iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VII **Month of publication:** July 2022

DOI: https://doi.org/10.22214/ijraset.2022.45183

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VII July 2022- Available at www.ijraset.com

Applications and Challenges of Augmente Reality in Education Sector: A Report

Rajan Amar Bahadur Pal[1], Dr. Minesh Ade[2]
[1, 2]*Late Bhausaheb Hiray S.S Trust's Institute of Computer Application*

Abstract: ***Augmented Reality (AR) is one of the emerging advanced technologies which bridges the gap between the real and the virtual worlds, that gives students prodigious possibilities to learn the information in a completely unique way. With the rising use of personal smart devices in this modern era, the vast potentials of AR have begun to be explored as the smart devices are capable of producing AR environments. In this paper, we have the purpose of exploring applications and challenges of adopting AR in education. Since augmented reality in education can serve a number of purposes. It helps students easily acquire, process, and remember information. Additionally, AR makes learning itself more engaging and fun. Therefore, this paper is based on the research that has been conducted on AR.***

It is also not limited to single age group or level of education and can be used equally well in all levels of schooling: from pre-school education up to college, or even at work. The potential of mixing smartphones and augmented reality for education is big, though it still has got to be fully discovered. AR, in various ways, could grant students extra digital information about any subject, and make complex information easier to know. Nowadays we may find some excellent samples of augmented reality in education worldwide. Ability to attach reality and digital content has been steadily improving, opening more options for adopting AR in education sector.

Keywords: Augmented Reality, Adoption in education, Smart Devices, Application and challenges

I. INTRODUCTION

Augmented reality or AR is an upgraded version that extends the actual environment through VR. The main difference between VR and AR is the reality. VR separates a user completely from the real world, whereas AR keeps the user in the real and virtual worlds at the same time through smooth interface, tools and applications such as head set, interactive glasses, tablets and 3D objects. AR consists of three main aspects: (1) integration of real and virtual objects, (2) interaction of these objects at the same time and (3) participation of real and virtual objects for the same task . Although the literature mentions numerous definitions, many scholars agreed that AR technology simultaneously combines virtual reality with actual reality. A few scholars defined AR as computer generated images that provide a composite vision to be seen by a user in the real world. Others stated that AR are devices that allowed virtual objects to be visualised in a real environment. AR is also defined as a direct or indirect presentation of a real environment, complemented by virtual elements created by a computer. Since the advent of this technology, researchers have used it in most fields (medical, military, industry, tourism, entertainment, advertising, psychology, marketing, engineering and the arts). AR has also wielded an effective and strong influence in education. This technology has incited considerable interest among students, stimulating their active participation, high concentration and deep understanding of the subject taught. Education researchers have recognised AR's remarkable potential and substantial impact on cognitive and emotional learning outcomes. This technique helps students connect what they observe in the real world with their previous knowledge and handle goals and tasks because of the following benefits. AR provides effective learning environments and new opportunities to enhance the learning process. For experiments, AR combines the digital environment with the real sensory experience, allowing real and virtual coexistence that in turn leads to engaging user interaction. AR provides not only knowledge but also guidance on how to process acquired information. In addition, this technology is an easy and natural method of teaching because it creates large areas for exploration. AR is a mature area of psycho-physical studies as well for those who suffer from a physical disability. The advantages of introducing AR technology in educational reliability include increased student experience in real-world environments and raised awareness of the environmental context through interface with digital components. Reality is enhanced with additional virtual information. AR also increases the sensory perception of users. Given the learning experience it provides, AR is a good interface for the next generation that enables different means of handling information by designing better educational environments. Designing an educational environment with electronic and scientific training activities can be achieved.

The results showed particularly significant benefits of using AR in primary and secondary schools (pre-university education), where the technology is a highly accessible medium.

©IJRASET: All Rights are Reserved

Previous research demonstrates that AR can improve education, but this technology has major determinants that must be considered to be acceptable in the field of learning, such as providing low-cost devices and applications based on AR technology. One of the ways to improve the learning process is by enhancing the quality of the educational system with AR, given its ease of use for applications and their benefits, including immersion and enjoyment for learners.

Learning through AR may promote student-teacher interaction and enhance students' satisfaction with the learning experience. It may also develop oral communication skills, social interaction skills and may encourage diversity understanding etc. Therefore, the objective of this paper is to explore the fundamental disputes and possible challenges of AR adoption in education.

