

# Learning Technologies through Augmented Reality Projects

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## Abstract

This article describes the need to use augmented reality technologies in teaching, as well as technologies for developing augmented reality applications in the educational process in engineering and IT areas. The directions of research of augmented reality technologies are given, such as the study of augmented reality technologies as a means of designing and developing applications, the use of pedagogical technologies for the visualization of laboratory training workshops, the definition and experimental verification of the organizational and pedagogical conditions for the effective use of such teaching aids in the educational process. It is proposed to introduce some disciplines into the training course for IT students, which would be studied from the 2nd to the 6th semester and had as their goal to prepare one large project using augmented reality technologies. The competencies obtained in the study of these disciplines, software, and the result of the project, as its component from semester to semester, are considered.

## Keywords 1

Augmented reality, AR applications, information visualization, design of augmented reality applications, modeling, the efficiency of the learning process

## 1. Introduction

The digitalization of modern society is playing a key role in the fourth generation of industrialization, in which the perspectives of augmented reality (AR) and virtual reality (VR) are vital for various businesses in different sectors around the world [1]. Educational technologies are being integrated into the digital space, which involves the use of modern teaching methods, technical and specialized means, attracting students to project activities, self-study, and self-education. The use of gadgets by students in everyday life involves the introduction of teaching techniques based on the use of such tools as smartphones, tablets, laptops, etc.

Educational technologies through virtual and augmented reality make it possible to more fully understand and master the studied material, including for students with disabilities [2]. Augmented reality technology will enhance the learning process through the development of spatial thinking with the use of vivid three-dimensional images, game elements, and also activates the interaction and participation of students [3].

The use of digital technologies in teaching makes it possible to increase the efficiency of the educational process while providing convenience and accessibility for teachers and students, and also make it easy to organize a remote lesson in discipline or conduct testing on the studied material [4]. Teaching staff must master new interactive pedagogical and technological methods and teaching techniques to maintain a high level of professionalism. This allows students to receive modern knowledge and competencies, which means it improves the quality of education. If a teacher lags behind his students in technical terms, he will not be perceived as a specialist, they will not want to learn from

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him. A student will not be able to come to such a teacher with a question, will not ask for advice to solve a complex problem or project.

A modern schoolchild, student, or young person enrolled in retraining programs practically freely master's computer technologies at the level of intuition and the "trial and error" method, using all kinds of technical means such as laptops and computers, smartphones and tablets, and also software platforms and social networks. The task of a modern teacher is to apply these skills, that is, to oppose empty time spent on the Internet with interesting and visual stories that aim not only to present information, but also to make one think, ask questions, and seek answers to them (independently or jointly).

Investing a set of knowledge, helping to remember a large amount of information - this is not a goal for a modern teacher. Knowledge, like information, is now widely available on the Internet, you just need to correctly compose a request or formulate a question in a search engine. The main task of the teacher is to direct the student to comprehend the studied information, to generalize it, and to obtain further conclusions.

Augmented reality can serve as a motivation or stimulus for learning and developing interest in the material being studied. The use of augmented reality with a skillful combination of technical, software, and didactic teaching aids for both schoolchildren and students of various specialties and areas can give an impetus to the development of interest in technical disciplines, which has significantly decreased recently.

The purpose of this study is to analyze augmented reality technologies and study the methods of using these technologies in the educational process when teaching technical areas of training.

## 2. Features of Augmented Reality

Augmented reality is an innovative technology for superimposing virtual information into the real world. AR in the modern world is becoming an indispensable assistant in the presentation of complex projects and designs, that is, augmented reality is becoming the best mediator between the consumer and the product.

One of the main principles of augmented reality is the interaction on the screen of a live image and virtual information tied to objects in the field of view of the gadget's camera.

Augmented reality (AR) can be represented in the form of adding some digital information to the real world, which is virtually generated to combine two worlds (real and virtual). To create a video sequence with complete visual fusion, the task is to integrate interdisciplinary knowledge, such as 3-D computer graphics (Fig. 1), computer vision, human-computer interaction, and hardware software and design, signal processing, sensor network, Internet of Things (IoT).



