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Formats of Virtual Learning



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Synonyms

Mobile learning; Online training; Virtual classrooms; Virtual laboratory format; Virtual learning; Virtual learning environment; Virtual Reality

Introduction

Since the 1960s, there has been the development of the virtualization of hardware platforms (systems). This ensured simultaneous access to it for many users and operation systems. Today we can speak of the virtual systems independent from each other, in which virtualization of applications (or processes) takes place. It creates some “abstract environment” making virtualization independent of hardware. Currently a lot of special applications for education are developed. Virtual Reality serves as a learning tool. The current human education can be presented in different formats, which is considered in this work.

Virtual worlds in the formats of virtual learning embody abstract knowledge and concepts, quite

specific “material” forms, and expressions. The work by Sánchez et al. (2000) presented this idea sufficiently.

The fundamental point, which scientists, pedagogues, and developers must take into consideration, is the idea that Virtual Reality in the human education process is not a passing fad but a universal technology. This technology is intended to improve the process of gaining knowledge, abilities, and skills by trainees. Besides, involvement of students in the virtual learning environment has a positive influence on the process of their socialization and motivational and cognitive sphere of their personal development. If we analyze virtualization of learning process, we see that there are more positive points than negative.

Some models of educational systems of Virtual Reality are presented in different studies in the sphere of informatization and electronic learning.

The works by Whitelock et al. (2000) describe exciting opportunities for users for entering new worlds using the Virtual Reality system. The experience of the practical use of Virtual Reality at school is described in the works by Lang (2004), Dipietro (2010), and Toppin and Toppin (2016).

Virtualization in mobile learning is described in the articles by Ikram et al. (2015) and Harley et al. (2016).

This article considers some formats of virtual learning, which have been used in theoretical and practical training of university students. The developed formats have had a positive influence on developing the students' knowledge and learning outcomes. The described learning formats proved that virtual learning really broadens the scope of educating people of different social status and position, studying in different countries. Besides, some forward-looking formats of Virtual Learning are presented, working at which enables to improve the education process further.

Emergence of Virtual Reality: History and Survey

Ideas of Virtual Reality appeared as early as antiquity and fascinated many prominent people for most of humankind's existence. It is worth recalling Johannes Duns Scotus, a medieval Scottish theologian, philosopher, and schoolman, who asserted the existence of matter or its reality regardless of the form, which defined only the quality of physical being. The existence of "some" reality was also of concern to the monk Gaunilo from Marmoutier who in his book *In Behalf of the Fool* constructed an ontological argument for the existence of reality in our imagination. He invited his readers to think of the greatest, or most perfect, conceivable island. It is likely that no such island actually exists. However, his argument was the following: "We aren't thinking of the greatest conceivable island, because the most conceivable island would exist, as well as having all those other desirable properties. Since we can conceive of this greatest or most perfect conceivable island, then it must exist."

If at the time of Gaunilo these arguments seemed absurd, then today it is possible to create such reality using twenty-first century technology.

The idea of the very first human immersion in the artificial world belongs to Morton Heilig. In 1960 Heilig opened a cinema with special moving armchairs, different potpourri scents, speakers for playing back sound, and a special screen. Using all these in his cinema, Morton succeeded in giving spectators a sense of artificially created

scenery such as a noise, a wind, and even some scents. Heilig's construction gave start and the future to Virtual Reality.

The main problem of the twentieth century is the creation of the artificial world where a living organism can successfully coexist with the machine. Therefore there appears a human-machine interface.

From "timid steps" in the sphere of entertainment, Virtual Reality enters the process of educating and teaching.

Modern education is a distance education with a complex virtual training technology of teaching. The use of virtual education technology is presented in the works of the scientists who share their working experience in this field.

Education and Information Technology of the Twenty-First Century

The modern world is characterized by transformation of the modern society, in which computerization and informatization are integrated as key tendencies.

Introduction of modern information and communication systems (electronic mail, electronic teleconferences, electronic and information resources with text, visual, audio, and video information) and Virtual Reality technology (Daydream, Vive VR, virtual game technology) turns the latter into a mass product. Virtual Reality as an abstract phenomenon in some way and at the same time having a certain product is widely used practically in all the spheres of the human society. The application of modern information and communication technology (ICT) and technology of Virtual Reality to the theory and practice of higher education creates objective conditions for the interactive communication of international education participants using LMS and for the development and introduction of the system of the professional training of specialists in the virtual educational environment of a higher education institution (Kerimbayev et al. 2017).

