSISTED RADIOLOGY AND SURGERY	Empirical research	10.1007/s11548-021-02408-y
Buchner et al., 2021	The impact of augmented reality on cognitive load and performance: A systematic review	JOURNAL OF COMPUTERS ASSISTED LEARNING	Synthesis	10.1111/jcal.12617
Geerlings-Batt et al., 2022	Enhanced Visualisation of Normal Anatomy with Potential Use of Augmented Reality Superimposed on Three-Dimensional Printed Models	MICROMACHINES	Design case	10.3390/mi13101701
Hajirasouli & Banhashemi, 2022	Augmented reality in architecture and construction education: state of the field and opportunities	INTERNATIONAL JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION	Synthesis	10.1186/s41239-022-00343-9
Estrada et al., 2022	Deep-Learning-Incorporated Augmented Reality Application for Engineering Lab Training	APPLIED SCIENCE-S-BASEL	Design case	10.3390/app12105159
Kovoor et al., 2021	Validity and effectiveness of augmented reality in surgical education: A systematic review	SURGERY	Synthesis	10.1016/j.surg.2021.01.051
Elfeky & Elbyaly, 2021	Developing skills of fashion design by augmented reality technology in higher education	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2018.1558259
Lin & Hou, 2022	The evaluation of a scaffolding-based augmented reality educational board game with competition-oriented and collaboration-oriented mechanisms: differences in analysis of learning effectiveness, motivation, flow, and anxiety	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2022.2091606
Zhao et al., 2022	An Augmented Reality Based Mobile Photography Application to Improve Learning Gain, Decrease Cognitive Load, and Achieve Better Emotional State	INTERNATIONAL JOURNAL OF HUMAN-COMPUTER INTERACTION	Empirical research	10.1080/10447318.2022.2041911
Thees et al., 2022	Augmented Reality for Presenting Real-Time Data During Students' Laboratory Work: Comparing a Head-Mounted Display With a Separate Display	FRONTIERS IN PSYCHOLOGY	Design case	10.3389/fpsyg.2022.804742
Toohey et al., 2022	Comparing the Psychological Effects of Manikin-Based and Augmented Reality-Based Simulation Training: Within-Subjects Crossover Study	JMIR MEDICAL EDUCATION	Empirical research	10.2196/36447
Liu et al., 2021	Comparing technology acceptance of AR-based and 3D map-based mobile library applications: a multigroup SEM analysis	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2021.1955271
Camille Linick Stewart et al., 2021	Study on augmented reality for robotic surgery bedside assistants	JOURNAL OF ROBOTIC SURGERY	Empirical research	10.1007/s11701-021-01335-z
Alvarez-Marin et al., 2021	The acceptance of augmented reality in engineering education: the role of technology optimism and technology innovativeness	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2021.1928710

Lampropoulos et al., 2022	Augmented Reality and Gamification in Education: A Systematic Literature Review of Research, Applications, and Empirical Studies	APPLIED SCIENCE S-BASEL	Synthesis	10.3390/app12136809
Paredes-Velasco et al., 2022	Augmented reality with algorithm animation and their effect on students' emotions	MULTIMEDIA TOOLS AND APPLICATIONS	Empirical research	10.1007/s11042-022-13679-1
Skirnewskaja et al., 2021	3D Computer-Generated Holograms for Augmented Reality Applications in Medical Education	APPLICATIONS OF DIGITAL IMAGE PROCESSING	Design case	10.1117/12.2595931
Kamarudin et al., 2021	Students' behavioural intention towards e-learning practices through augmented reality app during COVID-19 pandemic in Saudi Arabia	INTERACTIVE LEARNING ENVIRONMENTS	Empirical research	10.1080/10494820.2021.2016863
Elford et al., 2022	Fostering Motivation toward Chemistry through Augmented Reality Educational Escape Activities. A Self-Determination Theory Approach	JOURNAL OF CHEMICAL EDUCATION	Empirical research	10.1021/acs.jchemed.2c00428
