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Augmented Reality: Interaction of students with Avatars

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ABSTRACT

This paper delves into the educational applications of augmented reality (AR) within the realm of training. The study scrutinizes various scenarios utilizing AR technology. Numerous instances are outlined, particularly in higher education and simulation contexts, showcasing how AR can enrich and stimulate students' comprehension of specific subjects. It is demonstrated that through interaction with virtual environments, such as avatars or objects, students can expedite their learning process. AR furnishes students with an interactive platform, fostering engagement and facilitating learning across diverse thematic settings. Educators recognize that integrating avatars or objects into instructional content enhances learning outcomes. Indeed, several studies underscore AR's positive impact on classroom learning, including improvements in student motivation and teacher facilitation. This paper reviews some of the pertinent research in this field.

Keywords: educational applications, augmented reality, virtual environments, high education, learning, avatars

1. Introduction

Augmented reality (AR) is a technical field that employs computing and behavioral interfaces to replicate the behavior of three-dimensional entities within a virtual environment [1]. It may be beneficial to clarify the concept of "augmented reality." A virtual environment is described as a "computer-generated three-dimensional simulation of a real or imagined environment" [2]. Within these environments, students can engage with "avatars," allowing for direct responses based on their interactions within the virtual space [3]. AR offers numerous advantages for engaging students, enhancing motivation, and facilitating comprehension of complex concepts, particularly those traditionally challenging to convey through conventional instructional methods.

1.1. Augmented Reality Environments in Education

Integration of Augmented Reality in the Classroom:

To establish an augmented reality system in a classroom setting, essential components include a computer, webcam, and projector. The instructor utilizes avatars and virtual objects to support their explanations and engage with students. The necessary markers for interacting with augmented information are incorporated into textbooks or students' class notes, enabling visualization. Students can access this information either via a personal computer or through a developed AR application.

This setup not only enhances environmental control but also facilitates social interactions and individual personalities. Such features can significantly boost the self-esteem of students facing challenges in traditional classroom learning [4]. Augmented reality offers remarkable flexibility, allowing for the establishment of educational norms to streamline communication among users. Research in this domain underscores the efficacy of virtual objects, or "avatars," in facilitating experiential learning across various subjects such as physics, chemistry, and mathematics, as well as enhancing interpersonal communication, often surpassing face-to-face interactions in realism [5].

Students can assume significant roles within virtual environments created by augmented reality, replicating practical exercises, laboratory work, or guided activities [6]. Notably, interaction in augmented reality circumvents the need for intense direct relational engagement between students and others. This system also holds promise for heightening emotional experiences and the recognition of emotional expressions [7]. Furthermore, leveraging the educational potential of this technology allows students to engage with objects such as human skeletal models, as illustrated in (Figure 1).

It is also intriguing to replicate real-life scenarios, such as incorporating a sports scene (Figure 02), to enhance students' proficiency in athletic movements and skills, thereby preparing them for real-world events [8]. By allowing the teacher to select both real and modeled activities, augmented reality can simulate authentic environments, including real buildings and situations from students' immediate surroundings. This aspect aligns with the earlier discussion on the significance of personalizing models [9].

Augmented Reality in Laboratory Settings:

Limited physical space and financial constraints may pose challenges in laboratories where practical exercises are conducted, potentially affecting the availability of necessary computer equipment. To address this, markers and handheld devices such as smartphones or tablet PCs are utilized in virtual machinery laboratories, enabling students to interact and engage in training activities [10]. Additionally, markers strategically placed throughout the laboratory can guide students in performing maintenance tasks, setup procedures, and learning usage protocols for various machines.

Augmented Reality in Workplaces:

Augmented reality facilitates the integration of additional information into real-world workspaces [11]. While there are relatively few contributions focusing on the application of augmented reality technology in machine assembly, notable advancements have been made in fields like aerospace and healthcare, where applications support maintenance procedures

[12]. For instance, mechanics equipped with AR glasses receive step-by-step repair instructions and are guided to the required tools (Figure.03), enhancing diagnostic skills and facilitating training for specific tasks. Keith conducted a pilot study demonstrating the effectiveness of augmented reality in such environments, with the primary objective being the enhancement of student learning outcomes [13].

2. Problem of the subject

One problem I proposed regarding learning through augmented reality is the potential for distraction. While augmented reality (AR) offers immersive and interactive learning experiences, it also introduces the risk of diverting learners' attention away from the educational content. With the overlay of digital information onto the real world, there's a fine line between enhancing learning and overwhelming learners with irrelevant or excessive stimuli. Balancing engagement and focus is crucial for effective AR-based learning experiences.



Figure 01: learning through augmented reality: skeleton of a human being.



Figure 02: Learning through augmented reality: sporting gestures for students.



Figure 03: mechanical example.

