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Augmented Reality as a Form of Organising Educational Process of Seventh Technological Stage

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Abstract. *Possibilities of introducing information technologies in training and business games as promising formats of realising an educational process, enabling formation of the seventh technological stage by means of acceleration of knowledge acquisition and mastery of new experience, have been considered. Such form of education is defined as a kind of organising production of means of production of an intellectual product based on cognitive activity. Formation of knowledge has been considered as parallel supplying of information on a special discipline and formation of priorities of its importance for a future citizen and specialist possessing creative thinking. Dialogue technologies, in the course of which the interactions of a learner and a teacher are realised, have been proposed as one of the ways of such parallel solution. Regulation of effectiveness of the educational process in the real time mode has been suggested to be conducted with the help of intensifying an operative feedback. It has been demonstrated that the use of interactive tools in studies motivates students for harmonious perception of information. An interactive form of organising cognitive activity has been proposed as a form that enhances the productivity of interaction among participants of the educational process, which is determinative for information flow maximization under economic limitations. Comfort of training conditions has been determined as an important factor of understanding by participants of the educational process of their own progress, as well as awareness of their intellectual competence.*

Keywords: education, the seventh technological stage, knowledge acquisition, production of means of production of an intellectual product, dialogue technologies, interactive technologies, virtual world, augmented reality, education logistics, effectiveness and adaptability of an educational process.

Introduction

At present, formation of postindustrial economy takes place, the role of information in providing effectiveness of economic activity increases sharply[1,2]. The fact that mastery of knowledge is one of the most important production factors, having significant differences from traditional ones – labour, land and capital, is already undisputed.

The fifth technological stage, prevailing in economic complexes of the most developed countries, bases on the use of microelectronics, computing and

[1] M. Ia. Veselovskii, M. A. Izmailova, S. U. Nuraliev, «Formirovanie interaktivnoi modeli transfera tekhnologii kak faktor povysheniia innovatsionnoi aktivnosti kompanii» [Formation of interactive model of technology transfer as factor of increasing innovation activity of companies]," in *Voprosy regionalnoi ekonomiki*, 3, (2015), p. 9-20.

[2] M. J. Parfenova, V. D. Babishin, E. V. Yurkevich, V. D. Sekerin, M. N. Dudin, "Methodology Making Management Decisions Based on a Modified Ramsey Model," in *Asian Social Science*, 10 (2014), no. 17, p. 292-301.

fiber-optic machinery, telecommunications, robot industry, rendering information services, biotechnologies, space technology, chemistry of new materials with predetermined properties. However, in Russia, the fourth technological stage, i.e. so called an "epoch of oil and gas", is still the main one.

Nowadays, the world faces the sixth technological stage. Its contours have already started to form. These are nanotechnologies, cell technologies, gene engineering, hydrogen power engineering. Synthesis of achievements in such works must provide advancement of the systems of government of a state, society, economy to a fundamentally new level. When preserving the existing pace of technical and economic development in the 2020 – 2025s, a new scientific, technical and technological revolution, the basis of which will be developments, synthesizing achievements of the mentioned directions as base ones, may take place. At that, the sixth technological stage in the developed countries will have entered the maturity phase already in the 2040s.

There are reasons for such predictions. As of 2010, the share of the productive forces of the fifth technological stage in the most developed countries made on average 60 %, of the fourth — 20 %, and the sixth – about 5 %[3]. Unfortunately, separate studies undertaken in such directions in the countries of the former USSR, can not compete with world achievements.

An opinion of V.E. Lepskii, a principal research fellow of RAS, expressed at the meeting of the Innovative Development Club at the Institute of Philosophy of RAS, is of interest: *"Since one cannot catch up, then one must outdo…".* He expressed an idea of transition to the Seventh technological stage: "*The Sixth stage implies production of technologies, and the Seventh one must be understood as production of specialists capable of creating technologies, organising new forms of consciousness and life conditions*". To realise this fruitful idea in Russia, new methods and technologies of management of knowledge formation will be demanded[4,5.]

In this paper, perceived information is supposed to be considered only as "information resources". They can be considered as knowledge when a personality, possessing these resources, structures them by importance according to a goal of perception of received information[6].

In this case, one should understand that to form knowledge, parallel solution of two tasks is required: provision of information on this special discipline and formation of priorities of its importance for a future citizen and specialist

[3] W. Drechsler, R. Kattel, E. S. Reinert, *Techno-Economic Paradigms: Essays in Honour of Carlota Perez*, London, Anthem Press, 2011.