Hikmandayani et al., 2021	Learning media based on augmented reality (AR) increased the skill of physical examination of the integumentary system of pregnant women in midwifery students	GACETA SANITARIA	Empirical research	10.1016/j.gaceta.2021.10.040
Kurt & Ozturk, 2021	The effect of mobile augmented reality application developed for injections on the knowledge and skill levels of nursing students: An experimental controlled study	NURSE EDUCATION TODAY	Empirical research	10.1016/j.nedt.2021.104955
Kandasamy et al., 2021	Use of vision-based augmented reality to improve student learning of the spine and spinal deformities. An exploratory study	SOUTH AFRICAN JOURNAL OF PHYSIOTHERAPY	Empirical research	10.4102/sajp.v7i2.1579
Alvarez-Nieto et al., 2022	Effectiveness of scenario-based learning and augmented reality for nursing students' attitudes and awareness toward climate change and sustainability	BMC NURSING	Empirical research	10.1186/s12912-022-01023-9
Nemirovsky et al., 2021	Evaluation of Surgical Improvement of Clinical Knowledge Ops (SICKO), an Interactive Training Platform	JOURNAL OF DIGITAL IMAGING	Design case	10.1007/s10278-021-00482-x
Zhang & Robb, 2021	Immersion Experiences in a Tablet-Based Markerless Augmented Reality Working Memory Game: Randomized Controlled Trial and User Experience Study	JMIR SERIOUS GAMES	Empirical research	10.2196/27036
Velazquez & Mendez, 2021	Systematic Review of the Development of Spatial Intelligence through Augmented Reality in STEM Knowledge Areas	MATHEMATICS	Synthesis	10.3390/math9233067
Lin et al., 2021	Exploring Computational Thinking Skills Training Through Augmented Reality and AIoT Learning	FRONTIERS IN PSYCHOLOGY	Empirical research	10.3389/fpsyg.2021.640115
Morimoto et al., 2022	Digital Transformation Will Change Medical Education and Rehabilitation in Spine Surgery	MEDICINA-LITHUANIA	Design case	10.3390/medicina58040508
Hu et al., 2021	The development and construction of an AR-guided learning model with focused learning theories	JOURNAL OF COMPUTER ASSISTED LEARNING	Synthesis	10.1111/jcal.12583
Gelmini et al., 2022	Augmented reality in interventional radiology education: a systematic review of randomized controlled trials	SAO PAULO MEDICAL JOURNAL	Synthesis	10.1590/1516-3180.2021.0606.R2.27122021

Amores-Valencia et al., 2022	Influence of motivation and academic performance in the use of Augmented Reality in education. A systematic review	FRONTIERS IN PSYCHOLOGY	Synthesis	10.3389/fpsyg.2022.1011409
Vidal et al., 2021	New digital skills in students empowered with the use of Augmented Reality. Pilot Study	RIED-REVISTA IBEROAMERICANA DE EDUCACION A DISTANCIA	Empirical research	10.5944/ried.24.1.27501
Suresh et al., 2022	The Role of Augmented Reality in Surgical Training: A Systematic Review	SURGICAL INNOVATION	Synthesis	10.1177/15533506221140506
Neffati et al., 2021	An educational tool for enhanced mobile e-Learning for technical higher education using mobile devices for augmented reality	MICROPROCESSORS AND MICROSYSTEMS	Design case	10.1016/j.micpro.2021.104030
Rodríguez-Abad et al., 2022	Effectiveness of augmented reality in learning about leg ulcer care: A quasi-experimental study in nursing students	NURSE EDUCATION TODAY	Empirical research	10.1016/j.nedt.2022.105565
Van et al., 2021	Design and Development of Collaborative AR System for Anatomy Training	INTELLIGENT AUTOMATION AND SOFTWARE COMPUTING	Design case	10.32604/iasc.2021.013732
Mellos & Probst, 2022	Evaluating augmented reality for 'real life' teaching of food portion concepts	JOURNAL OF HUMAN NUTRITION AND DIETETICS	Empirical research	10.1111/jhn.13016