3. Methodology

The study will employ a mixed-methods approach, including literature review, surveys, interviews, and case studies. Data will be collected from educators, students, and educational technology experts to gain insights into the current state of AR integration in education and identify key challenges and opportunities. Based on the findings, recommendations and guidelines will be developed to support educators in overcoming barriers to AR adoption and integration.

A. Object Modeling and Interactive Training

Craft training, practical exercises, and puzzle-solving activities are instrumental in deepening understanding within each lesson. Augmented reality (AR) applications tailored for medical students offer an innovative approach to learning human anatomy, allowing for immersive exploration. Fundamentally, augmented reality entails interactive engagement with three-dimensional models, enabling users to manipulate features such as rotation, transparency, color schemes, and styles. Moreover, advanced animation techniques can be employed through specialized devices like holographic lenses, surpassing the capabilities of conventional smartphones [14].

In many instances, theoretical knowledge alone is insufficient for mastering specialized skills. Students should not merely act as passive recipients of information; active participation is essential. Engineering students, in particular, require practical experience and exposure to real-world scenarios within their field. Unlike virtual reality, augmented reality's interactive features facilitate a blend of digital modeling, simulation, and experiential learning [15].

It comes as no surprise that actively engaged students tend to grasp subjects more thoroughly and learn at a faster pace (Figure 04).

B. Learning in Augmented Reality Across All Ages

Despite challenges, augmented reality possesses the potential to revolutionize the education landscape, primarily due to its adaptability across various contexts and age groups.

- In primary and secondary education, AR applications enrich classroom experiences, facilitating interactive exploration of complex subjects like mathematics and physics. They also serve as a catalyst for fostering creativity among younger learners.

- In higher education, augmented reality solutions gain traction in universities, enhancing engagement and efficacy across disciplines such as humanities, technical sciences, and medicine, where AR facilitates the learning of anatomy.
- Amid the shift towards digital education prompted by the pandemic, augmented reality apps emerge as convenient platforms for sharing educational materials and promoting real-time collaboration, potentially transforming the traditional role of teachers.
- In vocational training, AR learning streamlines skill acquisition for junior profiles and individuals undergoing retraining, offering safe and immersive experiences with new equipment and practical understanding of work environments. Studies demonstrate significant productivity gains in industries like General Electric (GE) and GE Healthcare following AR-assisted training.

Augmented Reality Training Use Cases

Augmented reality finds application across various educational stages and fields, from astronomy to history, unlocking new dimensions for both educators and students.

Anatomy

Anatomy education benefits immensely from augmented reality, providing a nuanced understanding of complex anatomical systems. Apps like Complete Anatomy offer comprehensive 3D visualization of body structures, aiding in the mastery of technical skills and enhancing comprehension in industrial contexts.

Preparing Students and Teachers for Augmented Reality Learning

Augmented reality significantly impacts student engagement, performance, and confidence, rivaling other educational technologies. However, its implementation in classrooms or remote learning platforms necessitates adequate preparation. Teachers must familiarize themselves with the technology and adapt their teaching methodologies, while students require time to explore the myriad possibilities offered by augmented reality autonomously.

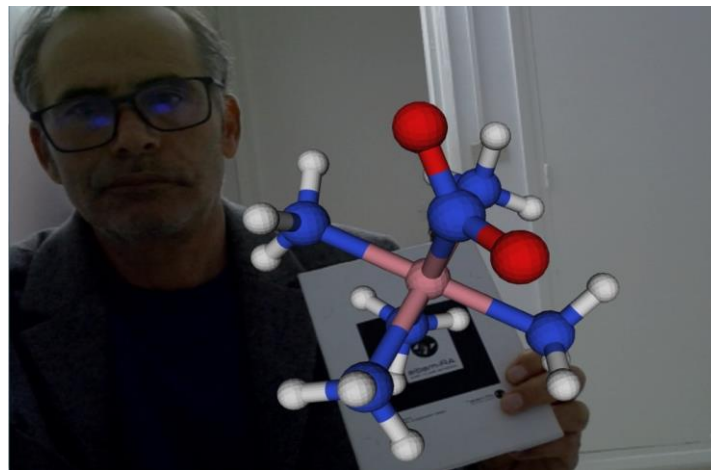


Fig. 04: Interactive Training

4. Discussion

Augmented reality (AR) holds significant promise in revolutionizing education by leveraging its ability to provide immersive and interactive learning experiences. By overlaying digital content onto the real world, AR enhances understanding and engagement for both teachers and students in the classroom setting.

One of the primary advantages of augmented reality in education lies in its capacity to present vast amounts of educational data and information in a visually compelling manner. Complex concepts that were previously challenging to grasp through traditional methods can now be presented in three-dimensional models, animations, and interactive simulations. This visual richness not only captures students' attention but also facilitates comprehension by presenting information in a more intuitive and memorable format.

Moreover, AR facilitates real-time interaction and immersion, allowing students to engage with educational content in ways that were previously unimaginable. Through AR-enabled devices such as smartphones, tablets, or wearable technology, students can explore virtual objects and environments as if they were physically present. This real-time interaction creates a sense of immediacy and tangibility, enabling students to gain a pre-realistic understanding of the modeled objects in 3D.

