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Methodology for Improving the Educational Process Based on Computer Simulation Models in Secondary Schools: In the Example of 11th Class Computer Science and Information Technology Science

Meliyeva Mohkinur Bakhromovna

Doctoral student, Samarkand state university named after Sh. Rashidov, Uzbekistan

Abstract
This article presents the scientific research conducted on the use of computer simulation models in the effective organization of the educational process in general education schools. Also, the stages of creating computer simulation models, recommendations on their use in teaching activities are given. Scientific publications of foreign scientists and CIS countries were analyzed.

Keywords: Computer simulation models, 3D printer, education progress, professional competence, methodology.

Introduction

At the present time, when modern technologies are developing, the attitude towards the introduction of information technologies into the educational process is changing. It is known that it is difficult to imagine the modern educational process without information technology. A clear example of this is the ever-increasing software pedagogical tools, games aimed at effective logical and independent thinking, and various test programs that test memory and knowledge. One of the important tasks in the development of the society is to use various modern methods to enrich the contents of the field of "Education" and ultimately prepare specialists who meet the requirements of the time.

Analyzing the research conducted by foreign scientists on the use of computer simulation models, the following can be observed:

If we look at the history of simulation modeling, Schild, E. In his scientific article "Simulation games in learning" we can see that he put forward important ideas on the use of simulation programs, tools and games to improve teaching and learning processes. [1]

Rutten, N., van Joolingen, Sh. R., & van der Veen, J. T.lar in the article "The learning effects of computer simulations in science education": "There are no clear conclusions about the effect of practical experiments or simulations on the educational results of students, however, empirical studies show that computer simulations help students participate in observing and investigating phenomena, and this said that the process supports students' conceptual change in science.

Thompson, Simonson, and Hargrave defined simulation as a representation or model of an event, object, or some phenomenon. According to Akpan and Andre, computer simulation is the ability to use a computer to simulate dynamic systems of objects in the real or imagined world.[2]

Leathrum Jr. suggests increased collaboration between industry and academic partners to develop simulation-based labs to enhance students' skills and better prepare them for their future careers. In their paper, they illustrate this concept with a simulation lab that allows students to test the performance of autonomous vehicles. [3]

McHaney provides best practices for using KIMs in cloud computing and big data courses. [4]

Kurland and Lynn Fashcett concluded that KIM facilitates the acquisition of quantitative-analytical skills among students who do not have strong mathematical backgrounds [5]. As for e-learning, Balci points to the added challenges of teaching modeling and simulation to online students. [6] They also provide some recommendations to overcome these challenges. Grasas, according to Ceberio, is actually an ideal resource in many online courses because of its ability to support the development of KIM virtual labs.[7]

Modeling is one of the ways to solve practical problems. Often, the solution to the problem cannot be found through large-scale experiments: building new facilities, destroying or changing the existing infrastructure may be too expensive, dangerous, or simply impossible. In such cases, it is appropriate to build a model of the real system, that is, to describe it in the language of modeling. This process involves moving to a certain level of abstraction, leaving unimportant details and taking into account only what we consider important. He argued that the real world system is always more complex than his model.[8]

Methodology

Simulation modeling is a technique used to create virtual copies of real-world systems or processes. It involves creating a computer-based model that simulates the behavior of the system being studied. By performing simulations in this model, students can analyze and evaluate various processes, understand how the system works under different conditions, and make optimal decisions. Such modeling allows researchers to experiment and predict the results of complex systems without having to implement them in practice, saving time and resources and reducing the risks associated with directly modifying or testing systems.

Simulation models use mathematical algorithms and statistics to reproduce the behavior of complex systems such as various actions and events, financial markets, biological processes. These models allow researchers to study the effects of different variables, test different strategies, and optimize system performance. Simulation modeling is particularly important in situations where conducting real experiments is impractical, expensive, or difficult. This information allows researchers to understand and mitigate potential risks, optimize processes, and improve the overall performance of various systems.

A model is a material or ideal object that has some similarity with the modeled object and reflects its main features from the point of view of the problem being solved. [9]

Modeling makes it much easier to get information about the properties of an object. It is a tool commonly used for prediction and comparison, which makes it possible to logically predict the consequences of various actions and indicate with sufficient certainty which one is preferable.

The components of the model are as follows:

- modeling object;
- the problem to be solved;
- method of creating and implementing the model.

The following goals are achieved in the modeling of didactic systems:

1. to study the essence, structural elements and relations between them of a specific didactic object or process;
2. explanation of the already known results of empirical research, coordination of the model and its parameters with the results of the pedagogical experiment;
3. to predict the behavior of such a system in new conditions under various external influences and control methods;
4. optimizing its operation, searching for a control algorithm that meets the selected optimality criterion. [10]

Imitation is a form of experiential learning based on simulation. The use of computer simulation models (CIMs) in the educational process is one of the interactive methods of effective teaching that is consistent with the principles of teaching. The task of the computer simulation model is to show with concrete examples how the processes go. Objects, their movement, what methods were used in the process, the logical process of thinking develops in the process of observation, and through this, the effectiveness of the educational process is achieved. Having determined the importance of computer simulation for the development of observational skills, the teacher should use a certain visual work material as effectively as possible. Models are often used as an excellent learning tool to find solutions to various contingencies before a critical situation occurs. Developing and using a simulation model allows you to "imagine" real processes and situations in the model, which greatly helps in understanding and feeling the problem.