II. DEFINITION

A. What Is Augmented Reality

Augmented reality (AR) is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology. It is a growing trend among companies involved in mobile computing and business applications in particular. Amid the rise of data collection and analysis, one of augmented reality's primary goals is to highlight specific features of the physical world, increase understanding of those features, and derive smart and accessible insight that can be applied to real-world applications. Such big data can help inform companies' decision-making and gain insight into consumer spending habits, among others.

B. Why Augmented Reality is Important in Education

Even though many teachers globally prefer to stick to traditional teaching methods, AR technology is making inroads in educational establishments and enterprises.

So, what is augmented reality in education, and how does it affect students' performance?

As they learn, many students find it difficult to perceive theoretical information without any visuals or relatable examples. As a result, many concepts remain incomprehensible and out of reach for students.

This is where augmented reality applications come to the rescue, visually transforming information and creating order from the chaos.

Talking about the future of augmented reality in education, the TOJET study was also in this vein. It demonstrated the positive impact of AR technology on knowledge retention compared to traditional teaching methods.

C. Benefits of Augmented Reality in Education

There are many advantages of using augmented reality applications in education that have already been discovered by practicing educators. Here are the main ones below:

1) Advantages of augmented reality in education

a. Access to learning materials. Educational institutions often lack up-to-date teaching materials; many students have to study outdated information or search for information on their own at home. In an AR application, you can download the latest data and display it in an interactive format.

b. Access to virtual equipment. In cases where it is necessary to explore specific equipment and learn how to use it, an augmented reality application can present the required 3D model and helpful explanations. This adds practical value to the traditional learning materials.

c. Higher student engagement. Students study the material more deeply through immersion, which makes it feel more real and relevant. This is a substantial change of pace and an exciting experience for many.

d. Faster learning. A new way of presenting information helps reduce the overall learning time. Subsequently, there is more time for practice and in-depth examination of niche topics.

e. Safer practice. In such cases as anatomy lessons, students no longer need to dissect real animals; this can be accurately simulated through software. Students get the same level of practice without harming anything or working with dangerous tools.

D. Augmented Reality Uses in Education

Thinking about how to use augmented reality in education? There are many fields where AR applications can become a great solution to many problems.

So, let's have a look at how augmented reality can be used in education.

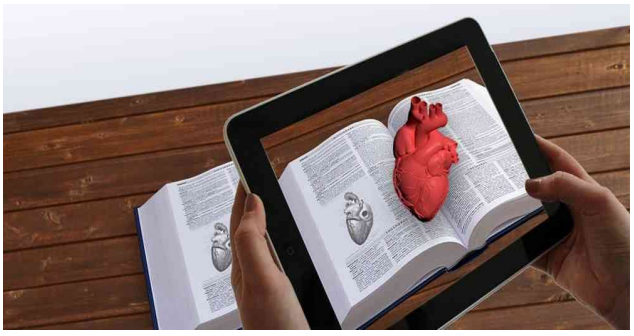
1) Augmented Reality In Schools



What is AR in school? It's an application that can be used during lessons for better representation of the material being studied. For example, school students can explore such complex sciences as biology, anatomy, physics, and even math more interactively and engagingly. In addition, an augmented reality app in the elementary classroom can simulate different cases that are hard to explain and even help develop children's creativity.

But do you know how to use augmented reality in the classroom? Most modern mobile devices such as smartphones and tablets are suitable for AR application use, and many of the young generation already have personal gadgets. Still, it's only a benefit as kids can do their homework with more excitement and learn whenever they want.

2) Augmented Reality In College



Whether students want to study humanitarian sciences or technical science, augmented reality solutions for a university can be very helpful. For example, medical students can learn anatomy and practice examining the body with an AR app representing the human body inside and out. In addition, many universities use augmented reality for teaching students engineering, math, design, astronomy, and much more.

Augmented reality for students makes the educational process more engaging and safer. The technology allows conducting experiments like trying different chemical combinations and seeing what can happen with no harm to students and university property. Moreover, AR applications can help students with creative activities in college and with organizing university events.

E. AR for distance learning



Over the past couple of years, the method of distance learning has become very popular due to the pandemic. For this reason and others, online education will likely continue to be used worldwide long after the situation stabilizes. Augmented reality applications

can serve as a convenient platform for online learning, where the student can receive the necessary materials and collaborate with other students and teachers in real time.

We should also mention that distance-learning students do not always need a teacher to explain the material. A good app can contain an entire presentation on each topic with a short or detailed explanation of the theory and interactive practice. Thus, students can study independently at a high level in the location most comfortable to them.

