Harnessing virtual reality and simulation technologies in education for sustainable development

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Abstract. Sustainable development is one of the key topics for modern society. Based on existing global challenges such as climate change and biodiversity loss, it is necessary to look for new ways of sustainable development that take into account economic, social and environmental aspects. The purpose of this study is to analyze the role of education in shaping sustainable development and assess the impact of new educational technologies on achieving sustainability. This study examines the importance of introducing virtual reality and simulation into the educational process in Russia. The authors discuss the benefits of using these technologies, such as increased student engagement, more visual learning, and professional skill development. Particular attention is paid to the ability of virtual reality to create a realistic learning environment that allows students to interact with the virtual world and put the concepts they are learning into practice.

1 Introduction

Before we talk about analyzing the role of education in the formation of sustainable development and assessing the impact of new educational technologies on achieving sustainability, it is necessary to give an accessible definition of the concept of sustainable development. So, sustainable development is a process that meets the needs of the current generation without interfering with the ability of future generations to meet their needs. Let us highlight the basic principles of sustainable development: economic, social and environmental sustainability. Education is important for sustainable development because it can help people understand sustainability issues and develop the values and attitudes they need to live sustainably [1]. Therefore, education is a tool for achieving sustainable development.

In the context of this study, speaking about education, we will not be talking about the traditional educational process, but about innovations in the educational environment that allow us to meet the challenges of our time on the path to achieving sustainability.

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With the rapid advancement of technology in the education sector, we are seeing inevitable changes in the learning environment. In education, there is a growing trend towards the use of information technology in the educational process [2]. Particular attention is paid to the use of technology to increase the accessibility of educational resources for students. Technology is radically changing teaching and learning processes. Online courses are widely used around the world, and blended learning [3] and learning experiences are becoming popular thanks to virtual reality (VR) technologies. Virtual reality is an advanced educational technology that can significantly improve educational practices. VR is a computer-generated environment that allows users to immerse themselves in a simulated real or fictional world [4]. This technology opens up broad prospects for education, as it promotes a deeper and more emotional understanding of educational material. As part of sustainable development, VR can be used to create educational scenarios that allow students to gain hands-on learning about environmental and social issues. For example, using VR, students can explore the impact of climate change on the environment, understand the consequences of unsustainable consumer behavior, and make important decisions regarding the conservation of natural resources [5].

Additionally, VR allows for the creation of interactive simulations in which students can develop strategies for sustainable energy, waste management or biodiversity conservation. These scenarios allow students to learn in real-world settings and evaluate the consequences of their decisions, which helps develop critical thinking and decision-making skills [6].

An important aspect of using VR in education is its accessibility. With the development of technology, VR is becoming more accessible to a wide range of students, which reduces the digital divide and allows students from different regions of the world to have access to education focused on sustainable development.

2 Methods

Let's look at innovative teaching methods that enable students to gain the knowledge and skills needed to achieve sustainable development. These include methods such as project-based learning, interactive learning and multimedia technologies. Research shows that new educational technologies can help develop sustainable skills and competencies in students [7].

Innovative teaching methods allow students to acquire knowledge and skills more effectively and interactively. These include methods such as project-based learning, interactive learning and multimedia technologies.

1. Project-based learning involves the active participation of students in the learning process, where they solve real problems and create projects that can be used in real life.

2. Interactive learning provides an opportunity for students to engage in dialogue with the teacher and other students, discuss ideas and share experiences.

3. Multimedia technology is used to create interactive learning materials that allow students to learn at their own pace and visualize complex concepts.

A feature of modern educational technologies is their adaptability to the various needs of students and the possibility of individualizing learning. They also allow students to develop critical thinking, problem solving and communication skills, which are important factors for achieving sustainable development.

Thus, innovative educational technologies play a significant role in supporting the principles of sustainable development. First, they promote more accessible education, which means more people can access education, including those who previously had limited access to learning resources. This promotes a more equal distribution of knowledge and skills, which in turn promotes social sustainability.