**Figure 1:** Example Augmented Reality

Augmented reality is a technology that offers a new educational approach to help students develop critical skills and a deeper understanding of the concepts behind scientific research. In addition,

augmented reality allows you to study abstract concepts, three-dimensional shapes, and geometric objects that are difficult to understand and represent using a description on paper, a picture on a plane.

Augmented Reality (AR) presents information in the right context of the real world. To do this, the system must know where the user is and what he is looking at. Usually, the user observes an object through a display that displays a camera image along with augmented reality. Thus, in practice, the system needs to determine the location and orientation of the camera relative to the object [6].

AR creates the effect of presence, very clearly displays the connection between the real and the virtual world, which psychologically attracts a person and activates his attention and sensitivity to the information component [7].

The research [8] examines using AR, which draws on previous scholarship about distributed spatial sensemaking to analyze the way groups interact over the material, social, and activity contexts.

The authors [9] have developed their software system for non-trivial multi-step instructions for assembling smart city elements and developing virtual assembly instructions using augmented reality.

At the same time, specialists who own augmented or virtual reality technologies will be more in demand in the labor market every year, since virtual and augmented reality technologies provide companies with many competitive advantages. Developers of both the devices themselves and the software for them can get a significant segment of the information technologies market as they have the potential to improve the quality and cut the costs, which will be in demand even in a crisis.

In a recent report, Gartner claims that AR technology will become one of the most important for companies that invest in the development and use of artificial intelligence. The main factor in the advancement of augmented reality technology is its penetration into various spheres of science, production, and services. Augmented reality acts as an indispensable component for specialized solutions that require deeper integration between the digital and the real world [10].

AR/VR is not only applied in many industries but is also used by scholars for education applications as it enables students to have an immersive learning experience to enhance their learning effectiveness and motivation [11].

### **3. Augmented Reality in the Educational Process**

In the modern education system, learning is structured in such a way that during training, theoretical knowledge dominates over practical knowledge. But it is well known that knowledge acquired by a practical method is assimilated by students better and is preserved for a longer period than knowledge gained only in the form of theory (10).

To consolidate the skills and abilities (or competencies) of IT students, it is necessary to include work with specialized software in practical classes, so that IT projects that students create are developed at the most modern level and become in demand.

The teacher must wield special software for the use of e-learning, skills in working in an electronic learning environment, and also use modern equipment (computer global networks, web-cameras, etc.) when teaching students [12].

When training in IT areas, it is proposed to study technologies for developing augmented reality applications. This requires a wide study of graphic design methods (pictures, drawings, color schemes, etc.), as well as software for designing applications, which improves the quality of general professional training (Fig. 2).



**Figure 2:** Drawing visualization during training

Foreign and domestic experience in the use of augmented reality applications in the classroom in various disciplines, including tools that can be used by a teacher in everyday activities, shows an increase in the effectiveness of teaching subjects and assimilation of the studied material [13]. This is due to clarity, involvement in the learning process, definition, creativity, and independence in the choice of decisions.

The study of augmented reality technologies by IT students can be divided into the following research groups:

- study of augmented reality technologies as a means of designing and developing applications, while students use special software, independently build augmented reality projects;
- the use of augmented reality technologies as a methodological goal for the visualization of laboratory training workshops to increase the assimilation of the studied material;
- application for organizational and pedagogical purposes to determine and experimentally test the conditions for the effectiveness of training by processing the results of the survey in real-time and storing these results in the students' database for further analysis of the success of mastering the material and applying the selected learning technologies.

In addition, augmented reality can become an indispensable aid in explaining terms and definitions, showing how inaccuracies in the definition change the essence of the object or process in question [14].

## 4. Discussions

If a few decades ago the main task of the teacher was the task of "teaching and giving knowledge", then at the present stage the task is "to develop students' skills to navigate in the information space, to receive and filter out reliable information, as well as to process it correctly." The introduction of elements of interactivity or practical activity into the learning process will allow instilling interest in the studied discipline, increasing the student's desire to receive new knowledge, deepening the existing ones. It is to this goal that augmented reality technology meets, allowing you to interest, unleash creativity, motivate for independent actions, and self-learning.