F. AR in Education Use Cases

There are several prominent examples of augmented reality in education that show the actual capabilities of such learning methods.

1) Children's safety education. More than 80 kindergartens in China made use of AR technology in an elementary education program to teach children from an early age all the basic safety rules and develop self-awareness in this area. The organizers suggest that this interactive education method has a better chance of making children remember such vital information and apply it in life.

2) Augmented reality in Western University. The Unity Charitable Fund was granted for an AR project for Western University that will allow students to swim with sharks! This is considered to be a great experience for making decisions under pressure and for students-biologists to explore the sharks' view and behavior up close.

3) Google Arts & Cultures in the classroom. In the conditions of quarantine and a pandemic, it has become much more challenging to organize excursions to museums, exhibitions, theatres, etc., for students. This application from Google allows you to conduct a virtual 3D tour of the most famous museums globally, spend a day at ballet, and even visit different countries without leaving a class or home.

G. Challenges of augmented reality in education

This section describes the common challenges found in AR used in education studies across different domains. The challenges discussed in this section are elaborated because they come from different domains. They are only shared based on their general importance in figure,

1) *Challenges related to individuals:* This challenge is meant to discuss some of the common issues associated with individuals in the literature. Three challenges are reported in individuals, namely, teachers, students, and developers.

a) *Related To Teachers:* The first is for teachers; many challenges have been associated or faced by teachers, such as the inability to teach in a sensory manner, followed by limited class time, limited knowledge of AR, fear of failure in using technology, lack of equipment and high cost and insufficient training for dealing with technology. Moreover, teachers may have misconceptions of using AR tools and cannot improve student performance due to a lack of reliance on AR. Teachers are insufficiently familiar with the AR technology. Teachers cannot afford these ad-hoc developments. Teachers are unaware of how to increase students' learning motivation with AR. Studies that attempted to engage the teacher to assess educational gains using different measures are lacking; furthermore, most studies did not include the teacher as an instructional designer.

b) *Related To Students:* This section aims to review the challenges faced by students during and after the use of AR in education as collected through literature. Among the most important challenges facing students while using AR technology are students' difficulties related to their abilities, being the pioneers in AR-enabled subject's difficulties in connecting and observing while also using AR technology. Other issues include imaginative abilities, the inability of students to keep up with the lessons, and a lack of student sensory perception for AR-related experiments. Additional issues are limited background knowledge, student difficulties in developing learning awareness, lacking spatial concepts, lacking cognitive load and learning motivations and the inability of participate and interact.

2) *Challenges Related To Equipment and Tools:* In this section, we explain the most important challenges related to the equipment and tools that are used in AR technology in terms of factors such as cost of equipment, difficulty in use, and inappropriate operation. The main challenge for users of the AR technology is expensive equipment, expensive educational systems financial restraints AR technology. Insufficient equipment. All of the above challenges led to limited access to labs. In addition, technical challenges arise in the equipment, such as complex instruments; difficulties arise in preparing devices and specialised instruments are needed. Other challenges are lack of relevant teaching facilities and creative design equipment, like tools.

Using equipment is also difficult. Insufficient learning outcomes of tools and a lack of effective learning strategy tools are other challenges.

