Virtual Reality in Education

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1 BACKGROUND

Virtual Reality (VR) technology has undergone significant advancements over time, becoming more compact in design while simultaneously enhancing its capabilities and performance. While VR has firmly established its popularity in the realm of gaming, it is also garnering increasing attention in education, training, and healthcare. This growing interest is fueled by the immersive experiences it offers, the strong sense of being fully present in virtual environments, and the sensation of disconnecting from the physical world (Wirth, 2007).

For this assignment, after conducting an extensive search across various topics, I have discovered that the significant role of virtual reality holds immense relevance within our education system. It is imperative that we delve into the insights gained from the developments in this field and identify the gaps that require bridging within our education technology by leveraging this innovative system.

2 PAPERS

In this section, we will present and thoroughly discuss fifteen scientific papers centered on the subject of "**virtual reality within the realm of educational technology**". All fifteen papers were found via Google Scholar Search.

2.1 Summary of Papers

1. (Zarzuela, 2013)

The authors employed virtual reality for educational tourism purposes by transforming the city of Valladolid in Spain into an engaging serious game. This innovative approach served as both an entertainment tool and an educational medium, facilitating the exploration and learning of various facets of the city, including its rich history, geographical features, and sporting culture.

The developed system offers a versatile new service for the city's Office of Information and Tourism. It provides a user-friendly experience suitable for individuals of all ages, regardless of their familiarity with technology. Moreover, its cost-effective hardware requirements enable installation in private homes, enabling remote learning without the need for physical travel. This Serious Game

is adaptable through XML file modifications, allowing customization of content and question complexity based on the user's profile, making it suitable for various audiences and learning levels.

2. (Budi, 2021)

This research reviews how virtual reality has been used in learning studies and its potential. It finds that virtual reality, particularly in physics learning, has been closely examined in terms of student perception, focusing on self-confidence, experience, satisfaction, motivation, and engagement. Recent trends show a growing use of virtual reality, with the HTC Vive being the preferred tool for such studies. They will focus on these three aspects: the potential of utilizing VR to assist educators, emerging patterns in VR adoption, and the equipment employed for VR-based learning.

The findings indicate that future research on VR simulations in physics will likely prioritize interactive laboratory activities. Post-perception is the most common evaluation process for performance measurement when using VR. Interactive VR such as HTC Vive is the most popular tool for learning physics.

3. (Liu, 2019)

This paper underscores the value of VR technology in distance higher education, introduces the components of a VR-based education system, and suggests five modes for its implementation, such as independent exploration, simulated experiments, remote open learning, virtual group discussions, and distance education platforms.

Virtual reality has seen significant advancements within higher education, and it is anticipated that in the future, education and teaching will benefit from models like virtual laboratories, virtual classrooms, and virtual training environments, breathing new life into higher education development. Nevertheless, implementing virtual reality in higher education is a multi-stage journey that demands sustained experimentation and practical application. In particular, critical technologies like dynamic environment modeling, three-dimensional graphics generation, and system integration still require further enhancement.

4. (Soliman, 2021)

This paper contends that virtual reality (VR) is a valuable tool in engineering education, supported by extensive research. VR offers cognitive and pedagogical benefits, enhancing students' understanding, performance, and grades, while also reducing costs and providing an equitable educational experience, especially for students with special needs and those in distance learning.

Integrating constructivist and variation learning theories into VR applications for engineering education is a novel approach that promises pedagogical benefits. VR surpasses traditional simulations by providing greater immersion and spatial presence for students. However, it's most effective when used alongside traditional and electronic learning methods, as discussed in the literature.

This paper also discusses the potential drawbacks of using Virtual Reality (VR) in education, including user discomfort and distractions. Some users reported dizziness, eye strain, and other physical discomforts while using VR, and distractions from the learning task were common issues. However, there are strategies to mitigate these drawbacks, such as simplifying the virtual environment and careful design aligned with educational objectives. Various VR development platforms and software tools are used for creating VR applications in education, but the process is described as time-consuming and requiring expertise in software and coding.

It emphasizes the need for careful design aligned with educational goals and learning theories to maximize student learning experiences. Continuous improvement through student feedback and collaboration with dedicated VR experts is essential for successful implementation. However, the availability of such resources may pose challenges for universities and instructors, potentially increasing their responsibilities in VR integration.