Humanity is progressing and is on its way towards technological progress. It is increasingly difficult for the human memory to keep a growing

body of information, knowledge, and skills. While information changes a new knowledge of changing abilities and skills needed for one or another sphere of human activity is required. It implies the need for such form of education, which would help gain these skills while remaining in main professional activity, or even creating conditions of virtual assistance and simulation, and immersing in the specific environment providing with learning “at a distance” with the effect of being present.

Distance learning is used to provide with such form of knowledge transfer. However, just transmission (postage or using Internet technology) is not sufficient today. Distance learning is enriched by new tools today.

Modern online education uses interactive video, gamification, applications, and explanation of the material in the format of scenarios, simulations and stories, and ready samples with the application of various interactive online teaching methods. Other important technological services are widely included in the education process, such as artificial intelligence, updated Virtual Reality, robots, and voice technology. Voice assistants participate in the learning process and can resume basic concepts of a lecture and carry out a session in the form of “question-answer” before the examination; with their help students can receive notifications of updates or their home tasks.

The distinctive feature of the modern higher education is emergence of virtual universities. The educational process of such learning format widely uses digital technologies. Online learning often becomes a contemporary alternative when students cannot be present at a lesson because of some reasons, for example, a heavy snowfall or a severe frost.

In a context of technological innovations and labor market demands, there arises a necessity of improving prior knowledge, gaining new abilities and skills in the professional environment. Sometimes one needs not a long academic instruction but a short and at the same time proper education providing the required knowledge and abilities. This implied the process of “microfication” of online education, which implied the duration of training sessions, as well. Here there arises the

problem of the teaching material itself, which is also presented in online format. Students usually cannot pay great attention to the material in the text format. A today’s student spends from a few seconds to a few minutes on looking through and studying such material. Such approach is called “snack learning.”

Virtual education uses the concepts of “synchrony” and “asynchrony.” Traditional learning at a school lesson, a university seminar, or lecture is synchronous education. Thus, synchronous education is the education involving teachers and students in an interaction at the same time. We can add that teaching and learning here takes place in the same room, and the participants of the traditional teaching-learning process interact at the same time. Asynchronous education is the form of education independent on a place or time, and the interaction between its subjects can take place at different time. One of the examples of such education is a part-time education. Before, part-time students used to receive educational and methodological material by postage, to use audio and video records and broadcast.

In the modern virtual education, synchronous and asynchronous forms are changed. Synchrony in virtual education is teaching-learning in real time. Means of organizing such education are videoconferences, chats, webinars, and message exchange in real time. Here a tutor has an opportunity to respond to students’ activity, answer their questions, and influence their motivation. Asynchronous education has had a number of technology-driven stages in its development. With the introduction of ICT, asynchronous education has been advanced further. Nowadays on the basis of virtual education, asynchronous education in the form of essays, online tests, MOOC, SCORM, Wiki, etc. is successfully realized. Asynchronous realization of the educational process on the basis of the combination of Internet technology and multimedia courses provides an opportunity to project individual learning pathways, including “a convenient time and convenient place,” with the possibility of modifying learning material and technical solutions. Here, the results of the activity itself, detection of reasons of achieving them, and the focus on the

further optimization can serve as quality criteria. In the asynchronous education, a student is quite free; he/she does not have to sit behind a computer at a scheduled time and work with his/her classmates at the same time. In virtual education students are free to choose between synchronous and asynchronous teaching and learning methods.

Formats of Virtual Training: Definition and Effective Ways of their Use

Online Training as Democratization of Education

The most popular form of distance learning now is online training, or e-learning. Such training is conducted using multimedia and Internet technology.

In 1994 there appeared an interesting, in our view, article by Jeff Graham, Tom Alloway, and Lester Krames in the magazine "Behavior Research Methods, Instruments"; it is "Sniffy, the virtual rat: Simulated operant conditioning." The article shared experience in using the operant chamber for studying Sniffy rat. Diane Jass Ketelhut in *Journal of Science Education and Technology* (2007) spoke of the multiuser environment in the article "The Impact of Student Self-efficacy on Scientific Inquiry Skills: An Exploratory Investigation in River City, a Multi-user Virtual Environment." In the article "Spatial updating in superimposed real and virtual environments," Xiaolang Irene Wan et al. (2009) studied how people navigate in real and virtual environments. Training in the virtual environment and the experience of such training is quite widely presented within the medical community. Urresti-Gundlach et al. in *BMC Medical Education* (2017) presented the experience of their work in the article "Do virtual patients prepare medical students for the real world? Development and application of a framework to compare a virtual patient collection with population data."