3) *Challenges related to teaching using AR :* This section reviews the challenges of teaching with the use of AR technology in terms of factors such as technical, scientific, and educational efficiency.
These challenges include lack of teaching experience, lack of experience in using AR in education, lack of teaching assistance, lack of teaching facilities and lack of various appropriate instructional AR applications.
Further challenges are lack of effective teaching materials, unknown learning effectiveness, the inability to provide interactive learning in outdoor learning environments, the inability to provide observational learning and its mechanisms and difficulties connecting to actual instances of the observed phenomenon. Time is an important challenge, that is, time is insufficient for teaching. Studies are lacking that compare the effectiveness of AR technology and other technologies on student learning. In terms of teaching languages, AR contributes less for students who need verbal assistance by removing the necessity for spoken language.
4) *Challenges Related To AR System and Development:* This section reviews the challenges of the system used in AR technology, such as limited capability, financial restrictions and system instability. Other challenges are the need to develop applications to help motivate students, especially in STEM applications , inadequate system design, lack of practical system content and excessive work needed to create content. Incorporating AR in courses is difficult, and the cost of development of AR-related content is not always affordable for educational institutions. Creating AR system experiments is challenging as is lack of virtual ongoing professional development. The development of an educational AR system is time consuming.
5) *Challenges Related To Usages of AR :* This section illustrates the challenges related to the use of AR technology collected from the literature. For example, no proper guidelines exist for applying AR for education, unfamiliarity with the environment, long-term involvement, occasional instability and cognitive overload.
Furthermore, users are sometimes not accustomed to using AR. In terms of training, challenges include no content available for practice, a lack of opportunities for practical observation, limited knowledge to use AR, few experiences of using AR in education, limited and unnatural experience and lack of AR use in education. Some of the challenges are in technological knowledge such as difficulties in use, and a lack of using AR and game-based learning in educational settings. Furthermore, computer skills are required, and academic staff must be involved actively when designing virtual learning scenarios to obtain maximum learning benefits.
Simulations for real scientific data are lacking. Developmental difficulties arise . Sufficient information about the educational usefulness of AR is lacking.
6) *Challenges related to environment:* In this section, the challenges are related to AR environments found in the literature are provided.
These challenges include the difficulties of learning in an outdoor environment is challenging and learning overload. Real environments are different from virtual environments. The objects in the real and virtual worlds must be properly aligned with respect to each other, or the illusion that the two worlds coexist will be compromised. Situational contexts for the environment are lacking.
7) *Challenges related to studies on AR:* This section illustrates the challenges collected from the literature on the quality and quantity of studies conducted on AR. T
hese challenges include the few studies that have been conducted in educational observation and academic collection. AR scaffold environments must be provided to support deep learning. Furthermore, few studies have been conducted on AR cognitive learning and on using AR in language. Comparative studies between the effectiveness of AR technology and other technologies on student learning are lacking. Comparative studies between AR teaching and traditional teaching method are lacking. Literature on using AR technologies in science teaching is lacking. Disadvantages of tools and content in analysis and discovery of data exist.
Studies are lacking in acceptance of AR as a learning tool and the perception of users in education. Studies the in elementary or secondary school context are lacking. Effects of AR technology in learning have not been comprehensively investigated. Studies on AR in education are lacking.
Few studies have explored how to use AR technology effectively for science education. No studies have been conducted on AR technology that involve taste and smell.



Figure 1: Challenges Overview

III. KEY TAKEAWAYS

1) Augmented reality (AR) involves overlaying visual, auditory, or other sensory information onto the world in order to enhance one's experience.

2) Retailers and other companies can use augmented reality to promote products or services, launch novel marketing campaigns, and collect unique user data.

3) Unlike virtual reality, which creates its own cyber environment, augmented reality adds to the existing world as it is.