[4] N. G. Kulikova, *Sovremennoe obrazovanie: filosofiia krizisa* [*Modern Education: Philosophy of Crisis*], Kemerovo, Praktika, 2014.

[5] N. N. Maslova, *Noosfernoe obrazovanie* [*Noospheric Education*], Simferopol, Dolia, 2012.

[6] E. A. Trakhtengerts, E. L. Ivanilov, E.V. Iurkevich, *Sovremennye kompiuternye tekhnologii upravleniia informatsionno-analiticheskoi deiatelnostiu* [*Modern Computer Technology of Management of Information and Analysis Activities*], Moscow, SINTEG, 2007.

possessing creative thinking[7]. One of the ways of parallel solution of the mentioned tasks can become dialogue technologies, in the course of which interactions of a learner and a teacher are realised.

When transiting to the Seventh technological stage, such form of education must act as a kind of organisation of production of means of production of an intellectual product based on cognitive activity.

Proceeding from the experience of organising educational processes, it is proposed to assess effectiveness of new material perception in correspondence with the results of the analysis of educability pyramid. The results of training activity, reduced to such pyramid, has showed that the percent of learners memorizing the material during lectures makes 5 %, by means of reading – 10 %, by means of audio-, videotraining – 20 %, as a result of demonstration and display – 30 %, as a result of discussions – 50 %, based on practical activity – 75 %, when a learner is taught by another learners – 90 %. That is, only 20 % of learners are able to perceive information in a "dry" form. For the rest 80 %, it is necessary to introduce additional measures allowing intensifying information perception.

The mentioned statistics determine accents that are necessary for improving the educational process, i.e. introduction of such additional measures. For example, extensive use of developing games and, in case of their absence, extension of pedagogues' "initiative" are desirable for full-fledged education.

Generally, traditional educational technologies base on the principle of an imperative form of presenting new material to learners. Requirements of intellectualization of production orientate pedagogy to development of individuality of the student personality. At that, acceleration of technological development in the production determines the necessity of correction of the training process in the real time mode, imposing the requirement for intensification of operative feedback. For example, the experience of using interactive means in studies shows effectiveness of motivating students for harmonious perception of information[8]. Thus, among instruments of organising education, let us consider some information technologies allowing solving tasks of formation of personalities capable of developing technologies of the seventh stage.

Methodological peculiarities of building interactive technologies as a mechanism of involving students in the educational process

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[7] I. A. Terentyeva, T. A. Nikitina, "The Education System as a „Soft Power" in the Prevention of Extremist and Radical Tendencies among Young People," in *Astra Salvensis*, VI (11) 2018, p. 641 – 652.

[8] V. D. Sekerin, Osobennosti informatsionnogo obespecheniia sovremennogo obrazovatelnogo protsessa. [Peculiarities of information support of modern educational process], in *Otkrytoe obrazovanie*, 2 (2016), p. 59-62; R. Mason, *Globalising Education: Trends and Applications*, London, Routledge, 1998; N. C. Burbules, C. A. Torres, "Globalization and Education: An Introduction," in *Globalization and Education. Critical Perspectives*, New York, Routledge, 2000, p. 348–349; V. E. Meierkhold*, Besedy s kollektivom Prazhskogo teatra "D-37", v sb. Stati, pisma, rechi, besedy [Conversations with staff of Prague Theater "D-37", in collection. Articles, letters, speeches, talks]*, Moscow, Iskusstvo, 1968.

Intensification of production technologies' development determines importance of organising learning in the form of interactive training. As a result, operative feedback allows participants of the educational process to feel their abilities in the real time mode.

In this paper, let us present the methodological model of interaction between a teacher and a learner as the elements of the information system in the form of an improvised play named as "Lesson". Let us present a teacher as a director, and learners as actors. The task of the teacher (director) is to create conditions, under which it will become interesting for learners (actors) to participate in this play, perceiving the information that is offered to them. In such case, spectators are a circle of participants of the educational process, i.e. the management of a potential employer, to whom a graduate after study will come, or the management of an educational institution and learner's parents controlling the educational process.

Using the logic of such presentation, let us consider development of K.S. Stanislavskii's doctrines on the most important task of each of the participants of a specific occupation, and on the task which an actor solves when going separately on stage. The most important task of learner is achievement of the (conscious or unconscious) goal: application of results of studying this discipline in practice. The analogue of the task that the actor solves when going specifically on stage is determined by the goal, which one wants to achieve participating in this study.

