3D VIRTUAL LABORATORY IN MATERIALS SCIENCE AS A MEANS FOR FORMING SUBJECT COMPETENCE IN INCREASING THE EFFICIENCY OF MASTERING THE DISCIPLINE

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Abstract

The article describes the creation of a virtual laboratory for materials science, IT technologies are described: from the choice of software, installation on existing platforms, such as Windows, MacOS , Linux, Web. The lab is a 3D simulator run using a Windows file (* .exe) consisting of a list of labs to be performed, instruments and supplies, hints, and instructions. The purpose of creating a 3D simulator is the formation of subject competence in improving the efficiency of mastering the discipline "Materials Science" in educational institutions of the city of Tashkent. And it meets the new requirements for the education system.

Keywords: 3D computer simulator, IT -technologies, Unity 3D game engine, virtual laboratory, Materials science.

Introduction

Currently, distance learning is developing in the Republic of Uzbekistan, as well as in the whole world, which means that the need for creating interactive lessons for students has increased, thus increasing the opportunity to get in touch with modern scientific achievements. Many educational institutions abroad are already using innovative technologies in the educational environment: such as virtual laboratories in chemistry, physics, biology, etc.

The best way to form competence is virtual laboratories, modeled in an electronic educational environment on real-world objects. [one].

In universities, professional colleges, an interactive course on Materials Science in the form of a virtual laboratory will provide an opportunity to both tell and show from primary crystallization to a complete study of the transformation during thermal and chemical-thermal treatment, to determine the mechanical properties and microstructure of materials.

Efficiency in the application and use of interactive classes, such as a virtual laboratory in the course of materials science in education, not only improves the quality of secondary and higher education, but also stimulates the formation of subject competence, saves time, financial resources, and also allows you to show interest in the course being studied.

The necessary conditions that contributed to the creation of a 3D simulator of the laboratory for Materials Science and the formation of subject competencies are: to create 3D models of the laboratory - classroom; taking into account the possibility of choosing laboratory work; implementation of a full-fledged movement around the audience and the possibility of passing laboratory work; conclusions of the results in a printed version are provided; allow re-execution; consolidation of the material covered in the form of tests.

The program created in the Unity 3D environment (v .4.2) supports the following platforms, shown in Table 1.

Table 1 Software platforms

No.	Platform	Unity3D (v.4.2)	Project Anarchy (v2013.2)
1	Windows	Yes	Yes
2	MacOS _	Yes	Yes
3	linux	Yes	No
4	Web	Yes	No

From table 1 we can conclude that Unity 3D (v .4.2) works on all existing platforms. But comparing versions by features, since Project Anarchy has many features not found in Unity 3D. These possibilities are presented in Table 2.

Table 2 Program Features

No.	Features	Unity3D Free (v. 4.2)	project Anarchy Free (v2013.2)	Unity3D Pro (v. 4.2)	Project Anarchy Pro (v2013.2)
1	CustomSplashScreen		No	Yes	Yes
2	Modern GUI system _		Yes	No	Yes
3	LOD support	No	Yes	Yes	Yes
4	Render pipeline low-level access		Yes	Yes	Yes
5	GPU skinning		No	Yes	No

From this, we can conclude that Project Anarchy cannot yet compete with Unity for game development, and in some cases, for mobile development, it can beat the best, but not for Web applications.

