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Didactic Possibilities of Using Simulators in the Organization of Robotics Circles through Virtual Educational Platforms

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Abstract: In this article, effective methods of using virtual simulation programs in the organization of robotics training are described in detail and mathematical statistical analysis is performed. The effectiveness of simulation programs for teaching robotics was evaluated.

Keywords: robotics, Lego Digital Designer, Bricklink, TinkerCAD.

Introduction

At the time when science and technology are progressing and various innovative technologies are being applied in the educational process, the use of pedagogical software tools based on modern science achievements in the course of the lesson, along with providing the necessary knowledge to the students, is of urgent importance.

Currently, virtual education is one of the important aspects of economic development trends. In this context, it is the need of the hour to widely introduce and develop the achievements of virtual educational technologies and pedagogical software tools in the educational process of general education schools. In this sense, it should be noted that the application of the achievements of educational robotics, which is taught as a science in the education system of developed countries, to the educational process of the comprehensive schools of our Republic is one of the most urgent issues today. In particular, by using the tools of virtual simulation programs in the educational process, to form a person who is able to set independent educational goals, monitor and evaluate scientific and technical achievements, work with various information sources, evaluate them, educate an inventor-programmer student who is able to think critically and independently observe on this basis. task is solved.

According to the state education standards of the Republic of Uzbekistan, mathematical literacy, awareness of scientific and technical innovations and the competence to use them - to be able to make personal, family, professional and economic plans based on accurate calculations, to be able to read various diagrams, drawings and models in daily activities, to ease human labor , implies the formation of abilities to use scientific and technical innovations that increase labor productivity and lead to favorable conditions. It is very necessary to include the elements of robotics in the educational subjects, starting from the primary grades, in the formation of these competencies in students through general education subjects. Also, based on the content of each general education subject, general competences related to science are formed in students. According to the basic concept of the content and structure of general education, the state education standard shows that the social importance of robotics and programming is becoming a necessary element of general education. is doing. At the same time, robotics repeats the general pattern of content introduction in modern sciences: before it becomes an element of formal education, it is tested in the framework of informal education (circles, competitions, Olympiads, etc.). Extracurricular work on the development of robotics, as a rule, is carried out in connection with the goals and tasks of general education, primarily computer science. In the process of this activity, the organization of classes

taking into account different age categories and levels of training is the basis for gaining interesting and valuable experience in learning robotics. By arousing interest in robotics in students starting from elementary school, it develops aspects such as critical and logical thinking, technical creativity, and designing creative ideas from a young age. Later, in the process of creating independent projects on robotics, it causes an interest in modeling, integrated systems, cyber security, cloud computing, augmented reality, Big Data, and artificial intelligence.

Main Part

The use of models in the educational process is not a new method. Models have been used in education since ancient times. Simulators can be used in almost all aspects of the educational process: from elementary education to higher education institutions, from simple language learning to mechanical fields. In recent times, simulators are used even in the field of medicine.

Computer simulators can be used mainly in two directions: modeling of real objects and development of these models. In modeling life objects, it is possible to create virtual prototypes from the simplest chips to complex computer systems. In the process of studying these virtual models, students will be able to further improve their working principles and methods.

The use of simulators is very important in the early stages of learning robotics. The shortest and, in our opinion, correct answer to this question is "Yes, of course." One of the main reasons for using simulators is that they are a much cheaper alternative to real objects. It is well known that in robotics education, specially purchased devices are mainly used in kits; in teaching programming languages trainings are conducted on creating certain programs. But building robots, installing and testing operating and control systems requires expensive equipment. It goes without saying that such opportunities are not widely available in schools and HEIs in Uzbekistan. Simulators provide an opportunity to build and test computer and control devices in a virtual state without such real equipment and facilities. This in itself not only saves a lot of money, but also does not require them at all. The fact that simulators require almost no financial resources makes it possible to repeatedly carry out certain studies by students hundreds, if necessary, thousands of times.

Another advantage of using simulators is that they are safe. Carrying out some research poses a risk to human life, for example, the study of the Network used to collect data in the process of monitoring ecologically dangerous zones. Such research not only requires a large financial cost, but also endangers the lives of the researchers. With the help of simulators, an ecologically dangerous zone and a network corresponding to it can be created in a virtual state, and as many experiments can be conducted on them.

In the process of using simulators, students apply the theory and knowledge they have learned during theoretical classes to life, even if it is virtual. In the process of these studies, they will directly contribute to the development of theory and life studies, as well as strengthening their knowledge. In addition, they can contribute to the further development of those simulators, bringing them to a level that gives results close to real-life research. This, in turn, makes students not only "listeners", but also direct participants in scientific research. This process makes students more interested in reading and research.

The rapid development of current science and technology makes it difficult for real-life research equipment to keep up with this development. Simulators do not have such barriers, and even these "virtual laboratories" add additional speed to the speed of scientific and technical development.

Of course, as in any field, there are objections to the use of simulators. The first of them is the inability of simulators to fully represent real objects and processes. This leads to discrepancies between the results obtained using simulators and the results obtained from real life experiences. Some simulators are made into games, such as flight simulators. They create a constant fascination with users and result in more gameplay than research.

However, the negative aspects of using the above-mentioned simulators are much weaker than the positive aspects, and there are opportunities to eliminate them. Therefore, they cannot be the main reason for limiting the use of simulators in some way.