In conversations with the performers of the studio named after Evg. Vakhtangov, V.E. Meierkhold claims that "*a paradoxical approach to the stage and an image disturbs spectator's quiescent state and indifference… This is the best theatre atmosphere. The actor perceives this atmosphere; it gives rise to one's creative activity*"[9].

Analysing the methodology of formation of this atmosphere, V.E. Meierkhold talked about the work of a director with an actor when creating a paradoxical approach to the solution of the scene and an image as follows: "*The director's work is unthinkable without joint work with an actor. The director has one end of the thread, at which one tags the actor, but the actor has another end of the same thread, at which one tags the director. It is in this regard that I claim that the director (as well as in the case of a teacher) does not have the right to develop one's plan in detail. Only when I come to the actor staff and feel the initiative of a multitude of people pouncing on me, when I have to elbow my way among the mass of impulses and variations, only then the production of the play will be given rise to. Certainly, I will never deviate from the general concept. I must always be ready for actor initiative, ready for countermovement, must find the best way out as in the chess game. I picture an initiative of an actor not in the things one says: "Mister Director, in my opinion, in this case it is necessary to make a step to the right, not to the left, but in the manner one understands my proposition. If I see that one reacts to it unconfidently, helplessly, it means that there is a mistake – either in my wish, which is not sufficiently evident for an actor, does not persuade one and does*

[9] V. E. Meierkhold, *Besedy s kollektivom Prazhskogo teatra "D-37", v sb. Stati, pisma, rechi, besedy [Conversations with staff of Prague Theater "D-37", in collection articles, letters, speeches, talks],* Moscow, Iskusstvo, 1968.

not penetrate freely in one's consciousness, or in the actor himself, who insufficiently tries to understand me"[10].

Is this not a recommendation for formation of an effectiveness criterion of information perception at a lesson? Paraphrasing V.E. Meierkhold, it is possible to say that if a teacher sees that a student reacts to one's narration unconfidently, helplessly, it means that there is a mistake either in the wish of a teacher, which is not sufficiently evident for a student, does not persuade one and does not penetrate freely into one's consciousness, or in the pattern of thoughts of the student himself, who insufficiently tries to understand the teacher. Consequently, the fullness of learners' and teacher's interest in the results of the educational process is suggested to assess by the amount and the structure of knowledge obtained as a result of the lesson, i.e. by the amount of knowledge and structure of their value, determined by spiritual aspirations of lesson participants.

The most important advantage of such technology is involvement of all learners in the process of cognition. Each of them must gain an opportunity of understanding and reflexing with respect to what they know and think. Organisation and development of dialogue communication enables interaction, mutual understanding, elaboration of joint solutions that are general but significant for each participant of such solutions of lesson's tasks. During dialogue training, students learn to think critically, to develop complex problems based on knowledge of specific circumstances and corresponding information, to compare alternative opinions, to elaborate balanced decisions, to debate, to communicate with each other.

In the organisation of such dialogue, use of tools, proposing virtual world in real time, increases the sensory persuasiveness and acuity of participants of the educational process. In this paper, the virtual world (artificial reality, computer models of reality, 3d virtual reality) implies an artificially formed reality, into which a learner submerses. In such representation, virtual reality is similar to computer games in many ways.

According to the approach developed by the authors, a teacher must not comment the image proposed by him, impose on a learner his vision of the object under discussion. However, the teacher is entitled to expect that the learners will understand and accept the course of his reasoning. In such case, to assess effectiveness of the results of lesson material perception is proposed to the teacher himself by the number of inconsistencies of the thing that he wanted to say or the thing the learners understood.

For example, trying to persuade the confabulator, the teacher tells that a literature character "intertwisted" his thought in such a way that a BARREL resulted. The teacher implied that a "barrel" was an aerial stunt, when a plane, preserving the direction of its movement, rotated about the longitudinal axis by 360 degrees. In turn, the learner had understood that a "barrel" was a thing where

[10] *Ibidem.*

cabbage was salted with admixing of different additions and tangled up in the train of teacher's thoughts.

In using such technology, there is a consistency between a natural mechanism of information perception, laid in a human being, and a mechanism of forming knowledge proposed during the lesson, which allows refocusing the effectiveness of the educational process in correspondence with the requirements of an Employer.

Ideally, an Employer assumes that new employees must be not only experts (possessing special information), but also patriots of their company. Formation of such qualities in graduates is determined in many ways by specifics of presenting augmented reality. For that, it is required to take into account characteristics of the system "specific educational institution – specific specialist – specific employer". At that, owing to constant development of technologies, such system is a developing one.