IV. CONCLUSION

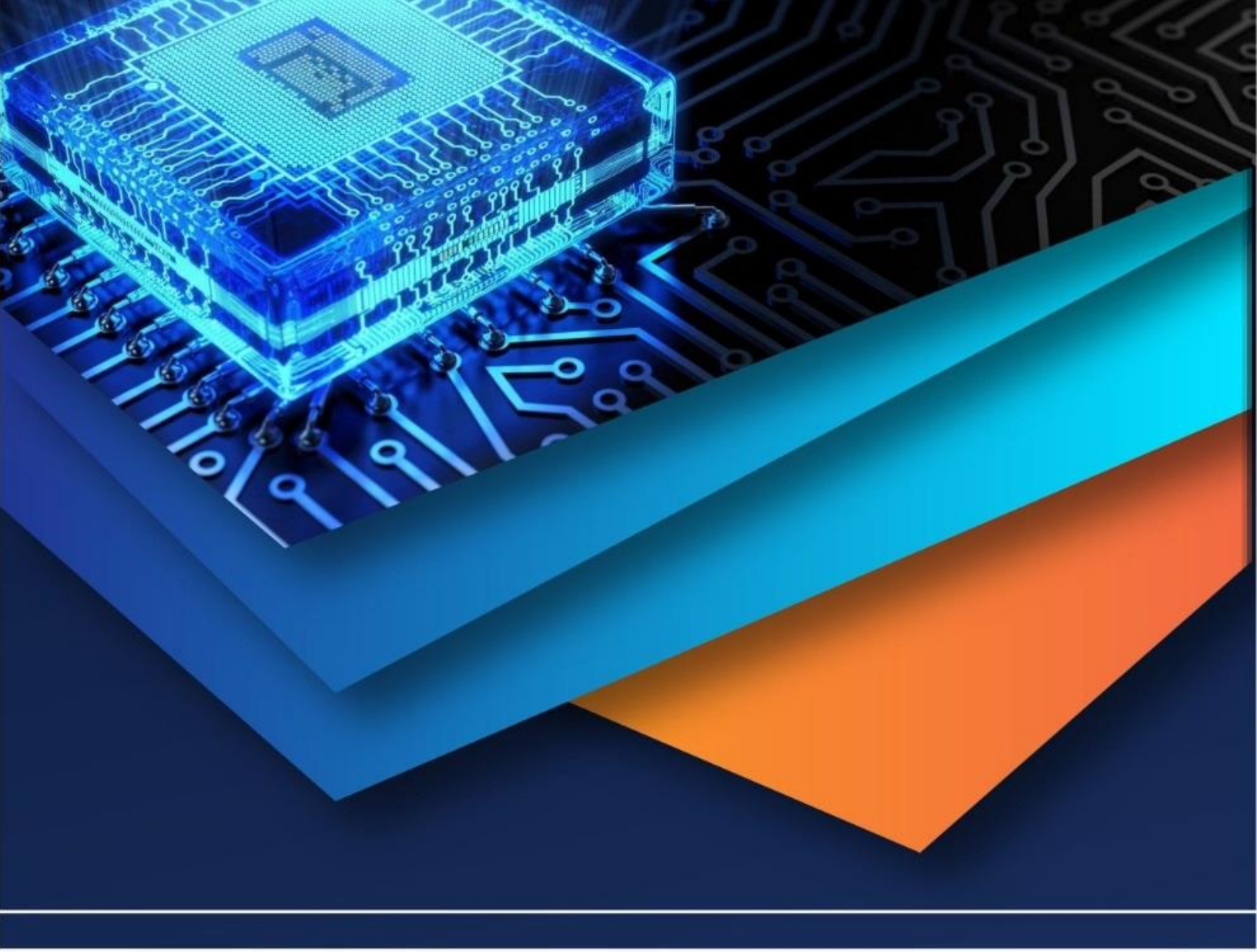
Researchers have attempted to use this technology in several areas, including education. However, the number of studies using AR in education has been relatively low. This technology is supposed to be used in the future because it is useful in education, as previous studies have shown, and it is likely to spread considerably in the near future. Many researchers have focused on AR in education with different ideas, different samples and different cultures. We conclude from this literature review that AR strongly supports the educational process. However, after comparing the research studies, we note that the effect of AR in education is not different from that of traditional methods.

We believe that the information that has been raised in literature is absolutely correct and unquestionable, but the greatest challenge is in the way to choose the applications of AR for each purpose and method of use. Lack of experience, technical problems, application user interface, fear of failure by teachers, and the time (lecture time is limited or insufficient). Additional factors are other costs (prices of smartphones and tablets), the Internet and technical problems. We believe that if these challenges are addressed, AR will be an extremely appropriate tool in education.