The experience of using various forms of virtual training in a number of articles was summarized. Kerimbayev (2016) in his article noted that it was important to consider two basic moments, i.e., impact mode of using virtual environment at

training process within one faculty of the university, directly at training quality, and what outcomes can be reached therewith. The work significance consists in studying the virtual environment effect instead of traditional educational outlook and online training in pedagogical sphere. He considers virtual (digital) educational resources, their potential adaptation to trainee's personality and realization during academic process at the university. Virtual training at the university is a total of virtual educational resource. Information and educational interaction exists in the process of subjects and objects interrelation. An integration of information and pedagogical technologies takes place in the process of subjects and objects interrelation. Herein training is connected with such human activity spheres as intellectual, cultural, emotional, and social.

The pioneers of experimenting with modern Internet technology are traditional education institutions. There appear a lot of articles revealing different aspects of distance and virtual learning.

The article "Virtual dialogues and exchanges. The social and cognitive dimensions of interactions among students" (2013) by Analía Claudia Chiecher and Danilo Silvio Donolo focuses on the topic of interactions among peers in virtual environments. The analytical approach considers both the cognitive dimension and the social dimension (addressed more recently in the literature) of interactions.

The current state of virtual education and search for answers to the question "How to design the process of virtual education?" is considered in a number of articles: "Supporting the education and well-being of children who are looked-after: what is the role of the virtual school?" by Drew and Banerjee (2018); "Augmented reality as multimedia: the case for situated vocabulary learning" by Marc Ericson C. Santos, Takafumi Taketomi, Goshiro Yamamoto, and others (2016); "Developing a mathematical modeling course in a virtual learning environment" by Orey and Rosa (2018); "Increasing student engagement through virtual interactions: How?" by Christopoulos et al. (2018); and in others articles.

As illustrated by a number of studies and methods of teaching in schools and universities,

online education for some indicators leaves behind the traditional attendance-based format. The basic argument for online education and one of its most important features is democratization of the learning process. Online learning makes it possible to remove most of the barriers: geographical, physical, and financial. Students are able to study in their comfort zone, at home, or on the way to work. Besides, they can choose a more convenient time, content, and pace of study. Online education is much cheaper than the classical one; it is even free. At the same time, there are increasing opportunities for higher education institutions, which can have access to those students who cannot attend lessons personally.

Online education using various formats of Virtual Reality provides different categories of persons with an opportunity to acquire new knowledge and skills: parents having small children, people with health problems, full-time employees who would like to change jobs, or those who could not get education at the time. Thus, such type of education as online education providing opportunities to study for different sectors of society and different categories of its persons is a factor of democratization of education.

The availability and openness of knowledge are accompanied by the development of digital technology. Online tools, the formats of Virtual Reality, which offer the largest possible number of people an opportunity to study subjects taught, are developed. Constantly increasing technical opportunities for communication, delivery, and consumption of online content led to the creation of first independent e-learning agents. They are both Moodle for discussions among students and RSS subscription for the dissemination of the material.

In the case of distance learning, students and teachers can be anywhere in the world. And using 3D glasses or helmets, all participants dive into the virtual world. Each of them can create an Avatar image, which can be present in a virtual classroom. Besides, students can listen to lectures and perform individual or group tasks.

On effectiveness, simulation can even exceed a real teaching process since things are speeding up

here; the space is concentrated; and, in contrast to reality, it is focused on increasing the amount of the material taught. With a help of simulations, one immerses in learning experiences, in which processes, knowledge, and skills are highlighted clearly, which is impossible to achieve in reality.

Simulations are one of the most effective training formats, since they provide opportunities to experiment, study, and repeatedly use a new knowledge within a safe model. A high-quality simulation helps some trainees and groups of trainees to develop a high level of understanding and to realize how their conclusions and intuitive reactions influence on what happens to the personnel and the institution as a whole. But it is possible only when simulation looks as reality. The participants “coming out of” the simulation should feel truly that they themselves have been in it, not just their characters.

The infrastructure of distance learning consists of organizational and technical solutions on virtual communication. Among means of communication enabling to realize training online, the following common and most available ones can be identified:

- Mobile telephones.
- Discourse via social networks.
- Collaboration under LMS Moodle.

If a student cannot attend lessons for special reasons, we can give him/her an opportunity to do it remotely. For this aim a classroom is to be equipped by a special camera, which surveys in the format of 360° and transmits a panoramic video of the whole classroom. The students attending a lesson remotely will be able to watch what happens in the classroom in the first person (e.g., from their place), to see their classmates, to communicate with their teacher, and to participate in the lesson. Virtual Reality helps remove drawbacks, which can appear during videoconferences or distance lessons, creating the effect of the personal presence. The teacher can see when a student has to “go out of the classroom” since helmets with built-in light sensors show whether the device is used by somebody or not.