In fact, the mentioned system represents a "logistic chain of education". The content of traditional logistics is establishing cause-and-effect relationships and regularities, peculiar to the process of movement of goods for the purpose of enhancing the effectiveness of used organisational forms and methods of managing material and financial flows[11].

Education logistics consider knowledge as goods. Consequently, the openness of the education system implies that in the information incoming in the form of augmented reality, there should be data not only of professional nature, but also data on specifics of financial flows, which are limitations in the work of the logistic chain of education at each of the stages of the life cycle of the expert formation process[12].

Such life cycle can be represented as stages: primary education; postprimary education, high education, secondary vocational education, undergraduate higher education, MA course, post graduate (residency, military) study (for a degree of Doctor of Philosophy), Doctoral study (for a degree of Doctor of Science), regular professional retraining.

The main purpose of building this chain is intensification of production. Let us suppose that among system-forming factors, rationality of cause-and-effect relationships among the participants of the educational process determines effectiveness of the work of the entire logistic chain. In this paper, let us take maximization of young specialist's competitiveness as a means of production of an intellectual product as a quality criterion of such relationships. At that, the labour market will be characterised by equilibrium between the training of graduates of an Educational institution and workers' knowledge, required by an Employer.

The peculiarity of organising the labour market is the necessity to coordinate the interests of an Employer, an Educational institution and a Specialist.

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[11] E. V. Iurkevich, V. D. Sekerin, "Logistika obrazovaniia – nauka ob upravlenii peredachei znanii [Logistics of education - science of managing knowledge transfer]," in *Informatizatsiia nauki i obrazovaniia*, 12 (2011), p. 192-203.

[12] *Ibidem.*

Being a consumer in the labour market, an Employer cares about profit for one's company. To extend technological possibilities of consolidating one's position in the market of the manufactured products, an Employer invites Specialists of certain qualification. Participating in the building of training courses, one offers to introduce maximum of information about the specifics of one's production in augmented reality. Thus, an Employer minimizes expenses on adaptation of new employees to the conditions of production, using a microeconomic criterion.

According to the state policy of technological development of a specific region, an Educational institution is suggested to form programmes of training Specialists, possessing a specific set of knowledge. Consequently, let us suppose that Educational institutions when building training courses according to the Federal Educational Standard (FSES), must form information of augmented reality by a macroeconomic criterion.

The peculiarity of training courses perception is that a would-be Specialist forms a strategy of choosing one's speciality according to a personality criterion, perception of microeconomic and macroeconomic aspects of building production.

Thus, each agent of the logistic chain of education has one's own purpose and, accordingly, tendencies to orientation of one's behaviour. The most important condition of agreement of criteria of educational process participants is formation of augmented reality[13] by means of information taking into account the interests of all agents of the logistic chain of education.

In this paper, the concept "interest" implies representation of an agent's focus on resources that are necessary for one to achieve one's goal[14]. Hence, development of the methodology of building virtual reality must be determined by characteristics of the logistical chain of education, coordinating the directionality of actions of its agents in view of differences in the interests of each of them. For example, to provide comfort of existence, an agent of the logistic chain at a corresponding stage needs financial resources with a subsequent transition to improvement of public recognition.

Result

Analysis of technologies of information perception has allowed making an important conclusion: if one builds the educational process in terms of affine space (i.e. by means of images disconnected with assessment of the amount of information embedded in them), then for any learner the number of simultaneously perceived messages, communicated by a teacher, can be considered as similar. Despite the fact that a trained learner perceives deeper, and an untrained one – superficially, both of them perceive the images, suggested to them, at the same

[13] Yu. F. Kathanova, K. I. Bestybaeva, "Tekhnologiia dopolnennoi realnosti v obrazovanii [Technology of augmented reality in education]," in *Pedagogical skills and pedagogical technologies: materials of VIII Intern. scientific-practical. Conf, Cheboksary, CNS Interactive Plus*, 2 (2016), no. 8, p. 289-291.

[14]

pace[15]. At that, it is necessary to take into account that if a learner got tired, the transmission capacity of one's communication channel had decreased, i.e. the amount of information, perceived by one per unit time, had decreased.