REFERENCES

[1] S. Giasiranis and L. Sofos, "Flow experience and educational effectiveness of teaching informatics using AR," Journal of Educational Technology & Society, vol. 20, pp. 78-88, 2017.
[2] J. Zhang, Y.-T. Sung, H.-T. Hou, and K.-E. Chang, "The development and evaluation of an augmented reality-based armillary sphere for astronomical observation instruction," Computers & education, vol. 73, pp. 178-188, 2014.
[3] S. Cai, F.-K. Chiang, Y. Sun, C. Lin, and J. J. Lee, "Applications of augmented reality-based natural interactive learning in magnetic field instruction," Interactive Learning Environments, vol. 25, pp. 778- 791, 2017. [4] S. Cai, X. Wang, and F.-K. Chiang, "A case study of Augmented Reality simulation system application in a chemistry course," Computers in human behavior, vol. 37, pp. 31-40, 2014.
[4] M. B. Ibáñez, Á. Di Serio, D. Villarán, and C. D. Kloos, "Experimenting with electromagnetism using augmented reality: Impact on flow student experience and educational effectiveness," Computers & Education, vol. 71, pp. 1-13, 2014. [6] G. A. Alshafeey, M. M. Lakulu, M. Chyad, A. Abdullah, and G. Salem, "Augmented Reality for the Disabled: Review Articles," Journal of ICT in Education, vol. 6, pp. 46-57, 2019.
[5] C. S. C. Dalim, H. Kolivand, H. Kadhim, M. S. Sunar, and M. Billinghurst, "Factors influencing the acceptance of augmented reality in education: A review of the literature," Journal of computer science, vol. 13, pp. 581-589, 2017.
[6] W. Tarng, Y.-S. Lin, C.-P. Lin, and K.-L. Ou, "Development of a lunar-phase observation system based on augmented reality and mobile learning technologies," Mobile Information Systems, vol. 2016, 2016.
[7] T.-C. Huang, C.-C. Chen, and Y.-W. Chou, "Animating eco-education: To see, feel, and discover in an augmented reality-based experiential learning environment," Computers & Education, vol. 96, pp. 72-82, 2016.
[8] H. S. Gan, N. Y. K. Tee, M. R. Bin Mamtaz, K. Xiao, B. H. P. Cheong, O. W. Liew, et al., "Augmented reality experimentation on oxygen gas generation from hydrogen peroxide and bleach reaction," Biochemistry and Molecular Biology Education, vol. 46, pp. 245- 252, 2018.
[9] S.-C. Chang and G.-J. Hwang, "Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions," Computers & Education, vol. 125, pp. 226-239, 2018.
[10] G.-J. Hwang, P.-H. Wu, C.-C. Chen, and N.-T. Tu, "Effects of an augmented reality-based educational game on students' learning achievements and attitudes in real-world observations," Interactive Learning Environments, vol. 24, pp. 1895-1906, 2016.
[11] P. Toledo-Morales and J. M. Sanchez-Garcia, "Use of augmented reality in social sciences as educational resource," Turkish Online Journal of Distance Education, vol. 19, pp. 38-52, 2018.
[12] T. H. Chiang, S. J. Yang, and G.-J. Hwang, "An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities," Journal of Educational Technology & Society, vol. 17, pp. 352-365, 2014.
[13] J. Martín-Gutiérrez, C. E. Mora, B. Añorbe-Díaz, and A. González-Marrero, "Virtual technologies trends in education," EURASIA Journal of Mathematics, Science and Technology Education, vol. 13, pp. 469-486, 2017.
[14] V. Gopalan, J. A. A. Bakar, A. N. Zulkifli, and A. Alwi, "A Review of Augmented Multimedia Elements in Science Learning," Journal of Telecommunication, Electronic and Computer Engineering (JTEC), vol. 10, pp. 87-92, 2018.