Dignity Project Anarchy is a larger variety of graphics features in the free version and slightly more advanced than Unity3D Free (v. 4.2). Otherwise, Project Anarchy is more complex, not as concise in mastering as Unity. It has no similarity to Unit Store with a lot of plugins and various packages. Also, a disadvantage of Project Anarchy is a big reliance on the Windows platform. All of its development tools are tied to Windows. Unity has a more cross-platform architecture. Also, the price for the Pro version of the Project is still unknown. anarchy. [2]
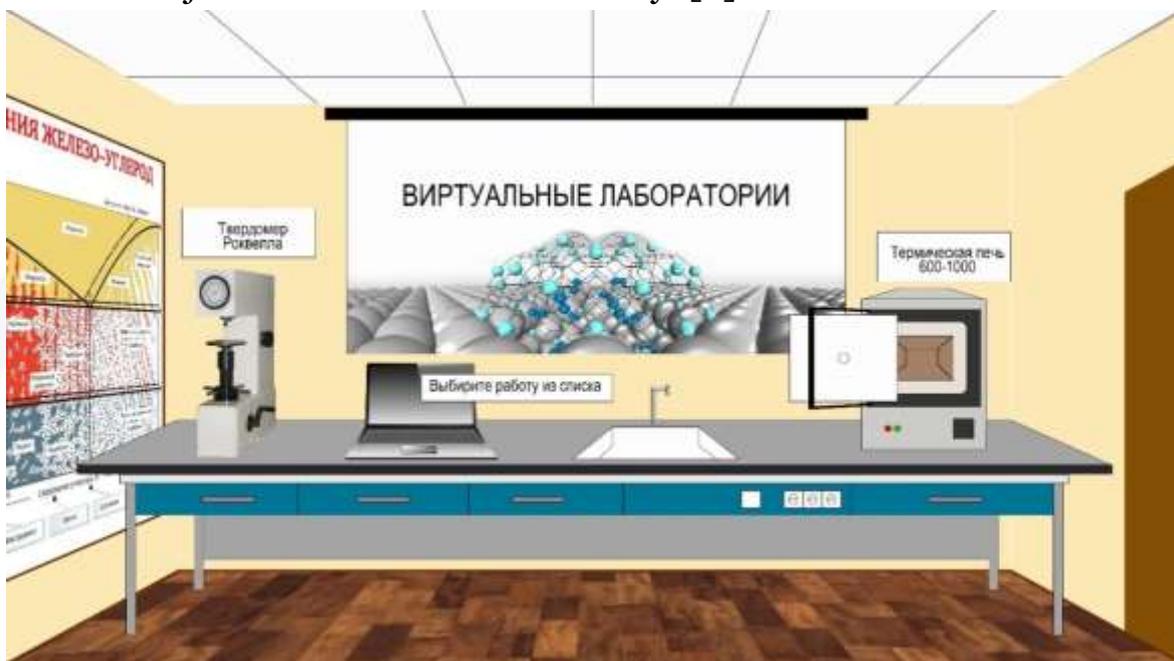

Figure 1. 3D models of the laboratory audience

Therefore, the software implementation is shown in Figure 1, consisting of a 3D model of the laboratory room, as a start room with a projector screen, computer, laboratory equipment, samples, and instruments, on which some scripts serve as a hint for performing laboratory work. Scripts can be written in one of three programming languages such as C#, JavaScript, Boo, but you can also use the standard editor that comes with Unity3d - MonoDevelop or use a third-party editor like Visual Studio, or even NotePad ++. Different scripts are responsible for different operations. MonoBehaviour is the base class of Unity3d, from which all our scripts are descendants, which allows us to use Unity3d functions in scripts. The scripts have event handlers such as MouseUp (occurs after the left mouse button is released), MouseDown (occurs when the left mouse button is pressed), handlers for pressing keys on the keyboard and mouse wheel. To simplify development, we have connected

the DOTween and iTween libraries, with their help you can easily make moving objects. The models were made in 3ds Max.

Having launched the program - a game on a computer in the form of a game, having studied the instructions for users, proceeds to a set of necessary instruments and accessories (samples, reagents, sanding paper, tongs, tank, etc.) or on a laptop from the beginning select a laboratory work by simply clicking on laptop screen → projector screen, and then proceed to set items. After, if the user considers that he has typed everything he needs, he can proceed to the execution. The laptop also provides for the procedure for performing laboratory work. For example, laboratory work on the topic of determining the hardness of carbon steel after heat treatment (hardening) using the Rockwell method [3]. The user performs all actions according to the instructions, namely: takes a sample by clicking on it with the mouse, transfers it to a thermal oven, sets the temperature values, closes the ovens, starts, maintains the specified time in the instructions, turns off the oven, removes the sample, releases it into a tank with water or oil, wipes the sample and puts it on the hardness tester, etc. (Fig. 2). Executes, writes the results to the report. If this is a microstructural analysis, then all structures are drawn in reporting tables. After completion, the user takes a test to consolidate the material covered. In the end, a test score is issued.
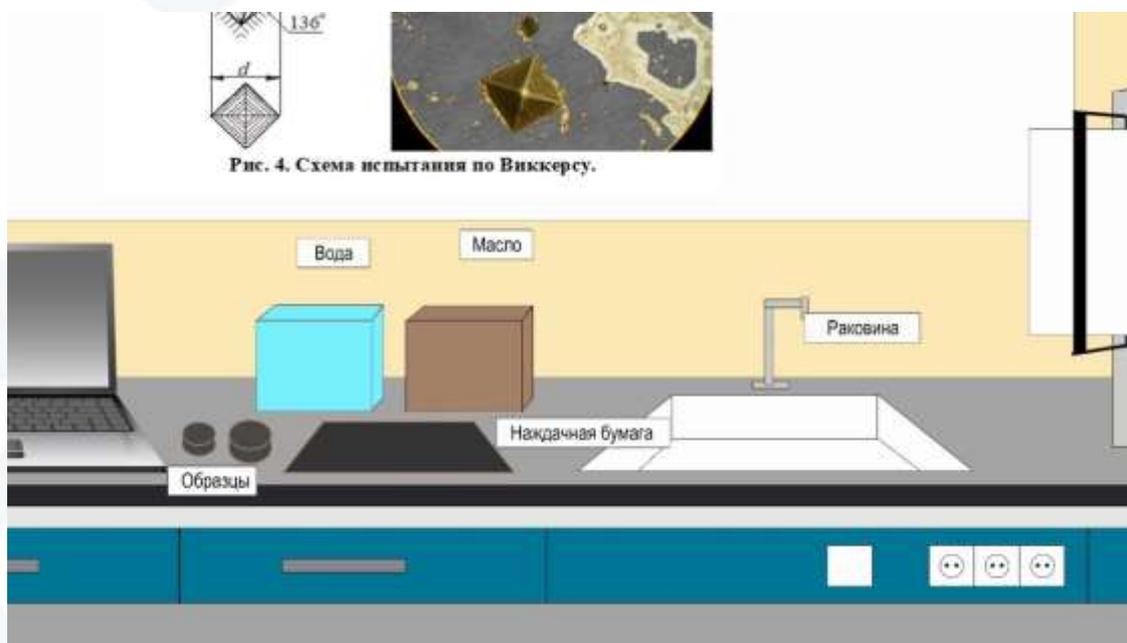