Mahrous et al., 2021	A comparison of pre-clinical instructional technologies: Natural teeth, 3D models, 3D printing, and augmented reality	JOURNAL OF DENTAL EDUCATION	Empirical research	10.1002/jdd.12736
McBain et al., 2022	Evaluating the integration of body donor imaging into anatomical dissection using augmented reality	ANATOMICAL SCIENCES EDUCATION	Empirical research	10.1002/ase.2157
Villanueva et al., 2021	Towards modeling of human skill learning for electrical circuitry using augmented reality applications	INTERNATIONAL JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION	Empirical research	10.1186/s41239-021-00268-9
Wang et al., 2022	Exploring the effect of improved learning performance: A mobile augmented reality learning system	EDUCATION AND INFORMATION TECHNOLOGIES	Empirical research	10.1007/s10639-022-11487-6
Marques & Pombro, 2023	User Experience of a Mobile App in a City Tour Game for International Doctoral Students	Education Sciences	Empirical research	10.3390/educsci13121221
O'Connor & Mahony, 2023	Exploring the impact of augmented reality on student academic self-efficacy in higher education	Computers in Human Behavior	Empirical research	10.1016/j.chb.2023.107963
Cheng, 2023	A study on learning analytics of using mobile augmented reality application to enhance cultural competence for design cultural creation in higher education	Journal of Computer Assisted Learning	Empirical research	10.1111/jcal.12855
Cao & Yu, 2023	The impact of augmented reality on student attitudes, motivation, and learning achievements—a meta-analysis (2016–2023)	Humanities and Social Sciences Communications	Synthesis	10.1057/s41599-023-01852-2
Lim et al., 2023	Mobile educational tool based on augmented reality technology for tooth carving: results of a prospective cohort study	BMC Medical Education	Empirical research	10.1186/s12909-023-04443-6
Hernández-Rodríguez et al., 2023	Competencies Development Strategy Using Augmented Reality for Self-Management of Learning in Manufacturing Laboratories (AR-ManufacturingLab)	Heliyon	Empirical research	10.1016/j.heliyon.2023.e22072
Elnaqilah et al., 2023	AUGMENTED REALITY IN HIGHER EDUCATION: A 10-YEAR SYSTEMATIC LITERATURE REVIEW	Journal of Theoretical and Applied Information Technology	Synthesis	NA

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Rodríguez-Abad e t al., 2023	Online (versus face-to-face) augmented reality experience on nursing students' leg ulcer competency: Two quasi-experimental studies	Nurse Education in Practice	Empirical research	10.1016/j.nepr.2023.103715
Rodríguez-Abad e t al., 2023	Online (versus face-to-face) augmented reality experience on nursing students' leg ulcer competency: Two quasi-experimental studies	Nurse Education in Practice	Empirical research	10.1016/j.nepr.2023.103715
Sabbah et al., 2023	Augmented Reality-Based Learning: The Efficacy on Learner's Motivation and Reflective Thinking	International Journal of Information and Education Technology	Empirical research	10.18178/ijiet.2023.13.7.1904
Taha et al., 2023	Exploring Media and Communication Students' Perception of Egyptian Universities' Use of Augmented Reality in Learning	Studies in Media and Communication	Empirical research	10.11114/smc.v11i4.6121
Utami et al., 2023	A BIBLIOMETRIC ANALYSIS OF AUGMENTED REALITY IN HIGHER EDUCATION	Journal of Engineering Science and Technology	Synthesis	NA
Lampropoulos et al., 2023	Integrating Augmented Reality, Gamification, and Serious Games in Computer Science Education	Education Sciences	Empirical research	10.3390/educsci13060618
Ou Yang et al., 2023	Effect of augmented reality-based virtual educational robotics on programming students' enjoyment of learning, computational thinking skills, and academic achievement	Computers and Education	Empirical research	10.1016/j.compedu.2022.104721