Tools of Virtual Education

For trainees the immersion in the virtual environment is a kind of training in which not only face-to-face meetings are “created,” but which offers various tools for their joint activities.

Online education defines the character of the teaching and learning process, its educational options. Today most students use their smartphones when taking some courses. That is why mobile versions of courses and applications are becoming a necessary requirement.

Web Meetings

This tool includes audio podcasts, record keeping, handling of archives, a joint work with a desktop, software for painting and drawing, and chats as well. The *format of video lectures* is convenient in distance learning for gaining more knowledge on a profession or for developing professional skills. A video lecture is the video record of the lecture material including fragments demonstrating a subject under study. Students are able to look through the material at their convenience. *Webinars* are “virtual” seminars organized through IT; they represent a remote mode of training in the form of videoconferences and virtual lessons. This system enables to hold videoconferences, talks, interviews, and teaching in real time. Videoconferences represent training in groups; here students can interact with an instructor in the “question-answer” format and listen to a lecture material. Training is organized via special programs supporting multichannel communication (Skype). The webinar format is widely used in distance learning within interactive lectures and seminars. Such kind of training combines an opportunity to cover a big audience and interactive engagement of users and teachers.

Virtual Classrooms

Virtual classrooms enable to organize content libraries; thematic archives; testing on the material studied; surveys of students’ knowledge, abilities, and skills; and assessment tools.

Open online courses enable to study a certain discipline remotely or to improve professional skills. As supplements to traditional materials of a training course, such as video, reading, and

homework, massive open online courses provide an opportunity to use users’ interactive forums.

Online courses enable students to gain required credit points while studying in universities – partners. Universities and colleges offer mixed or hybrid programs, in which standard “alive” lectures are combined with working online. Thus, one can attend lessons remotely, i.e., connecting to a translation in real time (synchronous operation) or listening to the recordings (asynchronous operation); a course can include Skype sessions and webinars.

Educational institutions are working at developing massive open online courses (MOOC). Today such courses on special MOOC platforms present the fastest developing sector of distance learning.

Virtual Learning Environment

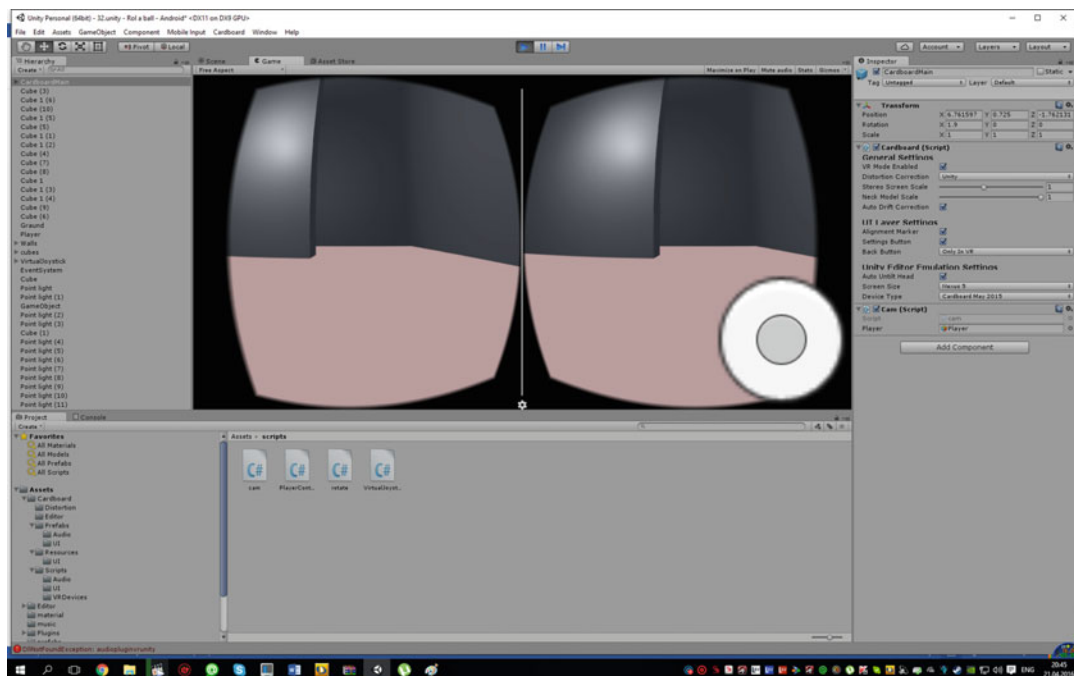
Virtual learning environment is a standing environment on the browser platform. It provides an easy access to information, thematic experts, and colleagues in real time. Such tools are used for the integration of informal and formal education based on simultaneous use of video and audio podcasts, virtual classrooms, web-based resources, and social networks into common educational space.