5. (Abulrub, 2011)

This paper showcases the utilization of a 3D interactive virtual reality visualization system to equip engineering graduates for real-world industrial experiences. It incorporates case studies from leading global businesses.

The authors illustrate, using practical real-life examples, how this innovative technology can be utilized to create engaging educational content and immersive learning environments for engineering. The technology chosen for research and education aligns with the expectations of today's modern students. While cost is acknowledged as a significant hurdle, many prestigious educational institutions have already integrated this technology into their research and education efforts. As technology continues to progress, it is anticipated that more institutions will adopt the hardware and software required for virtual reality to play a central role in the future of engineering education, with affordability improving over time.

6. (Abdelaziz, 2014)

This paper addresses and examines the difficulties and obstacles linked to the integration of a virtual reality-powered e-learning platform. It explores the educational applications of an e-learning environment coupled with VR technology.

The paper addresses challenges faced by educators in Higher Education when using virtual worlds for teaching. It emphasizes the need to develop pedagogical approaches that integrate synthetic experiences into the educational context. Some of the specific challenges discussed include orientation and navigation difficulties for first-time users, the selection of appropriate teaching activities, accessibility concerns for individuals with disabilities, the promotion of active student participation, dynamic teaching and learning processes, transitioning from static to dynamic content delivery, and the use of virtual simulations for effective learning.

7. (Hashemipour, 2009)

This article introduces the Virtual Learning System (VLS), a user-friendly modular interactive teaching tool suitable for individuals with limited computer expertise. VLS offers an adaptable and engaging environment designed for integration into Mechanical and Manufacturing Engineering courses. The evaluation of this system's effectiveness in the learning process involved the use of laboratory

reports, lab quizzes, and questionnaires, all facilitated by a tutorial monitoring application.

VLS establishes a flexible, accessible, and cohesive learning environment that supports continuous skill and capability development. Over a decade of experience with the VLS has shown that students genuinely grasp and value its practical benefits. Additionally, the techniques and tools developed for this package can serve as blueprints for future module development and reference.

8. (Lege, 2020)

In this article, the evolution of virtual reality (VR) in educational research and classroom application is examined by addressing two fundamental inquiries: (1) What advantages does VR bring to education?, (2) What obstacles exist when integrating VR into educational settings?

This article explores the advantages and obstacles associated with integrating virtual reality (VR) into education. VR in education offers benefits such as enhanced engagement, accessibility to otherwise inaccessible environments, improved spatial memory retention, empathy development, and expanded possibilities for distance learning. However, challenges include the absence of a well-defined VR-specific pedagogy, the cognitive demands VR places on learners, the need for maintaining immersion, addressing the technology's novelty factor, and considering gender-related issues when introducing VR in educational settings. Addressing these challenges is crucial to harnessing the full potential of VR for effective and engaging education.

9. (Freina, 2015)

This paper presents a survey of recent scientific literature (2013-2014) regarding the utilization of Immersive Virtual Reality (VR) in education. The survey highlights that VR, especially immersive VR, has primarily been employed for adult training in specific contexts and university-level education. The paper delves into the potential benefits and limitations of implementing VR in education, particularly for children and individuals with cognitive disabilities, with a specific focus on Down syndrome.

This literature review delves into the use of Immersive Virtual Reality (VR) and Head-Mounted Displays (HMDs) in education. Immersive VR offers educational advantages such as direct experiential learning, safety in training, and enhanced learner engagement through gamification. However, most research has centered on higher education and adult training, with limited focus on younger children and individuals with disabilities.

For children under 10, there's a lack of experimental data, and caution is advised due to potential developmental impacts. Middle school students may benefit from VR's ability to explore inaccessible objects, but teacher supervision is crucial, and usage should be limited. Extensive studies comparing immersive VR to traditional learning approaches for transfer are needed.

Immersive VR holds promise for those with cognitive impairments, aiding learning transfer. However, comprehensive studies comparing immersive VR to traditional methods are lacking and should be conducted to confirm these benefits.

10. (Kaminska, 2019)

In this paper, new opportunities in VR are presented, and the most intriguing recent applications of virtual reality in education are brought together, covering various educational domains such as general, engineering, and health-related education. Additionally, methods for creating scenarios and different approaches for testing and validation are included in this survey.