The main theorem of C. Shannon for communication channels without noise proves that information transmission without distortions is determined by the source intensity, which must not exceed the transmission capacity of the communication channel of a receiver. Only in this case, a message can be represented so that it would be perceived without distortions or queues[16]. Consequently, to support paces of information perception, a teacher needs to move to a new (unwearied) communication channel of a learner; for example, it is required to switch to another image, to another form of presenting material.

The existing possibilities of equipping educational institutions with tools of information technologies allow forming the perception of the surrounding world by means of the system of virtual reality. Use of special software on 3D displays/monitors, special virtual reality glasses, virtual reality helmets unveils potentials of virtual world, owing to which a human being can be brought to any spaces, dimensions, inside the work of mechanisms or at geographic spots on the globe.

For example, Mariott along with the Framestore studio have developed a project of a virtual tour round the world, having created and introduced the project "The Teleporter" – cabins equipped with virtual reality glasses "Oculus Rift", allowing imitating different climate conditions. "Teleporter" enables one to be carried to both Hawaii and New York or some other place, having matched a corresponding picture in virtual reality 3D glasses with the temperature and wind force appropriate for the chosen place. Planning tours, one can feel specific peculiarities of the climate and the atmosphere of the chosen place beforehand.

The company "Facebook" has demonstrated a new development in the field of virtual reality (Social VR). By means of virtual reality, two people being at a distance of tens of kilometers from each other can communicate as though they are in the same place.

Use of the mentioned (and similar to them) products in the educational process allows regulating the transmission capacity of data communication channels of learners by means of formation of augmented reality by a teacher. It bases on the technology of addition, i.e. introduction of messages about virtual objects in three-dimensional fields of human perception. Such additions allow perceiving information about these objects as of the elements of real life. If quality content is used, then the distinction between an artificially formed world and reality is erased in the human mind. This instrument excites maximum of emotions and also allows interacting with an object under study, i.e. examine it, decompose into

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[15] E. V. Iurkevich, *Mekhanizmy obespecheniia funktsionalnoi nadezhnosti v obrazovanii* [*Mechanisms for Ensuring Functional Reliability in Education*]. Moscow, FGUP "Proizvodstvenno-izdatelskii kombinat VINITI", 2008.

[16] C. Shannon, *Raboty po teorii informatsii i kibernetike* [*Works on Theory of Information and Cybernetics*], Moscow: Inostrannaia literature, 1963.

parts and etc. In the real time mode, augmented reality is introduced by means of such gadgets as tablets, smartphones with an AR function, virtual reality glasses ("smart glasses"), etc.

In this paper, it is proposed to regard augmented reality technologies as instruments arousing amazement, memorization and different WOW effects in people. Let us recollect about outright magic of Harry Porter's world, in which school halls were hanged with animated and interactive landscapes and portraits. Such combinations are quite effective when using noospheric technologies during the study of training courses of not only humanitarian orientation, but also technical ones, as well as mathematical disciplines, for example, when studying heating during friction of uneven surfaces or when determining coordinates of the maximum point in a complex figure in the n-th dimensional space. In future, these technologies can become determining ones in the purposeful formation of priorities of training material importance.

With the use of Android or IOS devices, augmented reality allows both learners and teachers to generate various layers of digital information on top of the physical world. In fact, the world of augmented reality combines real and virtual space in the real time mode. Submersing in augmented reality, a learner sees through the device as if through a window. Beyond such window, one sees a wonderful world, which is invented by a teacher.

As a result, the participants of the educational process perceive information not in the form of words or expressions, but images which are formed in their thoughts. Let us call such visions thought-forms as holistic representations of the object under consideration. The peculiarity of these representations is that they are the result of information perception by all human sensor channels.

Thought-forms are supposed to be considered as "*holistic images of an object (phenomenon) perceived individually by all sense organs*"[17]. They can accept the following forms[18]:

- an image of a thinker, i.e. a learner, thinking directly about the object under discussion, creates one's thought-form in the form of a specific object. A thought, generating it, must be strong. Such thought-form is held in the consciousness for a long time and is usually associated with other thought-forms of this class;

- a kind of a person or some other material object, for example, characters of literary works. In fact they start acting independently of the wish of their creator;

- one's own kind. They are created as personalities with good poetic (imaginative) thinking. Usually these are abstract figures dissimilar to specific material objects, but namely these figures are the most bright and efficient in the consciousness of their creator.

[17] N. N. Maslova, *Noosfernoe obrazovanie* [*Noospheric Education*], Simferopol, Dolia, 2012.