Kleftodimos et al., 2023	Location-Based Augmented Reality for Cultural Heritage Education: Creating Educational, Gamified Location-Based AR Applications for the Prehistoric Lake Settlement of Dispilio	Digital	Design case	10.3390/digital3010002
Mirmoghtadaie et al., 2023	Is Using Blended Learning of Lab Skills by a Modest Augmented Reality-Based Educational Booklet Beneficial to Pharmacy Students?	Strides in Development of Medical Education Journal	Empirical research	10.22062/sdme.2023.198379.1182
Liu et al., 2023	Beyond borders: exploring the impact of augmented reality on intercultural competence and L2 learning motivation in EFL learners	Frontiers in Psychology	Empirical research	10.3389/fpsyg.2023.1234905
Martin et al., 2023	The use of augmented reality for inquiry-based activity about the phenomenon of seasons: effect on mental effort and learning outcomes	Frontiers in Education	Empirical research	10.3389/feduc.2023.1223656
Mokmin et al., 2023	Impact of an AR-based learning approach on the learning achievement, motivation, and cognitive load of students on a design course	Journal of Computers in Education	Empirical research	10.1007/s40692-023-00270-2
Rodríguez et al., 2023	QUIZZES VIA AUGMENTED REALITY ON LEARNING MANAGEMENT SYSTEM: A CASE STUDY OF MOODLE	Journal of Educators Online	Empirical research	10.9743/JEO.2023.20.1.5
Ghobadi et al., 2023	Augmented Reality Applications in Education and Examining Key Factors Affecting the Users' Behaviors	Education Sciences	Empirical research	10.3390/educsci13010010
Schwenderling et al., 2023	Activation modes for gesture-based interaction with a magic lens in AR anatomy visualisation	Computer Methods in Biomechanics and Biomedic	Empirical research	10.1080/21681163.2022.2157749

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Hewitt et al., 2023	Ecosystem Education with Augmented Reality: A Flexible Tool for In-Field Learning	Professional Geographer	Empirical research	10.1080/00330124.2022.2134151
McBain et al., 2023	Evaluating the integration of body donor imaging into anatomical dissection using augmented reality	Anatomical Sciences Education	Empirical research	10.1002/ase.2157
Álvarez-Marín et al., 2023	The acceptance of augmented reality in engineering education: the role of technology optimism and technology innovativeness	Interactive Learning Environments	Empirical research	10.1080/10494820.2021.1928710
Gießler et al., 2023	Evaluation of MetaHumans as Digital Tutors in Augmented Reality in Medical Training	Current Directions in Biomedical Engineering	Empirical research	10.1515/cdbme-2023-1011
Grodzki et al., 2023	Enhancing manufacturing education based on controller-free augmented reality learning	Manufacturing Letters	Design case	10.1016/j.mfglet.2023.08.068
Felinska et al., 2023	Telestration with augmented reality improves surgical performance through gaze guidance	Surgical Endoscopy	Empirical research	10.1007/s00464-022-09859-7
Baumann & Arthurs, 2023	Augmented Reality Technology Used for Developing Topographic Map-Reading Skills in an Earth Science Course and its Potential Implications in Broader Learning Venues	Journal of Science Education and Technology	Empirical research	10.1007/s10956-022-10011-2
Huang et al., 2023	The effectiveness of an augmented reality app in online civil engineering learning	Innovations in Education and Teaching International	Empirical research	10.1080/14703297.2022.2058050
Liu et al., 2023	Comparing technology acceptance of AR-based and 3D map-based mobile library applications: a multigroup SEM analysis	Interactive Learning Environments	Empirical research	10.1080/10494820.2021.1955271