Simulators are used in the virtual learning environment. The traditional approach to learning is expected to change to full gamification, flexibility and the use of the latest technologies for better and full understanding of the gained knowledge. One of such tools is Dialog Simulator format with elements of gamification.

An example is the “Maze,” an educational virtual game with the support of 3D glasses (Fig. 1). In the game one must find the exit from the maze and gather 12 keys. Performing required actions a player develops his attention, motor skills, and spatial orientation.

Along with Virtual Reality (VR), it is better to use augmented reality (AR). Augmented reality enriches existing technologies with unique ones and enlarges the horizons of virtual potential.

The Dialog Simulator format is the most effective for learning when one needs to develop practical skills. Dialog Simulator enables to immerse



Formats of Virtual Learning, Fig. 1 Fragment of the software for the virtual game, “Maze”

entirely in virtual learning. Dialog Simulator can represent an interactive game simulator with an intricate plot and articulated dialogs. It is perfect for training skills related to communication. It provides more interactivity, fuller involvement, and greater learning efficiency.

Dialog Simulator entirely “plunges” a trainee into history, and it is ideal for training managerial and communicative skills.

An educational game is effective if it is necessary to develop particular professional skills.

The use of interactive cases for teaching is the most effective way for developing required practical skills. Cases enable to train required skills within a safe gaming environment, to analyze mistakes made in the game, and avoid them in real-life situations.

Tests are used for controlling a user’s knowledge both in the process of learning and for summarizing learning outcomes after studying a certain topic.

The creation of the virtual environment using methods of three-dimensional modeling enables a user to train the practical skills, which require a special training.

The basic objective of the online directory is creation of the single information and conceptual field for all users. Having a great number of users and having to accumulate knowledge base, it is useful to store it in a single place.

WIKI (encyclopedia) is a knowledge base, using which students work independently when they need certain information. The instructor works at granting students’ requests for information providing new articles to the knowledge base. The creation of one’s own knowledge base in the corporate network increases the attendance and the overall training level of employees.

Format of Students’ Direct Communication (Blog, Chat, Forums, Social Networks, Etc.)

Such communication can take place both among students of the same university and among students from different universities. Such complex inter-institutional system of gaining knowledge works through using distance learning sites of the institutions, which have reciprocal hyperlinks.

The social networks such as “My world” (www.mail.ru), “In contact” (www.vkontakte.ru), which is very popular with youngsters, and

“Facebook” (www.facebook.com) can be used as tools of distance learning technologies.

Chats, forums, and conferences in social networks are kinds of virtual communication. Students can organize chats and conferences and create contemporary groups for preparing for exams and discussing some content questions in real time. The participation of a teacher in such chats turns a “vertical” interaction to “horizontal” one; it causes greater confidence among students and contributes to improve the process of acquiring information.

As an example can use “Virtual,” the portal, which introduces a text chat, using which one can communicate during a virtual training course.

Chat supports a great number of simultaneously connected users due to the asynchronous architecture in real time. When one user writes a message, another one receives it immediately. In one chat “room,” several users can communicate simultaneously. During lessons students use chat for discussing the material taught, expressing their opinions and points of view concerning a problem. In order to enjoy a conversation, it certainly should be interesting. Having analyzed interlocutors’ messages, one can make conclusions how well they acquired the material taught.

Social networks help reduce the time spent on notifying trainees of coming events in the learning process. It becomes possible to counsel lesson bunkers and lesser students, since they can be reached more frequently in social networks than in classrooms. Communication can take place through comments in discussions and real-time messages among those participants who are online at the moment. Communication in social networks has a number of advantages; one of them is that students communicate in informal environment when a student can ask questions to a teacher without being afraid of looking unaware of the answer to a question. Today youngsters spend a lot of time in social networks, and their communication along with the possibility to gain knowledge through social networks is becoming a familiar and pleasant experience for them, which results on more effective acquirement of learning material.

The use of a social network will be effective if a teacher places a link to a distance learning site on his/her (teacher’s) site as an additional learning resource.