The education system has continuously evolved, adapting to available technology and student needs. With the advent of Generation Z, who are digital natives, educators face a unique challenge. VR technology offers several benefits, including immersive visualization, inclusivity, unlimited access to information, increased engagement, and efficient blended learning. However, its rigid nature can limit flexibility and hinder teacher-student interaction. Striking a balance between modern technology and human interaction is crucial to ensure the development of both hard and soft skills in students, maintaining a mentorship approach alongside digital solutions in education.

11. (Izard, 2018)

This article examines two distinct applications of Virtual Reality (VR) in the field of medicine. Firstly, it explores an interactive VR simulator designed for scoliosis surgery, enabling users to perform surgical steps virtually. The article delves into the benefits of this system and the technologies employed in its development. Secondly, it discusses the utilization of spherical or 360-degree recordings to develop educational systems emphasizing hands-on learning through practical visual experiences.

This technology management enhances students' knowledge and practical skills, fostering teacher innovation and elevating academic quality. In the future, it may enable live viewing of surgical procedures and support remote operations. While this virtual simulator represents an initial step toward more intricate surgical simulations, it stands as an excellent example of how interactive Virtual Reality simulations can aid medical professionals in comprehending surgical processes, practicing in a virtual environment, and familiarizing themselves with various surgical tools. The system proves valuable for learning about surgical tools and procedure steps, offering the advantage of unlimited practice, in contrast to limited real-patient experiences, facilitating the automation of surgical steps and the retention of essential points for each procedure.

12. (Kesim, 2012)

This research serves a twofold purpose. Firstly, it offers a definition of augmented reality (AR), delineating this emerging artificial and enhanced environment. It outlines the attributes of augmented reality systems and categorizes the technologies employed within this framework. Secondly, it explores the potential of augmented reality in the realm of education within this defined context.

Augmented reality (AR) has the potential to transform computer usage, especially in education. AR interfaces seamlessly blend the real and virtual worlds, allowing learners to interact naturally with 3D information and objects. However, harnessing AR's potential in education requires collaboration between specialists, including instructional designers, engineers, and researchers, to create engaging learning experiences. This interdisciplinary approach is essential to develop AR applications and content effectively.

13. (Nersesian, 2019)

The study was carried out in four high school chemistry classes, chosen due to the suitability of chemistry education for visually enhanced explanations of abstract concepts. This choice created a robust testing environment for both current and extended reality (ET) technologies. The primary objective of this research project is to assess whether ETs hold the potential for engaging high school students in STEM classes.

This study compares MB and VR educational technologies to traditional methods in teaching chemistry. It explores their potential for enhancing comprehension and retention of abstract concepts. The research aims to understand the classroom's problem space better and serves as a foundation to assess the engagement of high school students in STEM classes through technology. Despite various classroom variables, we observed changes in students' academic performance, emphasizing the importance of isolating factors in future experiments for educational research.

14. (Gorman, 2021)

This article describes the creation and evaluation of a Virtual Reality (VR) Classroom designed for delivering a food-related lesson to middle school students in a New Zealand school. Traditional kitchens in schools can be expensive and pose safety challenges for teaching practical cooking skills. Prioritizing student engagement and motivation, the study gathered data through student observations within the virtual classroom and a post-test survey.

The VR Classroom developed for teaching food safety messages received a highly positive response, indicating its potential to motivate students. Participants expressed a strong desire to use the system again and suggested the integration of similar technology in other subjects, underlining its engagement potential.

In the context of global lockdowns and remote learning, VR holds promise in supporting education and transforming the way it's delivered. Virtual classrooms can provide an engaging alternative for students learning from home, and in traditional classrooms, VR can offer quality virtual lessons, allowing teachers to cater to individual learning needs more effectively. The accessibility of 360-degree

content creation and distribution, coupled with VR's capacity to engage learners, should encourage educators to embrace this technology and bring VR education to fruition.

The study raises questions about whether the high motivation observed in the VR Classroom is primarily due to its novelty. To investigate this, a study similar to Wang (2015) could be conducted, comparing two sample groups exposed to the VR Classroom in different frequencies to assess motivation sustainability. Additionally, future research could collect data from the in-VR multi-choice quiz and compare it with data from the control group. The VR Classroom has potential to reduce classroom distractions, but adding virtual characters and exploring their impact on user focus and learning is an area for further investigation. Moreover, the VR Classroom can support inclusive education by allowing flexible attendance, providing a quieter learning environment, helping students with autism adapt to new spaces, and facilitating remote learning during school closures.