For teachers, augmented reality offers powerful tools for enhancing instructional delivery and student engagement. By integrating AR applications into lesson plans, teachers can create dynamic and interactive learning experiences that cater to diverse learning styles and preferences. For example, instead of relying solely on textbooks or lectures to explain complex scientific concepts, teachers can use AR to visualize abstract concepts such as molecular structures or astronomical phenomena, allowing students to manipulate and explore these concepts in real time.

Furthermore, augmented reality promotes active learning by encouraging students to take an active role in their education. Rather than passively consuming information, students become active participants in the learning process, experimenting, and problem-solving within the AR environment. This hands-on approach fosters critical thinking, creativity, and collaboration skills, which are essential for success in the 21st-century workforce.

In conclusion, augmented reality has the potential to transform education by providing immersive, interactive, and engaging learning experiences. By harnessing the power of AR technology, teachers can unlock new opportunities for student learning, comprehension, and engagement, paving the way for a more dynamic and effective educational experience.

5. Results

The study is expected to generate actionable insights and recommendations for educators, educational institutions, policymakers, and technology developers. By addressing the identified challenges and barriers, we aim to promote the widespread adoption and effective integration of augmented reality technology in education, ultimately enhancing teaching and learning experiences for all stakeholders involved.

AR can captivate learners by providing interactive and immersive experiences, making learning more engaging and

enjoyable. By overlaying digital content onto the real world, AR brings abstract concepts to life, making them easier to understand and remember, and Improved Retention: Studies suggest that AR enhances retention rates compared to traditional learning methods. By associating information with real-world contexts and experiences, AR helps learners retain knowledge more effectively.

AR allows for personalized learning experiences tailored to individual preferences and learning styles. Learners can interact with content at their own pace and receive real-time feedback, fostering a more adaptive and effective learning process.

the AR enables hands-on learning experiences without the need for physical materials or equipment. Learners can manipulate virtual objects and conduct experiments in a safe and controlled environment, facilitating experiential learning.

and a good Collaborative Learning: AR fosters collaboration among learners by enabling shared experiences and interactions. Collaborative AR applications allow learners to collaborate on projects, solve problems together, and share their insights and discoveries in real time.

Good Accessibility: AR has the potential to make learning more accessible to diverse learners, including those with disabilities or special educational needs. By providing alternative modes of interaction and representation, AR can accommodate different learning preferences and abilities.

AR bridges the gap between classroom learning and real-world application by simulating authentic scenarios and environments. Learners can practice skills in simulated contexts, preparing them for real-world challenges and opportunities.

Challenges and Limitations: Despite its potential benefits, AR also presents challenges and limitations, such as technical constraints, cost implications, and concerns about privacy and data security. Additionally, integrating AR into educational settings requires careful planning, training, and support for educators.

Future Directions: The future of learning and teaching through AR holds promise for continued innovation and development. Advancements in AR technology, coupled with ongoing research and collaboration, are expected to further enhance the effectiveness and accessibility of AR-based learning experiences.

Overall, learning and teaching through augmented reality offer exciting opportunities to transform education by making it more engaging, interactive, and effective. However, realizing the full potential of AR in education requires addressing challenges and leveraging its capabilities to create meaningful learning experiences for learners of all ages and backgrounds.

6. Conclusion

In conclusion, the integration of augmented reality (AR) into learning and teaching practices holds immense potential to revolutionize education in the digital age. By bridging the gap between the virtual and physical worlds, AR technology offers unprecedented opportunities for immersive, interactive, and personalized learning experiences. Through AR-enhanced activities, students can engage with educational content in ways that transcend traditional methods, allowing for hands-on exploration, experimentation, and problem-solving. Visualizing abstract concepts in three-dimensional space fosters deeper understanding and retention, while real-time interaction promotes active engagement and critical thinking skills.

For educators, AR presents new avenues for delivering dynamic and engaging instruction, catering to diverse learning styles and preferences. By leveraging AR tools and platforms, teachers can create customized learning experiences that resonate with students, inspiring curiosity and sparking creativity. Furthermore, AR facilitates collaborative learning environments, enabling students to work together on projects and activities in real time, regardless of physical location. This promotes peer-to-peer interaction, communication, and teamwork, essential skills for success in the modern workforce. However, the effective integration of AR into education requires concerted efforts from educators, policymakers, technology developers, and other stakeholders. Investments in infrastructure, professional development, and content creation are needed to ensure equitable access to AR technology and resources for all learners.

In conclusion, augmented reality has the potential to transform learning and teaching practices, making education more engaging, accessible, and effective for learners of all ages. By embracing AR as a tool for innovation and exploration, we can unlock new possibilities for the future of education, empowering students to thrive in an increasingly complex and interconnected world.

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