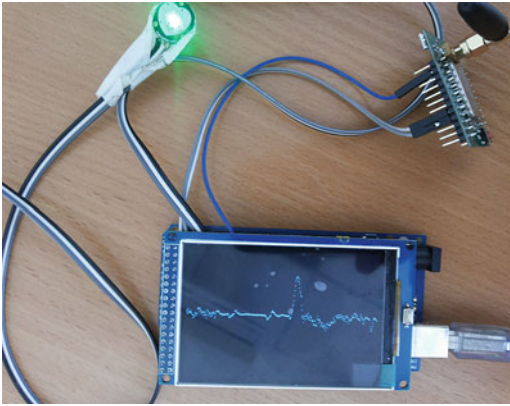
Thus, thanks to using educational sites and social networks, students adapt easier when they study a new discipline, since they enter a specific information environment, which is created by their teacher, save time for searching for new information, and can get their home task at their convenience.

Virtual Laboratory Format

Virtual laboratory is the software-hardware complex enabling to experiment without reality. A virtual laboratory can be accessed via a computer, including the Internet. A virtual laboratory enables to replace real laboratory studies by math modeling of the processes under study with a virtual interaction of a student with laboratory facilities. The possibilities provided by modern imitational computer models create a perfect illusion of working with real equipment. A virtual laboratory makes it possible to observe periods of physical or chemical phenomena, which are impossible to see in real time, and to model processes, which are impossible in the real laboratory.

Thanks to the virtual laboratory, it is possible to examine processes in details and observe what is taking place in different time scale, which is relevant to the processes taking a fraction of a second or, on the contrary, lasting for several years. An important advantage of the use of virtual laboratories is safety when working, for example, with high voltage or with chemicals. Since a computer manages a virtual process, it is possible to quickly conduct a series of experiments with different values of input parameters, which is often necessary for correlating output parameters with input ones.

The disadvantage of a real laboratory is the problem of inputting gained information to the computer. There is not such need in a virtual laboratory, since data can be saved in the electronic results table directly with experimenting by an experimenter or automatically. Therefore, time is saved and the number of possible mistakes decreases.



Formats of Virtual Learning, Fig. 2 Hardware implementation of the heart rate monitor, “pulse sensor”

Virtual Reality Format in Mobile Learning

Today almost all people have mobile devices, mobile phones, or tablets, including even very young children. While children mostly use them for playing, adults use them as an “information navigator”: they read news, map routes, seek contact information, etc. The diversity of the consumed content has one similarity, its relevance. Taking a smartphone we search for the information, which we need here and now, which is exact and sufficient.

Mobile learning must also be relevant in this regard. Mobile devices enable to organize learning independently of the location and time. Most mobile devices have built-in sensors or special applications, which can, for instance, recognize a voice, have location services, and can measure the speed and direction of their owners and even their biorhythms.

We, for example, have developed a pulse sensor. It is a tiny programmable heart rate monitor, which triggers the alarm at the doctor’s phone when the patient’s heart rate is slow (Fig. 2).

Data of mobile analytics of using educational systems, sites, and applications, combined with a user’s physiological, geolocation-based and other personal data, offer great prospects for creating a personalized system of e-learning. Today new technologies combine the potentials of networks, smartphones, messengers, and online maps.

The implementation of mobile learning has been possible by a broad set of functions of

modern mobile devices, which today include voice communications, messaging, graph sharing, Internet browsers, and others.

There are increasing opportunities of social networks in the sphere of Virtual Reality. An interactive telephone conference can be held among several friends. Users can “meet” in 3D virtual world connecting headphones to their telephones.

The system of mobile learning in Virtual Reality solves such urgent problem as realization of a high degree of trainees’ socialization, development of their communicative competences, and the ability to work as a team.

Mobile learning with the use of Virtual Reality requires the development of mobile applications. Such mobile applications should have certain functions enabling to perform various actions.

Referring to mobile applications for education, it is worth mentioning their possibility of accessing cloud services, which are used as a single information field for storing the information of students and teachers and indicators of learning and teaching activities.

Cloud Format

Cloud is a model of online repository, in which data is stored and processed in virtual server. Physically such servers can be located geographically remotely one from another. Besides, this format enables to hold a so-called cloud videoconference. Connection via videoconference requires relevant equipment, software, and a team of experts. But the emergence of the “cloud-related solution” allows avoiding these requirements.

During a cloud videoconference, users are physically present anywhere in the world; the main thing is access to the Internet. Besides, thousands of users can participate in the same videoconference simultaneously. It is quite easy: an initiator inputs the title and the time of a conference, sends invitation to users via e-mail, clicks at the link in the browser, and becomes the conference participant.

The study undertaken in this area suggests that students consider virtual learning efficient and even more qualified than the traditional education.