15. (Radianti, 2021)

In this study, established design principles from VR research in higher education were employed to assess available VR apps. These apps were gathered from online platforms to provide an up-to-date market snapshot. The analysis involved categorizing these apps based on design features and educational content. The objectives included identifying available app types, exploring any gaps in offerings, comparing existing literature with the educational VR app market, and scrutinizing frequently used design elements for educational VR.

While some VR apps aim to replace teachers with virtual agents, their effectiveness remains uncertain. Future research should explore the extent to which teachers can be replaced in VR-based teaching and seamlessly integrate VR into the curriculum, with case studies assessing design element utility in supporting research content.

An in-depth analysis of the VR app market was conducted, expanding upon Radianti et al.'s design element framework. The investigation focused on popular

VR app stores like Google Play, Steam, and Vive, with an emphasis on design elements and learning content. Biology/Zoology, Astronomy, and Engineering were found to be the top three application domains. However, it was revealed that HMD VR apps span across 27 application domains, indicating a growing trend in VR adoption for educational purposes. While some findings align with existing literature, a gap exists between scientific research on VR for education and the actual offerings in app markets.

2 SYNTHESIS

Here's some cool stuff about using VR (virtual reality) and AR (augmented reality) in schools and other places:

Tourist Learning: Zarzuela (2013) showed how VR helps tourists learn better about places. It's a cheap way to learn from far away.

Physics: Budi (2021) says VR is cool for learning physics. Students like the HTC Vive tool.

College: Liu (2019) and Radianti (2021) talk about using VR in colleges. VR helps with online learning.

Engineering: Soliman (2021) says VR helps engineering students. It's cheaper and helps them understand better.

Problems: Abdelaziz (2014) and Hashemipour (2009) talk about the challenges of using VR and AR. There are some issues to solve.

Tools: Izard (2018) talks about fun VR tools for engineering students.

Helping Everyone: Some studies say VR can help students with disabilities.

Creating Lessons: Kaminska (2019) talks about making VR lessons that mix tech with real people.

Medicine: Izard (2018) shows how VR can help doctors learn.

Schools: Gorman (2021) says a VR classroom taught kids about food safety. VR can help especially when schools are closed.

All these studies show that VR and AR can change the way we learn. But there are things to fix, like training teachers and making lessons. We need more studies to see how VR really helps in the long run. As tech gets better, VR and AR will change schools a lot.

3 REFLECTION

The process of finding sources, reading academic papers, synthesizing their contents, and building my understanding has been both challenging and rewarding. It required a structured approach, critical thinking, and a willingness to delve deep into various domains of educational technology. Here's a reflection on the different aspects of this process:

I've been reading and understanding papers about using VR and AR in education. It's been hard but also fun. Here's what I found:

Hard Parts:

Different Topics: The papers talked about many things, like using VR in travel, engineering, or medicine. Each time, I had to learn new words and ideas.

Big Words: There were many technical words about VR, AR, and teaching. I had to look them up.

Deep Details: Some papers had lots of details. It was hard if I didn't know about it already.

Fun Parts:

I Learned a Lot: I learned new things about tech in education.

Connecting Ideas: I found similar ideas in different papers. It's interesting to see how VR and AR are used in teaching.

New Trends: I saw new things like using HTC Vive or thinking about how to mix tech with talking to people.

Next Steps:

New Teaching Ways: I want to see how VR and AR can change how we teach.

For Everyone: I want to make sure everyone, even people with disabilities, can use these tools.

Checking Results: I want to see if VR and AR really help students learn better.

Mixing Tech with People: It's important to use tech but also talk to people. I want to find the best way to do that.

3 PLANNING

Next week, I plan to continue my exploration of the literature on virtual reality (VR) and augmented reality (AR) in education, building on the foundation I've established this week. Here's my plan for the upcoming week:

I will start by categorizing the papers I find into thematic groups to identify common trends and areas of interest. This will help me structure my research log effectively.

