CONTEMPORARY TOOLS FOR TEACHING NATURAL SCIENCES

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Nowadays, the development of information and communicational technologies allows to modernize the education process in general schools, utilizing various trends of the contemporary education. New methods of teaching natural sciences, as well as chemistry, have to deal with up-to-date requirements for using information technologies [4]. Applying information and communicational technologies (ICT) within chemistry training allows to intensify the educational process, accelerate the knowledge and experience transfer, as well as upgrade the quality of study and education [4]. Multi-media presentations, Internet-resources during the lessons give teacher an opportunity to explain the theory understandable, increase the pupils' interest for study, keep their attention in a better way.

At the same time, natural sciences are mostly experimental ones. An effective pupils' knowledge perception in these subjects depends not only on the way of presenting the theory, but also on accomplishment of the experimental part in practical works and laboratory experiments, which demands decent theoretical background both from the teacher and the pupils. Besides, the nowadays condition of material support of the majority of schools demands an update and does not allow a proper performance of practical works and laboratory experiments by the pupils.

One of the methods of solving this problem while training upcoming natural sciences teachers is gaining mobile learning and augmented reality skills within physics, chemistry, biology and natural sciences lessons in secondary school establishments, which nowadays is an extremely crucial task of learning process modernization.

Augmented reality (AR) gives the ability to visualize an object (atoms and molecules, their interference, circuits of the devices, technological processes, etc.) as much as possible, meaning to convert a 2D image to 3D, as well as «make it alive». The main task is the selection and creation of 3D-study demonstration material and video data of practical works and laboratory experiments, according to the current programs in physics, chemistry, biology for secondary education establishments, which can be used by the teacher and pupils to prepare an effective performance.

Two methods of augmented reality implementation were combined for the maximal visualization of the study material. The first one is utilization of 3D-images, which made the 2D-pictures of handbooks alive, with animation support; the second one is reproduction of the developed video-data on mobile gadgets by «connecting» to individual markers for every practical or laboratory work.

The stated methods give the opportunity to apply different approaches for using augmented reality in education [6; 1; 5; 2; 3] that can be provisionally divided into three main groups:

1. Visualization of 3D pictures to create a demonstration image of the study material. So, during an explanation, in case of 3D-visualization, the pupil receives, an image, which gives an ability to understand the structure of the compound, mechanisms of chemical bonds and course of chemical reactions: 3D-images of the atoms' structure, 3D-images for organic chemistry and crystal chemistry.

So, during an explanation of the atom structure, in case of 3D-visualization of an atom model, the pupil receives, an image, provided on the fig. 1, which gives an ability to understand the structure of the compound, mechanisms of chemical bonds and course of chemical reactions.

2. Recognition and marking the real objects. The stated approach gives an opportunity to develop video material for the experimental part of studying natural sciences. Taking to consideration the fact that mobile gadgets are simple, effective and, nowadays, popular in the pupils' environment, the study material is appropriate to be reproduced not through a traditional PC, but with a mobile application [9]. In order to improve its portability and to decrease the resource consumption of the mobile gadget, the stated project was realized with a system of «connecting» the video material, located on an open-to-public Internet-resource, to special images-«markers», developed according to the subject of every practical or laboratory work.
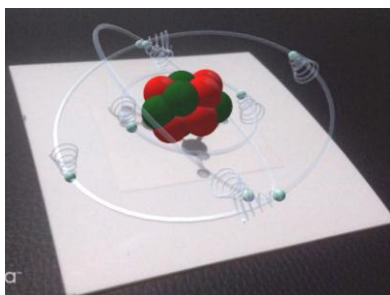

Fig. 1. AR 3D-image of an atom model, generated with AR

Pictures of snips of a practical work or a laboratory experiment, developed by «Vuforia» platform, realized in software, as objects of augmented reality with a multiplatform instrument for development of two- and three-dimensional applications «Unity 3D», were chosen as «markers».

3. Interaction of the virtual object, created by a computer (smart phone), with a human in a real-time environment. Fig. 2 provides the mechanism of reproduction of 3D-images for studying plant cell structure. When the mobile gadget is pointed on the black and white image of the leaf, it is generated into a 3D-picture (Fig. 2a). At the same time, an instrument for zooming the object appears on the screen; it provides the

ability to view not only the external structure of the leaf, but also the structure of the cell, (Fig. 2b.) and the core (Fig. 2c).

In summary, the increase of mobility of the population stimulates the search of new approaches to organization of the study process and creation of study material in natural sciences with usage of mobile gadgets and augmented reality.
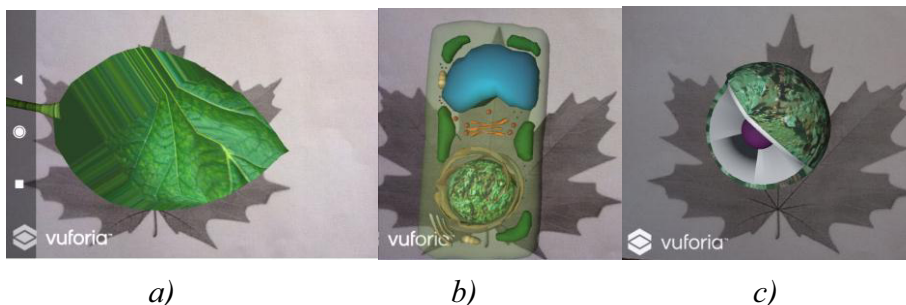

a)   *b)*   *c)*

Fig. 2. AR 3D-images of the external structure of the leaf (a), cell (b) and core (c)

Utilization of augmented reality objects will boost the level of memorizing information by means of interactivity of its reproduction in 3D format, will give the opportunity to the contemporary teacher to explain big amount of theory quick and understandable, will increase the demonstration ability of study material, and for the pupils to memorize it effectively, improve the development of critical thinking, boost motivation to study and provide the possibility to develop certain skills for experimental performance.

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