Virtual Reality (VR) Promising Formats and Disadvantages of Introducing VR into Education

Virtual worlds are the most complicated and the most promising tools for organizing training. Their use requires very sophisticated software. Such training faces increased requirements for a teaching staff and service personnel. It enables to introduce the most complicated scenarios of informal and formal education. Virtual worlds are the most cost-effective and efficient solutions for organizing distance learning. Virtual learning environment is being implemented in institutions owing to its economy, interactivity, and simplicity of use. It is much more difficult for adult students to adapt to the real learning process. They feel much more confident in a virtual environment. This explains sympathy for virtual environments; besides they focus on the thematic content and are constantly developing technologically.

What opportunities for education does Virtual Reality propose? Today education is considered one of the most promising areas for developing and introducing Virtual Reality technology. The idea of applying Virtual Reality to teaching and learning is not new anymore, and VR technology has been used for a long time, from virtual excursions at History or Geography lessons to training flying a plane or running a bullet train. Virtual Reality provides new opportunities for studying theory and improving practice, since traditional methods can be rather costly or too complicated.

There are five basic advantages of using VR in the education sector.

- **Visibility.** 3D graphics enables to reproduce the detail of even most complex processes invisible to the human eye, up to the decomposition of nucleus or chemical reactions. Besides, nothing prevents from improving the level of detail in order to see the movement of electrons or to reproduce, for instance, a mechanical model of the development of a human body's cell at different stages. Virtual Reality enables to reproduce or model any processes or phenomena known to contemporary science.

- **Safety.** Practical fundamentals of piloting aircrafts and jet planes can be perfectly safely mastered at a VR device. Besides, VR enables to train too complicated medical operations or manipulations without harming the humans or putting them at risk.
- **Involvement.** VR technologies enable to model any mechanics of activities or behavior of an object, to solve complicated mathematical problems in the form of games, etc. Virtual Reality enables to travel in time looking through main scenarios of important historical events or to see the inside of humans at the level of the movement of red blood cells.
- **Focusing.** A space modeled in VR can be easily examined in 360° panoramic view not distracted by external factors.
- **Possibility of conducting virtual lectures.** Thanks to the option for displaying a modeled first-person space and the effect of one's own participation in virtual events, it has made possible to conduct different types of lessons in Virtual Reality mode.

Let us consider what advantages and disadvantages learning in Virtual Reality mode has.

Formats of VR in education trigger the process of gaining required material. Besides being able to read or listen of the most extraordinary experiments, trainees can see them before their eyes. Virtual Reality technology provides excellent opportunities for acquiring an empirical material. The traditional lesson format remains almost unchanged; it is only supplemented by the immersion into VR for 5–10 min. It is possible to divide one lesson into several stages, in each of which the most complicated moments are visualized in the virtual world. As before the basis of the presentation of a new material remains a lecture. But Virtual Reality enables to improve a lesson by involving students in full immersion in learning process visualizing key moments of the material covered. When learning in Virtual Reality mode, the efficiency, the level of memorizing information, and the interest in learning increase. VR technology offers opportunities to model any situations, including emergency, which are difficult

or impossible to realize when learning in real life; there is no necessity to take any risk of being injured, as, e.g., through handling high-risk equipment; there is no necessity for a trainee to be present at hazardous establishments; there is no risk of damaging real equipment when learning; VR simulators are cheaper than complex and cumbersome life-size training devices, which have to be bought and installed.

At the present stage, the newest models of VR devices have not yet been developed perfectly for their full application in order to teach at school or university; therefore, the potential use of Virtual Reality has a number of disadvantages.

- **Workload and labor intensity.** Almost every subject has a large amount of an important material; therefore, the creation of one such course requires a lot of work for creating a virtual content. It can be both a specific lesson on each topic and dozens of specific applications. The companies, which plan to work on developing lessons in Virtual Reality mode, have to be prepared to the fact that this process will take a lot of time and resources without the possibility to make a profit until a proper lesson or a complete course consisting of several lessons is developed.
- **Cost of equipment.** In the case of distance learning, students need to be concerned about accessing gadgets able to visualize Virtual Reality; besides, educational institutions need to purchase an expensive equipment for the classrooms, where virtual lessons are conducted, which requires a lot of money.
- **Functionality.** Like any other similar technology, Virtual Reality needs to use its own language. In order to create a perfect virtual lesson, one needs to choose proper tools.
- **Existing applications of Virtual Reality for education** cannot take advantage of all potential of the technology and, therefore, do not perform their core functions.