Secondly, innovative educational technologies enrich the educational process. They enable students to more effectively explore complex topics and develop the critical thinking needed to solve problems related to environmental and social sustainability. Project-based learning, for example, provides students with real-life challenges and allows them to apply their knowledge in practice, which helps develop practical skills and an awareness of sustainability.

The third important aspect of innovative educational technologies is their ability to adapt to the needs of each student. An individualized approach to learning allows you to take into account the level of knowledge and interests of each student, which makes the learning process more effective and motivating. It also promotes the development of cross-cutting competencies needed for sustainable development, such as collaboration and communication.

3 Results

The Russian education system still uses traditional teaching methods, which require students to acquire knowledge from textbooks and lectures without always having the opportunity to apply it in practice [8]. This creates a gap between educational theory and its practical use, which can make it difficult for students to understand the relevance of the material being studied and its application in real life. In addition, this approach can reduce the motivation of teachers, since it is difficult for them to interest students in the learning process.

In Russia, the educational system is heavily focused on memorizing facts and formally getting good grades, often without paying enough attention to understanding concepts. The quality of basic education has an impact on students' further education, especially in the context of higher education [9].

In recent years, interactive computer simulations have become part of the educational process and have significantly improved learning. It provides students with realistic experiences and the opportunity to explore the environment, reflecting real-life situations. Interactive computer simulations also allow you to interact with situations that might not be possible in real life. It provides a dynamic, interactive and visual learning experience, allowing students to simulate different situations, practice decision making and develop critical thinking.

Technology makes learning more interesting and can be effectively used by teachers to explain concepts. Computer simulations can transfer abstract ideas into concrete concepts and improve students' understanding of requirements and concepts. Such simulations also promote cognitive development and help students connect theory with practice.

Despite the benefits of such teaching methods, there is still little research in Russia related to the use of simulators in educational activities. In other countries, simulators have been successfully used to train specialists in various fields, including medicine, automotive driving, aviation and construction.

Virtual reality and augmented reality are promising technologies that have the potential to change the traditional education system. They provide deeper and more engaging learning, which can be particularly useful in the context of distance learning and practical skills acquisition. These technologies have great potential for a variety of educational applications such as anatomy visualization, emergency medicine training, and virtual museums and laboratories [10].

4 Discussion

When studying the field of virtual reality and simulation in the educational process, several strengths of these technologies can be identified [11]:

1. Virtual reality is quite plausible. It plays an important role in improving education, student engagement and professional development. Teachers can use virtual reality to make learning more visual and interesting by showing students examples in a virtual environment. This helps students better understand how to apply the concepts they are learning in practice, as they can not only see but also interact with the virtual world.

2. Virtual reality is immersive and allows students to become fully immersed in the learning process. It creates a real-world environment that promotes deeper learning and the development of important skills such as problem solving, critical thinking and attention to detail.

3. Virtual reality is suitable for learning in science, technology, engineering and mathematics (STEM) fields. It allows students to test their knowledge in practice and feel more connected to the material they are learning.

4. Intelligent tutoring systems provide students with feedback and guidance to improve their skills. This is useful in distance learning where students can get help and advice from experts.

5. Simulations allow students to understand and apply the material they are learning through simulating real-life situations. They provide instant feedback and help students develop academic and professional skills.

6. Diagnostic assessment tools help teachers analyze students' successes and weaknesses, which allows them to more effectively plan the educational process and develop students' skills.

5 Conclusion

This study examined key aspects of the use of virtual reality and simulations in the educational process. The factors determining the strengths of these technologies and their impact on learning were analyzed.

The study found that virtual reality exhibits a high degree of believability, making it a powerful tool for improving education and student engagement. Students using virtual reality have the opportunity to not only see information, but also interact with it, which promotes deeper understanding and application of the concepts being learned. Virtual reality can be successfully used in STEM educational programs, providing more effective learning and student interaction with educational material. Intelligent learning systems and diagnostic assessment tools have proven to be important components of distance education, providing students with the feedback they need and helping them develop professional skills.

The study results confirm that virtual reality and simulations have enormous potential to transform the educational system and enrich learning at all levels.

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