[15] P.-H. Wu, G.-J. Hwang, M.-L. Yang, and C.-H. Chen, "Impacts of integrating the repertory grid into an augmented reality-based learning design on students' learning achievements, cognitive load and degree of satisfaction," Interactive Learning Environments, vol. 26, pp. 221-234, 2018.
[16] S. K. Kim, S.-J. Kang, Y.-J. Choi, M.-H. Choi, and M. Hong, "Augmented-reality survey: from concept to application," KSII Transactions on Internet and Information Systems (TIIS), vol. 11, pp. 982-1004, 2017
[17] M.-B. Ibáñez and C. Delgado-Kloos, "Augmented reality for STEM learning: A systematic review," Computers & Education, vol. 123, pp. 109-123, 2018.
[18] M. E. C. Santos, A. Chen, T. Taketomi, G. Yamamoto, J. Miyazaki, and H. Kato, "Augmented reality learning experiences: Survey of prototype design and evaluation," IEEE Transactions on learning technologies, vol. 7, pp. 38-56, 2013. [21] C.-p. Chen and C.-H. Wang, "Employing augmented reality-embedded instruction to disperse the imparities of individual differences in earth science learning," Journal of Science Education and Technology, vol. 24, pp. 835-847, 2015.
[19] I. Radu, "Augmented reality in education: a meta review and cross-media analysis," Personal and Ubiquitous Computing, vol. 18, pp. 1533-1543, 2014.
[20] C. Pribeanu, A. Balog, and D. D. Iordache, "Measuring the perceived quality of an AR-based learning application: a multidimensional model," Interactive Learning Environments, vol. 25, pp. 482-495, 2017.
[21] Y.-H. Wang, "Exploring the effectiveness of integrating augmented reality-based materials to support writing activities," Computers & Education, vol. 113, pp. 162-176, 2017.
[22] M. Akçayır and G. Akçayır, "Advantages and challenges associated with augmented reality for education: A systematic review of the literature," Educational Research Review, vol. 20, pp. 1-11, 2017.
[23] J. A. Chen, S. J. Metcalf, and M. S. Tutwiler, "Motivation and beliefs about the nature of scientific knowledge within an immersive virtual ecosystems environment," Contemporary Educational Psychology, vol. 39, pp. 112-123, 2014. [27] X. Wei, D. Weng, Y. Liu, and Y. Wang, "Teaching based on augmented reality for a technical creative design course," Computers & Education, vol. 81, pp. 221-234, 2015.
[24] V. Havlíčková, A. Šorgo, and M. Bílek, "Can Virtual Dissection Replace Traditional Hands-on Dissection in School Biology Laboratory Work?," EURASIA Journal of Mathematics, Science and Technology Education, vol. 14, pp. 1415-1429, 2018.
[25] M. Perez-Sanagustin, D. Hernández-Leo, P. Santos, C. D. Kloos, and J. Blat, "Augmenting reality and formality of informal and non-formal settings to enhance blended learning," IEEE Transactions on Learning Technologies, vol. 7, pp. 118-131, 2014.
[26] M. M. da Silva, J. M. X. Teixeira, P. S. Cavalcante, and V. Teichrieb, "Perspectives on how to evaluate augmented reality technology tools for education: a systematic review," Journal of the Brazilian Computer Society, vol. 25, pp. 1-18, 2019.
[27] H. Bursali and R. M. Yilmaz, "Effect of augmented reality applications on secondary school students' reading comprehension and learning permanency," Computers in Human Behavior, vol. 95, pp. 126-135, 2019.
[28] I.-J. Lee, "Using augmented reality to train students to visualize three-dimensional drawings of mortise–tenon joints in furniture carpentry," Interactive Learning Environments, vol. 28, pp. 930-944, 2020.
[29] J. L. Chiu, C. J. DeJaegher, and J. Chao, "The effects of augmented virtual science laboratories on middle school students' understanding of gas properties," Computers & Education, vol. 85, pp. 59-73, 2015.