Virtual Reality technology can be applied to education, and most likely in the near future, we

will be able to witness a real breakthrough in this area and numerous interesting discoveries.

Conclusion

Prospects for the development of virtual learning are that in the future, such type of education will become usual and content-oriented. As an integral component of the universal social educational structure, this type of tutoring will become more useful and widespread. It will affect virtual education of the future. It will become even more available and informative and enable more people to participate in the process of gaining knowledge. However, it will not be able to completely displace more common for us form of learning. Technologies of virtual communication will be approaching to modeling its real analogue with time.

Cross-References

- [Adoption of Virtual Laboratories in India, Learning Assessments and Roles of ICT Skill Learning Tools](#)
- [International Virtual Precollege Digital Makerspaces in Future Learning Environments](#)
- [Virtual Learning Environments](#)
- [Virtual Schools](#)

References

- Chiecher AC, Donolo DS (2013) Virtual dialogues and exchanges. The social and cognitive dimensions of interactions among students. *Int J Educ Technol High Educ* 10(2):285–300
- Christopoulos A, Conrad M, Shukla M (2018) Increasing student engagement through virtual interactions: how? *Virtual Reality* 22:1–17
- Dipietro M (2010) Virtual school pedagogy: the instructional practices of K-12 virtual school teachers. *J Educ Comput Res* 42(3):327–354
- Drew H, Banerjee R (2018) Supporting the education and well-being of children who are looked-after: what is the role of the virtual school? *Eur J Psychol Educ* 34:1–21
- Graham J, Alloway T, Krames L (1994) Sniffy, the virtual rat: simulated operant conditioning. *Behav Res Methods Instrum Comput* 26(2):134–141

- Harley JM, Poitras EG, Jarrell A, Duffy MC, Lajoie SP (2016) Comparing virtual and location-based augmented reality mobile learning: emotions and learning outcomes. *Educ Technol Res Dev* 64(3):359–388. <https://doi.org/10.1007/s11423-015-9420-7>
- Ikram W, Jeong Y, Lee B, Um K, Cho K (2015) Smart virtual lab using hand gestures. In: Park J, Chao HC, Arabnia H, Yen N (eds) *Advanced multimedia and ubiquitous engineering*. Lecture notes in electrical engineering, vol 352. Springer, Berlin/Heidelberg
- Kerimbayev N (2016) Virtual learning: possibilities and realization. *Educ Inf Technol* 21(6):1521–1533. <https://doi.org/10.1007/s10639-015-9397-1>
- Kerimbayev N, Kultun J, Abdykarimova S, Akramova A (2017) LMS Moodle: distance international education in cooperation of higher education institutions of different countries. *Educ Inf Technol* 22(5):2125–2139. <https://doi.org/10.1007/s10639-016-9534-5>
- Ketelhut DJ (2007) The impact of student self-efficacy on scientific inquiry skills: an exploratory investigation in River City, a multi-user virtual environment. *J Sci Educ Technol* 16(1):99–111
- Lang M (2004) The online educator. A guide to creating the virtual classroom, M. McVay Lynch. *Educ Inf Technol* 9(1):91–93
- Orey DC, Rosa M (2018) Developing a mathematical modelling course in a virtual learning environment. *ZDM* 50(1–2):173–185
- Sánchez Á, Barreiro JM, Maojo V (2000) Design of virtual reality systems for education: a cognitive approach. *Educ Inf Technol* 5(4):345–362. <https://doi.org/10.1023/A:1012061809603>
- Santos MEC, Taketomi T, Yamamoto G, Rodrigo MMT, Sandor C, Kato H (2016) Augmented reality as multimedia: the case for situated vocabulary learning. *Res Pract Technol Enhanc Learn* 11(1):4
- Toppin IN, Toppin SM (2016) Virtual schools: the changing landscape of K-12 education in the US. *Educ Inf Technol* 21(6):1571–1581. <https://doi.org/10.1007/s10639-015-9402-8>
- Urresti-Gundlach M, Tolks D, Kiessling C, Wagner-Menghin M, Härtl A, Hege I (2017) Do virtual patients prepare medical students for the real world? Development and application of a framework to compare a virtual patient collection with population data. *BMC Med Educ* 17(1):174
- Wan XI, Wang RF, Crowell JA (2009) Spatial updating in superimposed real and virtual environments. *Percept Psychophys* 71(1):42–51
- Whitelock D, Romano D, Jelfs A, Brna P (2000) Perfect presence: what does this mean for the design of virtual learning environments? *Educ Inf Technol* 5(4): 277–289. <https://doi.org/10.1023/A:1012001523715>