Scientific studies and analysis show that by showing the simulated process, the listener's imagination is awakened, and he gets a more complete understanding of the object. The description of the topic develops students' creative thinking skills. It should be emphasized that in the introduction of this type of training into the educational process, the professional competence of the teachers, the ability to work with technology and software occupy a special place.

Today, there are various software environments for creating computer simulation models, which differ in their ease of use, parameters, and openness. They include:

- AnyLogic;
- Arena;
- GPSS World.
- -Macromedia Flash
- -Adobe After effects
- -Adobe Animate
- -Blender.

Blender is one of the few tools in the ever-evolving field of 3D modeling and animation that has made a significant impact in the industry. Blender is a multipurpose, open source software that has become an essential tool for artists, designers, and creative enthusiasts worldwide. [11]

Blender's appeal lies in more than just its ease of use. It's a powerhouse of creativity, allowing artists to create a variety of visual wonders, from intricate architectural designs to remarkable character animations and dazzling visual effects. With its user-friendly interface, extensive modeling and sculpting options, modern material and texture systems, and advanced rendering engines like Cycles and Eevee, it's perfect for projects of all sizes. However, Blender's capabilities are not limited to modeling and rendering. Character setup, animation, complex simulations, particle systems, and dynamic effects are all areas where it shines. Its node-based shader editor allows artists to create realistic materials. At the same time, its UV

exposure and texture painting capabilities allow precise control over the appearance of the model. [12]
According to the analysis mentioned above, the application of computer simulation modeling to the educational process has not been fully analyzed. 11th grade computer science and information technologies based on the new Cambridge textbook is one of the tasks ahead of us to improve the effectiveness of the educational process.

Results

Methodology of teaching the topic "3D printer" of the chapter of new technologies based on computer simulation models:

A three-dimensional (3D) printer is the creation of an object based on a blueprint created using modeling software. To create an object, thousands and thousands of cross layers are created from the bottom of the model to the top. The machine uses heated plastic to cast one layer at a time. It takes a long time for a 3D printer to create an object." (Figure 1)

Picture-1. 3D printer

Now the 3D printer is used in many situations:

- In medicine, 3D printers are being used to create braces for broken bones. These braces are more flexible than their predecessors and do not fully occupy the fractured body part.
- Prosthetics and organ replacements have also been developed in medicine.
- In medicine, artificial blood vessels can be printed. They can be used to replace damaged blood vessels.
- Recently, houses were built in China using large-scale printers.
- The US space agency (NASA) has used 3D printing to print parts for a variety of space equipment, auto parts, and vehicles.

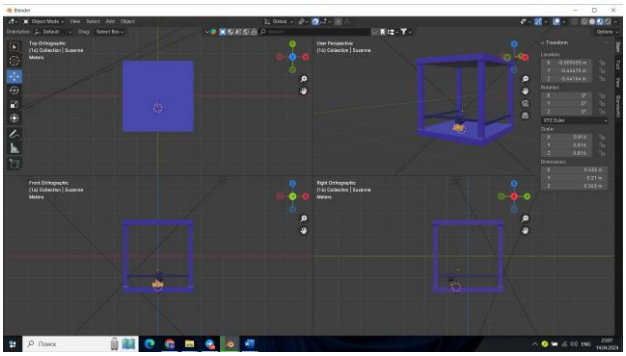
Picture-2. Tools created on a 3D printer

Picture-3. Tools created on a 3D printer

The following examples show the great potential of a 3D printer:

- Using a 3D printer to build houses allows people to quickly move into new homes in the event of a natural disaster that leaves most of the civilian population homeless.
- In medicine, long queues for organs are a big problem in many cases. In the future, if the printing press can meet the demand, this problem may also disappear. Then people don't have to worry about the short life or the compatibility of the organ with the blood.
- If any part of the spacecraft breaks down in space, the team will not have to abort the mission. Using a 3D printer, it is possible to print a spare part and replace a damaged part.

This model shows the working process of a 3D printer. This model was created in Blender 4.1, a 3D printer created using the Cube element, and the process was finally rendered. The object inside the printer has been moved upwards by the mesh command.



Picture-4. The process of creating a 3D printer in Blender

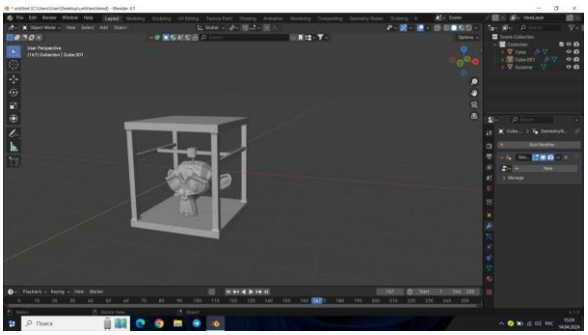


Image-5. The process of creating an object on the 3D printer

Conclusion

In conclusion, it should be noted that visualization of the learning process increases students' interest in science, increases educational efficiency. Students' 4K skills develop. The use of computer simulation models in this process accelerates the learning and understanding process.

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