I will aim to delve deeper into specific educational domains where VR and AR are making a significant impact. This includes areas like medical education, engineering, and distance learning. I'll look for recent papers that provide insights into the latest developments and challenges in these domains.

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Activity

Paper

Hashemipour, M., Manesh, H. F., & Bal, M. (2011). A modular virtual reality system for engineering laboratory education. Computer Applications in Engineering Education, 19(2), 305-314.

Need

There is a need for People with limited computer skills require a user-friendly teaching tool called the Virtual Learning System (VLS).

Method

The authors developed a VLS which can be used for courses of many different engineering disciplines. It is composed of modules which uses VR-based simulations. Assessment was also performed for this study.

Audience

The audience this study was undergraduate and graduate students of mechanical engineering at Eastern Mediterranean University.

Results

The Mechanical Engineering Department at EMU has effectively utilized the VLS, a VR-based system, for the education and training of their undergraduate courses with average score of 4 out 5.

Critique

The usability evaluation they employed aimed for a score between 40-60, which appears low. Furthermore, they did not reference any claims comparing it to most commercial software products.

Paper

Abdelhameed, W. A. (2013). Virtual Reality Use in Architectural Design Studios: A case of studying structure and construction. Procedia Computer Science, 25, 220-230.

Need

There is a need to integrate and apply micro-simulation functions, using XML algorithms developed by the researcher, within the VR Studio program for use in architectural design studios.

Method

Observing the design changes students make while using VR, and having them document their reasons for such alterations. Once documented, these modifications were systematically analyzed.

Audience

The audience this study was students at University of Bahrain.

Results

From students' textual feedback, it is evident that utilizing Virtual Reality in design presents distinct advantages. Throughout their discussions and presentations in the studio, students underscored specific benefits of incorporating VR. Notably, there was an enhanced understanding and heightened awareness of the structural system and its components during their design exercises.

Critique

I found this survey weak as the number of students responding to the survey was not equal in each part and there was not any statistic performed on the analysis to lead to a solid conclusion.

Paper

Zarzuela, M. M., Pernas, F. J. D., Calzón, S. M., Ortega, D. G., & Rodríguez, M. A. (2013). Educational tourism through a virtual reality platform. Procedia Computer Science, 25, 382-388.

Need

There is a need for an increased number of serious games specifically tailored for the tourism sector, as the current number of such games is notably low.

Method

Design and programming using Unity 3D software and finally testing using a survey of 100 questions.

Audience

The audience this study was a group of 10 people from school of telecommunications engineering.

Results

The outcomes were quite pleasing, with these questions receiving correct answers in a range of 90-100% across all participants.

Critique

I found this survey weak as the number of students responding to the survey was only 10 and the graphical representation of the Unity model was not advanced.

Paper

Nersesian, E., Spryszynski, A., & Lee, M. J. (2019, March). Integration of virtual reality in secondary STEM education. In 2019 IEEE Integrated STEM Education Conference (ISEC) (pp. 83-90). IEEE.

Need

There is a need to determine the efficacy and potential of next-generation educational technologies, such as monitor-based (MB) and virtual reality (VR) applications, in enhancing STEM education, particularly in high school chemistry classes.

Method

The study compared MB and VR educational tools with traditional teaching methods, like textbooks and hands-on lab work, to assess their effectiveness in enhancing understanding and engagement in chemistry topics.

Audience

The audience this study was a group of 1208 students from Dwyer Technical Academy.

Results

The analysis showed significant differences when comparing students' learning assessment by VR compared to control.

Critique

They should have removed the observants from the experiment. That may have adverse effect on students performance during exam. Time is another problem for data collection of 1208 participants.

Paper

Gorman, D., Hoermann, S., Lindeman, R. W., & Shahri, B. (2022). Using virtual reality to enhance food technology education. International Journal of Technology and Design Education, 32(3), 1659-1677.

Need

There is a need for VR learning classeses for food-based education due to the cost, lack of enough cooking facilities, and teacher shortage in New Zealand.

Method

The study used VR classrooms to provide food-based education. Then they used survey to test their method.

Audience

The audience this study was a group of 12 students.

Results

10 out of 12 students showed that VR classrooms are better than the traditional one.

Critique

The number of participants is low and apparently the environment of the class was noisy as some of the students spoke during the class which may distract other participants.