International Journal of Pedagogics

VOLUME Vol.05 Issue02 2025
PAGE NO. 161-163
DOI 10.37547/ijp/Volume05Issue02-43

Training using virtual and augmented reality

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Received: 21 December 2024; **Accepted:** 23 January 2025; **Published:** 25 February 2025

Abstract: In the context of the rapid development of technologies and the digitalization of society, education faces new challenges. Traditional teaching methods often struggle to engage students and explain complex concepts. Virtual Reality (VR) and Augmented Reality (AR) represent innovative approaches that can significantly enhance the educational process. These technologies allow for the creation of interactive and engaging learning materials that promote a deeper understanding of the subject. In particular, in the field of informatics, where abstract concepts can be difficult to grasp, VR and AR open new horizons for learning.

Keywords: Virtual reality, augmented reality, education, informatics, learning technologies, interactive learning, visualization, pedagogical technologies, digitalization.

Introduction: Brief Introduction to Technologies

Virtual Reality (VR) is a technology that creates a fully digital environment in which users can interact with three-dimensional objects and spaces. VR allows users to immerse themselves in alternative worlds, making learning more engaging. Augmented Reality (AR), on the other hand, overlays digital elements onto the real world, allowing users to interact with them in the context of their surroundings. AR can be used through mobile devices or specialized glasses, making it more accessible to a wider audience.

Development and Application in Education

Since the early 2010s, VR and AR have been actively introduced into educational institutions. The emergence of affordable devices, such as VR headsets (e.g., Oculus Rift, HTC Vive) and mobile AR applications (e.g., Google ARCore, Apple ARKit), has made these technologies more widespread. In the educational environment, VR and AR are used to create interactive learning materials, simulations, and virtual laboratories. For example, students can conduct virtual experiments in chemistry or physics, allowing them to safely explore complex processes.

Advantages of Using VR and AR

1. Enhanced Visualization: Complex concepts, such as algorithms and data structures, become more understandable through visual representations. For

example, students can see how a sorting algorithm works by observing the movement of objects in three-dimensional space.

2. Interactivity: Students can interact with the material, which promotes better information retention. In a VR environment, they can manipulate objects, making the learning process more active.

3. Safe Practice Environment: VR allows for simulations that may be dangerous or difficult to conduct in real life. For instance, students can learn about networking or cybersecurity without risking real systems.

4. Increased Engagement: Game elements and interactive tasks make learning more engaging. Students using VR and AR often show more interest in the subject and participate more actively in the learning process.

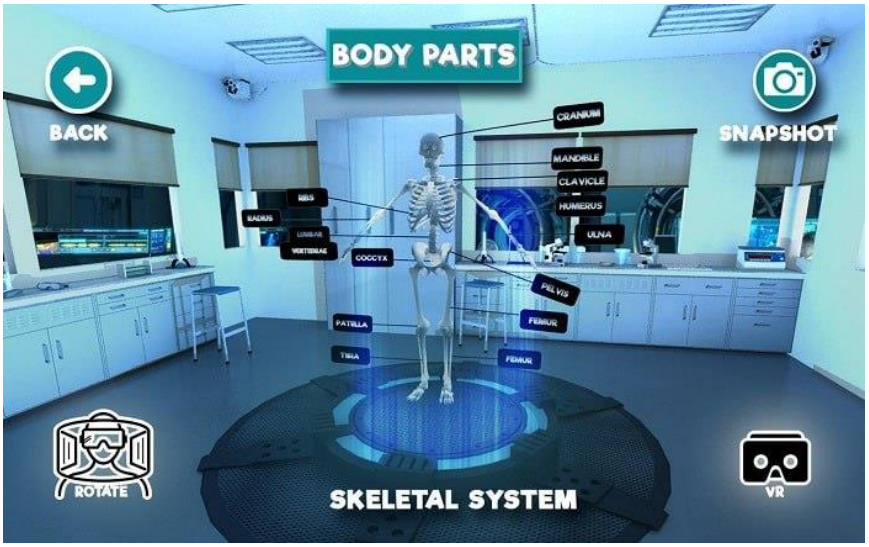
5. Personalized Learning: VR and AR enable the adaptation of the learning process to meet individual student needs, allowing them to study at their own pace.

Examples of Successful Applications

- Case 1: A VR program was developed at a university for teaching programming. Students created virtual applications while interacting with three-dimensional models. This helped them better understand how algorithms and data structures work.

- Case 2: An AR program was implemented in a school to visualize sorting algorithms. Students used mobile devices to overlay digital objects onto real surfaces, helping them see how each algorithm functions in action.

- Case 3: In medical education, VR is used to simulate surgical operations. Students can practice in a safe environment, significantly enhancing their confidence and skills.



Problems of Using VR and AR

1. Technical Barriers: The need for high-quality equipment and software can be a significant obstacle for many educational institutions. Not all schools and universities can afford to purchase the necessary technology.

2. Financial Costs: The high cost of implementing technologies in the educational process can limit their use. This applies to both equipment and software development.

3. Teacher Training: There is a need for training educators to effectively use VR and AR. Teachers must be prepared for new teaching methods and be able to integrate technology into their lessons.

4. Accessibility Issues: Not all students have access to the necessary devices, which can lead to inequality in educational opportunities. This is especially relevant for students from low-income families.

5. Psychological Aspects: Some students may experience discomfort or even fear when using VR, which can negatively affect their learning.

Example of a Computer Science Lesson Using VR and AR

Lesson Topic: Basics of Algorithms

Lesson Objectives:

- Understand how sorting algorithms work (e.g., bubble sort and quicksort).

- Learn to visualize algorithms and apply them in practice.

Methods:

- Use VR to create a virtual environment where students can visualize the sorting process.

- Apply AR to overlay information on real objects, helping students better understand the algorithms.

Lesson Process:

1. Introduction (10 minutes): The teacher explains the

basic concepts of algorithms and their importance in computer science. Students discuss what an algorithm is and how it is used in programming.

2. Visualization in VR (20 minutes): Students put on VR headsets and immerse themselves in a virtual environment where they can observe how bubble sort works. They see how elements move and swap places, helping them understand how the algorithm sorts an array.

3. Practical Assignment in AR (20 minutes): Students use mobile devices with an AR application that overlays visualizations of algorithms on real objects (e.g., on a table). They can manipulate the objects to see how quicksort works in real-time.

4. Discussion of Results (10 minutes): After completing the assignments, students share their impressions and discuss what they have learned. The teacher asks questions to check their understanding of the material.

5. Conclusion (10 minutes): The teacher summarizes the lesson, emphasizing the importance of algorithms in programming and their practical application.

RESULTS

The use of VR and AR in computer science education has shown positive results. Students better grasp the material, their interest in the subject increases, and their critical thinking and problem-solving skills develop. During the lesson, students actively participated in the process, asked questions, and shared their observations. The application of technology made learning more interactive and engaging. However, to successfully implement these technologies, it is necessary to overcome existing barriers such as technical and financial limitations, as well as to ensure teacher training. It is also important to consider the individual needs of students and to ensure accessibility of technology for all.

CONCLUSION

The future of technology in education: With the development of technologies such as artificial intelligence and machine learning, VR and AR can become even more powerful tools in education. The integration of adaptive learning systems that take into account individual student characteristics can significantly improve the quality of education. It is important to continue exploring new approaches and methods to ensure the most effective use of these technologies. Virtual and augmented reality represent promising tools for transforming the educational process. Their successful implementation requires a comprehensive approach that includes technical support, teacher training, and the creation of accessible infrastructure for all students.

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