[30] S.-J. Lu and Y.-C. Liu, "Integrating augmented reality technology to enhance children's learning in marine education," Environmental Education Research, vol. 21, pp. 525-541, 2015.
[31] M.-B. Ibáñez, A. Di-Serio, D. Villarán-Molina, and C. Delgado-Kloos, "Support for augmented reality simulation systems: The effects of scaffolding on learning outcomes and behavior patterns," IEEE Transactions on Learning Technologies, vol. 9, pp. 46- 56, 2015.
[32] R.-C. Chang, L.-Y. Chung, and Y.-M. Huang, "Developing an interactive augmented reality system as a complement to plant education and comparing its effectiveness with video learning," Interactive Learning Environments, vol. 24, pp. 1245-1264, 2016.
[33] A. F. Lai, C. H. Chen, and G. Y. Lee, "An augmented reality-based learning approach to enhancing students' science reading performances from the perspective of the cognitive load theory," British Journal of Educational Technology, vol. 50, pp. 232-247, 2019.
[34] I. Kazanidis, G. Palaigeorgiou, A. Papadopoulou, and A. Tsinakos, "Augmented Interactive Video: Enhancing Video Interactivity for the School Classroom," Journal of Engineering Science & Technology Review, vol. 11, 2018.
[35] E. P. dos Santos Nunes, L. G. Roque, and F. d. L. dos Santos Nunes, "Measuring Knowledge Acquisition in 3D Virtual Learning Environments," IEEE computer graphics and applications, vol. 36, pp. 58-67, 2016.
[36] Y.-M. Huang and P. H. Lin, "Evaluating students' learning achievement and flow experience with tablet PCs based on AR and tangible technology in learning," Library Hi Tech, 2017.
[37] I.-J. Lee, C.-H. Chen, C.-P. Wang, and C.-H. Chung, "Augmented reality plus concept map technique to teach children with ASD to use social cues when meeting and greeting," The Asia-Pacific Education Researcher, vol. 27, pp. 227-243, 2018.
[38] S. Cai, E. Liu, Y. Yang, and J. C. Liang, "Tablet-based AR technology: Impacts on students' conceptions and approaches to learning mathematics according to their self-efficacy," British Journal of Educational Technology, vol. 50, pp. 248-263, 2019.
[39] S. Küçük, R. M. Yýlmaz, and Y. Göktaþ, "Augmented reality for learning English: Achievement, attitude and cognitive load levels of students," Education & Science/Egitim ve Bilim, vol. 39, 2014.
[40] N. T. A. Akin and M. Gokturk, "Comparison of the Theory of Mind Tests on the Paper, 2D Touch Screen and Augmented Reality Environments on the Students With Neurodevelopmental Disorders," IEEE Access, vol. 7, pp. 52390-52404, 2019. [45] C.-Y. Lin, H.-C. Chai, J.-y. Wang, C.-J. Chen, Y.-H. Liu, C.-W. Chen, et al., "Augmented reality in educational activities for children with disabilities," Displays, vol. 42, pp. 51-54, 2016.
[41] J. J. Nagata, J. R. G.-B. Giner, and F. M. Abad, "Virtual heritage of the territory: Design and implementation of educational resources in augmented reality and mobile pedestrian navigation," IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, vol. 11, pp. 41-46, 2016.
[42] E. Solak and R. Cakir, "Investigating the role of augmented reality technology in the language classroom," Online Submission, vol. 18, pp. 1067- 1085, 2016.
[43] T.-C. Hsu, "Learning English with augmented reality: Do learning styles matter?," Computers & Education, vol. 106, pp. 137-149, 2017
[44] H.-C. K. Lin, M.-C. Chen, and C.-K. Chang, "Assessing the effectiveness of learning solid geometry by using an augmented reality-assisted learning system," Interactive Learning Environments, vol. 23, pp. 799-810, 2015.
[45] J. Joo-Nagata, F. M. Abad, J. G.-B. Giner, and F. J. García-Peñalvo, "Augmented reality and pedestrian navigation through its implementation in m-learning and e-learning: Evaluation of an educational program in Chile," Computers & Education, vol. 111, pp. 1-17, 2017.
[46] K. Tian, M. Endo, M. Urata, K. Mouri, and T. Yasuda, "Multi-viewpoint smartphone AR-based learning system for astronomical observation," International Journal of Computer Theory and Engineering, vol. 6, pp. 396-400, 2014.
[47] R. Cakir and O. Korkmaz, "The effectiveness of augmented reality environments on individuals with special education needs," Education and Information Technologies, vol. 24, pp. 1631-1659, 2019.
[48] A. Harncharnchai and T. Saeheaw, "Context-aware learning using augmented reality and WebQuest to improve students' learning outcomes in history," International Journal of Innovation and Learning, vol. 23, pp. 283-303, 2018.
[49] C. Lindner, A. Rienow, and C. Jürgens, "Augmented Reality applications as digital experiments for education–An example in the Earth-Moon System," Acta Astronautica, vol. 161, pp. 66-74, 2019.
[50] G. Mylonas, C. Triantafyllis, and D. Amaxilatis, "An augmented reality prototype for supporting IoT-based educational activities for energy-efficient school buildings," Electronic Notes in Theoretical Computer Science, vol. 343, pp. 89-101, 2019.
[51] N. F. Saidin, N. Halim, and N. Yahaya, "A review of research on augmented reality in education: Advantages and applications," International education studies, vol. 8, pp. 1-8, 2015.
[52] H. Tobar-Muñoz, S. Baldiris, and R. Fabregat, "Augmented reality game-based learning: Enriching students' experience during reading comprehension activities," Journal of Educational Computing Research, vol. 55, pp. 901-936, 2017.
[53] T. H. Chiang, S. J. Yang, and G.-J. Hwang, "Students' online interactive patterns in augmented reality-based inquiry activities," Computers & Education, vol. 78, pp. 97-108, 2014.
[54] C. Erbas and V. Demirer, "The effects of augmented reality on students' academic achievement and motivation in a biology course," Journal of Computer Assisted Learning, vol. 35, pp. 450-458, 2019.
[55] E. A. Kyza and Y. Georgiou, "Scaffolding augmented reality inquiry learning: The design and investigation of the TraceReaders location-based, augmented reality platform," Interactive Learning Environments, vol. 27, pp. 211-225, 2019.
[56] Z. A. Yilmaz and V. Batdi, "A meta-analytic and thematic comparative analysis of the integration of augmented reality applications into education," Egitim Ve Bilim, vol. 41, 2016.
[57] P. J. Ponners and Y. Piller, "Investigating the impact of augmented reality on elementary students' mental model of scientists," TechTrends, vol. 63, pp. 33-40, 2019.
[58] H. Tekedere and H. Göke, "Examining the effectiveness of augmented reality applications in education: A meta-analysis," International Journal of Environmental and Science Education, vol. 11, pp. 9469-9481, 2016
[59] H. Altinpulluk, "Determining the trends of using augmented reality in education between 2006-2016," Education and Information Technologies, vol. 24, pp. 1089-1114, 2019.
[60] https://program-ace.com/blog/augmented-reality-in-education.
[61] https://dzone.com/articles/augmented-reality-in-education.
[62] https://online.maryville.edu/blog/augmented-reality-in-education.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)