[18] N. V. Maslova, E. V. Yurkevich, *Gologaficheskie mysleobrazy: rozhdenie, upravlenie, transformatsiia* [*Holographic Thought Images: Birth, Management, Transformation*], Moscow, Traditsiia, 2017.

Technologically, introduction of augmented reality in the educational process is simple. For example, when focusing the cameras of mobile devices on different objects, corresponding text explanations, photographs, video files or a complex of text information and a video series appear on the screen. Training applications with augmented reality are supposed to be built according to the following scheme: use of special tags; reading the tags by a computer or a mobile device; displaying a layer with additional information on the screen. In the framework of using augmented reality (through a mobile device), it is necessary to meet the following requirements:

- the mode of augmented reality must have an option of switching off with a possibility of switching to a customary mode of operation, where the surrounding space is replaced by any "empty" background or a static 3D-scene, and the content is positioned so that it would be possible to view it using a device;
- text must be displayed on the background providing its contrast and convenient reading on the screen with an option of scrolling;
- a photo gallery must be screened on the background convenient for viewing, and have elements of transiting to the following/previous photo;
- an audio track must be played through an audio system of the device, and a toolbar of play control with an option of pausing/restarting audio playback, as well as transition to an arbitrary spot of an audio track, must be visually represented;
- a video recording must be played with a sound (in the presence of it) on the background for convenient viewing on the screen and have a toolbar of play control with an option of pausing/restarting video, as well as transition to an arbitrary spot of recording;
- initially, a 3D-scene is prepared by a teacher for correct representation in the augmented reality mode and can have its own individual controls depending on the scenario.

The requirements for conditions of viewing the augmented reality repeat the conditions of virtual reality formation; at that:

- the introduced content must be organically "framed" by a background and other objects in the background to look naturally in conditions of a 360-degree field of vision;
- an application for playing back presentations must take into account the orientation of both a VR-helmet and additional controllers that a teacher may use;
- the entire content, being initially two-dimensional, must be appropriately visualized by a teacher so that it would be convenient for one to view it in the 3D mode in virtual space.

At present, the augmented reality technology in the 3D format has been embodied in practice, beginning from the first stage of the logistic chain, for instance, when creating an interactive alphabet. One of the effective versions of this alphabet has been published in the form of a dictionary[19], being developed

[19] N. V. Antonenko, T. M. Klimenkova, O. V. Naboichenko, M. V. Ulyanova, *Rodnoi bukvar [Native alphabet]*, Training pack, 2nd enlarged ed., Moscow, Traditsiia, 2016.

using noospheric technologies. Such approach allows intensifying the study of the alphabet, analysing the proposed images by separate layers of their understanding. Learners will be able to form purposefully individual thought-forms studying the objects with a turn of up to 360 degrees.

The interactive alphabet, developed by the authors, includes three game platforms: a book (pages of which are special tags), an application with 2D games and an interactive training game in augmented reality. For example, when one directs a smartphone to the alphabet, animated 3D characters may appear on the pages.

Conclusion

Application of the augmented reality technology helps to enhance the effectiveness of educational processes. Use of virtual reality allows not only narrating and showing learners a history of the world, but also illustrating the real world from the positions of specific conditions. Learners can both be sent in microcapsules to tours round a human body and choose a right track for expeditions on board of Magellan's ship. Use of virtual reality allows changing scenarios, exerting influence on different experiments or solving mathematical problems in games and accessible for understanding forms.

The practice of using the interactive alphabet has shown that the augmented reality technology allows providing:

- strong emotional feedbacks since appearance of virtual characters brings learners to a state of delight and surprise, which is of paramount importance for the growth of children's involvement in the training process;
- involvement and activity of perception of proposed material, which contributes to its stable memorizing;
- possibility of interaction between gadgets and an artificial world, discovering essential advantages of augmented reality with respect to virtual reality;
- connection between Digital and Offline;
- conducting virtual lessons. One of the main peculiarities of the virtual reality is a sensation of involvement and an opportunity of first-person observations. This makes it expedient to conduct lessons wholly in virtual reality.

More complete involvement in the educational process enables increasing motivation and progress in obtaining knowledge. Observations of maximally realistic images stimulate brain activity. During such lessons, there is a transition from VR and AR-technologies to a qualitatively new level of processing information. For example, a learner can participate personally in historical events; observe physical processes in complex mechanisms; manipulate different technological processes; visit the interior of reagents during chemical reactions; carry out analysis of large volumes of data, etc.

On the whole, use of augmented reality technologies in educational processes discloses a spectrum of unlimited opportunities in studying subjects.