Crocodile ICT program

It is very effective in teaching computer science in European countries. With the help of this program, the programming process in informatics, more precisely, the algorithm section, can be more clearly delivered to the student. PHET site Nobel laureate, physicist K. The Physics Education Technology (PHET) site was created by Viman. The PHET site has models on a variety of topics, created in Java (and in HTML5 formats). The models presented on the PHET site can be used as open source (Open Source).

Figure 1. PHET Site Overview.

Lego Digital Designer

Lego Digital Designer, a virtual 3D design platform on the computer. It is free and licensed. It contains almost all parts of the main Lego sets, including the LEGO Education Wedo. It allows you to create a step-by-step 3D model design, select a virtual location for it, and save the created model to the library, also allows you to print it. The capabilities of this platform can also be used to study mechanical gears: gear, crown, belt, worm. The child can not only assemble the desired model according to the instructions, but also develop the instructions for the new model himself. The Lego Digital Designer program is developed in English, there is also a Russian version.

Figure 2. Lego Digital Designer program window

Tinkercad

Tinkercad is a free online 3D modeling software that runs in a web browser and is known for its simplicity and ease of use. Since its introduction in 2011, it has become a popular platform for creating models for 3D printing, as well as introducing elementary structural geometry to schools with the help of a 3D project department.

Tinkercad educational platform uses a simplified method to create complex geometric models. The design consists of basic shapes that can be "complex" or "hole". By combining solids and holes, you can create new shapes, which in turn can define the properties of the solids or holes. In addition to the standard basic form library, the user can also create custom form generators using the built-in Java Script editor.

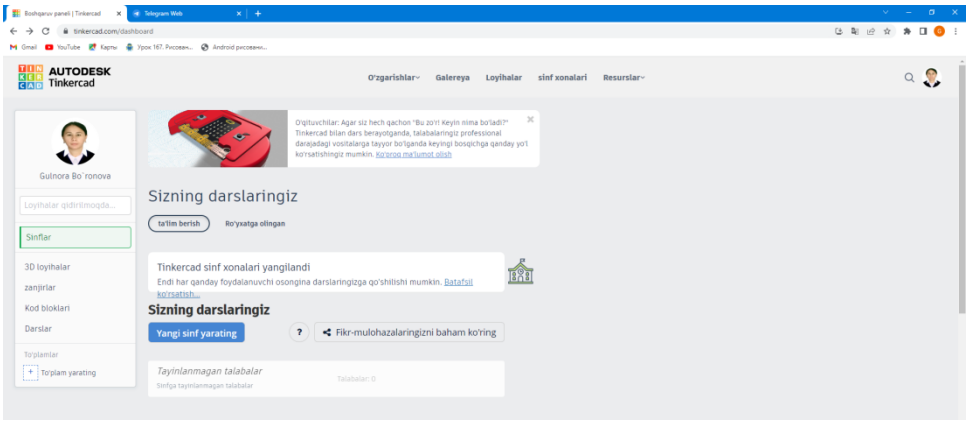

Figure 3. Personal profile view on the Tinkercad learning platform.

Shapes can be imported in three formats: STL and OBJ for 3D and 2D SVG shapes for 3D shapes as well as for experimentation. Tinkercad exports models to STL and OBJ formats ready for 3D printing. These printed objects are then used by the student to create his own realistic robot. Tinkercad also includes the ability to export 3D models to MineCraft Java Edition and offers the ability to design structures using LEGO bricks.

BrickLink Studio 2.0

Studio (attached as Stud.io) is a free computer program for creating virtual 3D robotics models with LEGO bricks. It was released as an open beta on BrickLink on December 13, 2016. The next major software update, Studio 2.0, was released in open beta on July 18, 2018. The program has several features, including a Photorealistic rendering option, BrickLink integration for ordering parts to physically process the model, and an instruction generator, which is very useful for students learning the basics of robotics.

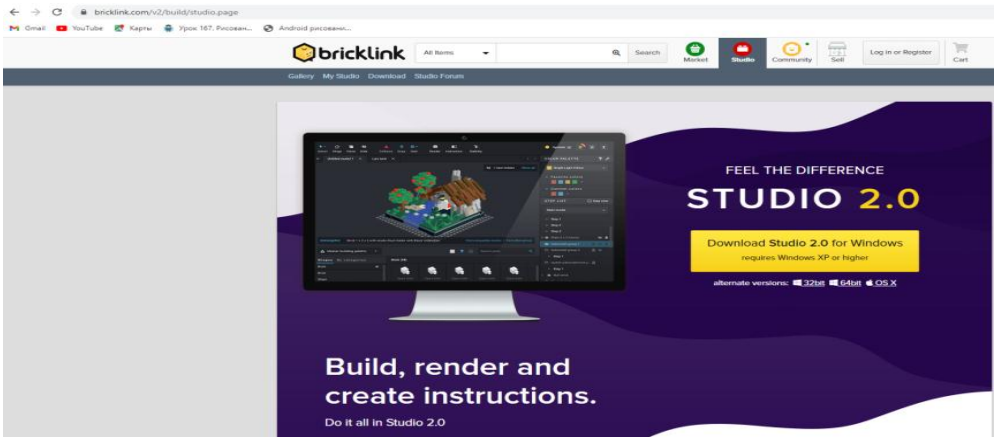

Figure 4. Bricklink Studio 2.0 software window.

Conclusion

Today, various kits are created for robotics, and such kits are not available in all educational institutions. In solving this problem, the use of virtual simulation programs is very important. When learning robotics, Lego digital designer, Bricklink, and Tinkercad programs can serve as a basis for organizing training.

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