When developing projects, we propose to visualize spatial objects that are depicted in a two-dimensional drawing, which will allow you to see "bottlenecks" or poorly understood details of the figure, due to which you can provide steps to ensure the reliability of an object or process, as well as draw the right conclusions [5].

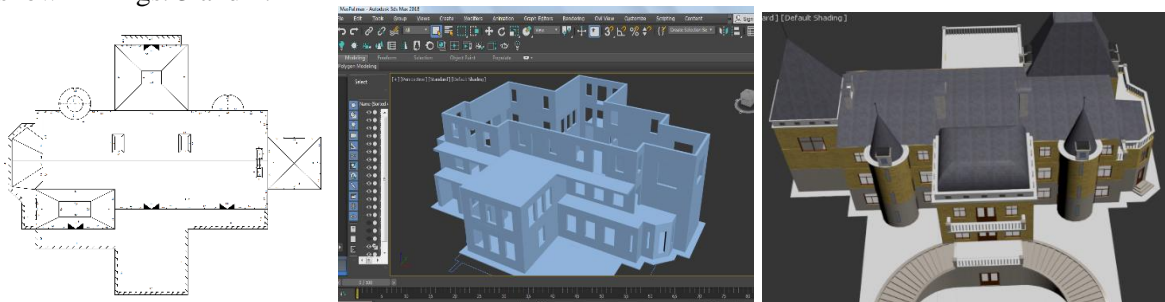
To get a high-quality three-dimensional image or a time series (video), it is necessary to introduce a whole cycle of disciplines into the curriculum of IT students, which are studied from semester to semester without interruption. As practical or laboratory tasks for these disciplines, you can propose the development of one end-to-end augmented reality project, which starts with a simple drawing and ends with an augmented reality project (Table 1).

**Table 1**

Implementation of an augmented reality project throughout the disciplines studied by students of IT directions

Semester	Discipline	Software	Competencies	Result (project)
2	Descriptive geometry	-	Technical documentation, construction of drawings	Freehand drawing
3	Computer engineering	Compass, AutoCAD	Building a drawing in specialized software	Drawing made in specialized software
4	Computer design	Photoshop, Corel, Illustrator,	Working with color, composition, collage of objects, filters, and creating textures	Creation of textures, a project of the composition of objects
5	3-D computer graphics	3-D MAX	Working with the wireframe of the project, creating textures for covering the wireframe, assembling a 3-D model of the project	3D model of the project (image)
6	Virtual and augmented reality technologies	Vuforia, Unity	Work with project composition, lighting, static 3D or dynamic, application scene transitions	Implementation of a 3-D model on the project scene, creation of lighting, transitions between project elements, text descriptions

Thus, studying the proposed disciplines, the student will master the technologies that precede the creation of augmented reality projects during 5 semesters. And on the last discipline, he will be able to prepare an augmented reality project using previously created parts of the project. As a result, a project of some sight of a settlement or a tourist object, for example, can be obtained the Massandra Palace, is shown in Figs. 3 and 4.

**Figure 3: Preparatory design (3D model)****Figure 4: Final Augmented Reality Project**

## 5. Conclusion

Thus, it is proposed to use augmented reality (AR) technologies in teaching IT students by introducing disciplines into the student training program, which, over 5 semesters, form competencies that allow creating augmented reality projects in the future. This will improve the quality of training due to 1) increasing the interest of the audience in the stated and studied material, 2) developing the desire to use modern interactive technical capabilities and technologies, 3) replacement of manuals and laboratory equipment with multimedia computer models, 4) motivation of students to self-study [3]. In addition, modern teachers will receive higher learning outcomes and moral satisfaction from their professional activities when using augmented reality technologies.

AR applications or augmented reality applications, due to the visualization of information that is difficult to perceive, can increase the effectiveness of training. If you need to memorize a large amount of material and analyze it, then projects of augmented reality come to the fore due to the visibility of information and actual actions with it. In addition, the development of augmented reality applications by students of engineering and IT areas allows them to interest and involve young people in self-development and self-education, which guarantees the training of highly professional personnel in this field.

The use of AR provides a new quality of education and simultaneously facilitates the personification and a significant intensification of the educational process, increasing students' motivation, and contributing to a more objective personal fulfillment of the students [15].

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