Figure 2. Laboratory work in progress

It is possible to conduct laboratory work on all topics from the list on a laptop again, but the test is passed once.

The task is to complete all the steps from the instructions for specific laboratory work. In total, the user is allowed to perform 10 virtual laboratory work on Materials Science (Fig. 3) [4].
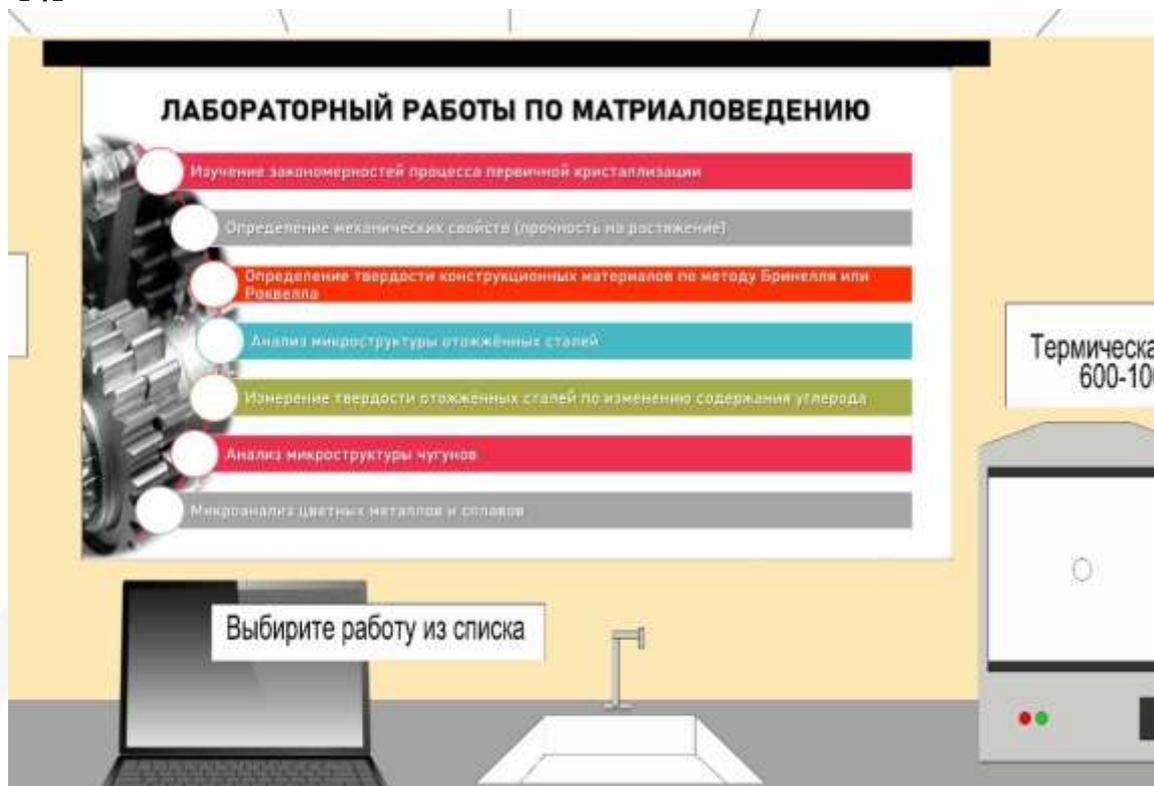

Figure 3. List of labs for the user

Thus, a virtual laboratory workshop is one of the progressively developing types of laboratory classes, the essence of which is to replace a real laboratory study, reduce the time of experiments, the possibility of self-study, and activation of the educational process. It will also allow people with disabilities and those who cannot personally be present in a real laboratory to undergo laboratory work. As for the unity3d environment, it will allow us to port the application to the most popular platforms.

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