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MODERN TECHNOLOGY ENHANCED ADAPTIVE AND COGNITIVE LEARNING IN THE VIRTUAL REALITY ENVIRONMENT

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СОВРЕМЕННЫЕ ТЕХНОЛОГИИ УЛУЧШИЛИ АДАПТИВНОЕ И КОГНИТИВНОЕ ОБУЧЕНИЕ В СРЕДЕ ВИРТУАЛЬНОЙ РЕАЛЬНОСТИ

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VIRTUAL BORLIQ MUHITINI MOSLASHUVCHAN VA BILISHGA OID ZAMONAVIY TEXNOLOGIYALAR ORQALI TAKOMILLASHTIRISH.

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This text deals with the design of virtual reality systems. Infrastructure includes providing a powerful adaptive or cognitive learning to use the different levels of complexity that will be adapted for each student, empowering those who present more difficulties for learning. Smart devices and intelligent technologies create learning environments that respond to each learner's profile and needs and offer conditions for realizing personalized and adaptive learning.

Keywords: *virtual reality for education, adaptive or cognitive learning, passive and active learning in virtual world.*

В этом тексте рассматривается проектирование систем виртуальной реальности. Инфраструктура включает в себя обеспечение мощного адаптивного или когнитивного обучения для использования различных уровней сложности, которые будут адаптированы для каждого учащегося, расширяя возможности тех, кто представляет больше трудностей для обучения. Интеллектуальные устройства и интеллектуальные технологии создают среду обучения, которая отвечает профилю и потребностям каждого учащегося и создает условия для реализации персонализированного и адаптивного обучения.

Ключевые слова: *виртуальная реальность для обучения, адаптивное или когнитивное обучение, пассивное и активное обучение в виртуальном мире.*

Ushbu maqolada virtual borliq tizimlarini loyihalashga bag'ishlangandir.So'ngra maqolada moslashuvchan va bilishga oid tizimlarni ta'lim sohasida infratuzilma har bir talaba uchun moslashtiriladigan turli xil murakkablik darajalaridan foydalanish o'z ichiga oladi. Bu esa o'rganish uchun ko'proq qiyinchiliklarga duch kelganlarga imkoniyat yaratadi. Aqlli qurilmalar va intellektual texnologiyalar har bir o'quvchining profiliga va ehtiyojlariga javob beradigan, shaxsiylashtirilgan va moslashuvchan ta'limni amalga oshirish uchun sharoit yaratadigan o'quv muhitlarini yaratadi.

Kalit so'zlar: *o'rganish uchun virtual haqiqat, adaptiv yoki kognitiv o'rganish, virtual dunyoda passiv va faol o'rganish.*

1 Introduction

The journal *Smart Learning Environments* was launched in 2014 with the aim "to help various stakeholders of smart learning environments better understand each other's role in the overall process of education and how they may support each other". To identify the requirements for the distinguishing feature of an SLE – that it provides *better and faster learning* – Koper introduces the concept of a Human Learning Interface (HLI), a "set of interaction mechanisms that humans expose to the outside world, and that can be used to control, stimulate and facilitate their learning processes". [3] What HLIs there are to be considered in a SLE are, according to Koper, depending on what learning theories one subscribes to. An extended definition of Koper's SLE,

with both the technical and pedagogical characteristics covered, is therefore the "physical environments that are improved to promote better and faster learning by enriching the environment with context-aware and adaptive digital devices that, together with the existing constituents of the physical environment, provide the situations, events, interventions and observations needed to stimulate a person to learn to know and deal with situations (identification), to socialize with the group, to create artifacts, and to practice and reflect" (Koper, 2014, p. 14). Testing the SLE reference model can be done in two steps. First, the model must withstand requirements coming from other SLE conceptualizations. Second, the model must prove itself useful for the main purpose of this research that is related to further standards development: Will the model work as a framework for ITLET standards development? To reach a conclusive answer this will need testing. Additionally, 'reference implementations' can support the standardization process in contexts where innovation in technology is fast moving [4].

Adaptive Training Development Experience

Boeing's approach to a learner-centered adaptive training implementation has evolved over the course of the past few years. Initial implementations focused on creation of an architecture and authoring solution in support of intelligent tutoring. The product of this effort was Web-based, SCORM®-conformant computer-based training. More recent efforts focused on development of simulation-based instruction that monitors student performance in real time and adapts the scenario accordingly. More details of both approaches are provided below. Adaptive learning within simulated training environments can be challenging if access to information for assessing performance have not been built into the simulator or gaming engine. Many times, simulators communicate performance at the mission level, whereas student performance needs to be evaluated at the switch or button push level. Adding the capability to perform automated performance assessment within the simulation proves costly and time-consuming. However, adding access to the events and data at the switch or button level for evaluation by tools like the ITS and VI have proven to be minimal. Finally, adaptive training has yet to be widely accepted within the educational community. We speculate that this is due in part to the added cost of creating multiple sources of adaptive content (something that is getting better with continuous improvements in authoring capability), as well as a potential increased time to proficiency based on student performance. While ample evidence documents improvements to student training performance, training transfer and long-term knowledge retention based on adaptive training solutions, there is reluctance to adopt these approaches given the potential added complications of each student progressing at his or her own pace. As part of the final practice assessment, students don a virtual reality (VR) headset, and using two 3D VR hand controllers, they are able to navigate to various places on the aircraft, perform the required troubleshooting tasks while adhering to required safety protocols, diagnose the fault and replace the faulty part (Figure 2). The VI within the ADAPT system scores the student on targeted learning objectives, provides on-demand student assistance to help locate components, and provides scoring to determine whether the student passes or fails the practical assessment. [5]

Currently, virtual reality (VR) is widely used in various fields, especially in computer systems, technology and medicine. However, experimental research remains one of the main barriers to education at a higher cost. Every day that goes by, research and educational needs of universities and research institutions change with developing technology. Based on the experience of implemented development VR content in education can be noted that technology brings positive results when it is using by short sessions or as simulators and trainers. It is inappropriate to use VR for lectures and seminars. In addition to reviews of how virtual reality has been used in education, discusses the advantages and disadvantages of using these technologies in the classroom, and describes how virtual reality and augmented reality technologies can be used to enhance teaching at university.

They said by combining dynamic cognitive load assessment with other performance measures, data analytics and artificial intelligence (AI), they create the potential opportunity to establish a new partnership between the learner and the learning environment. In addition to providing adaptive and dynamic responses to the learner, continuous and pervasive awareness of the learner's cognitive load allows the environment to customize certain parameters to individual learners, optimizing learning outcomes. Finally, utilizing AI and machine learning algorithms, simulated environments may be able to predict and anticipate learner cognitive states, which in turn can help further support the learning process.[6].

Education 4.0 is being empowered more and more by artificial intelligence (AI) methods. they observe a continuously growing demand for adaptive and personalized Education. There are also an innovative approach to promoting AI in Education 4.0. Our first contribution is AI assisted Higher Education Process with smart sensors and wearable devices for self-regulated learning.

Secondly they describe their first results of Education 4.0 didactic methods implemented with learning analytics and machine learning algorithms. The aim of this case study is to predict the final score of students before participating in final examination [7].

TABLE I. SUMMARY OF LEARNING TECHNIQUES - AUGMENTED REALITY, ADAPTIVE LEARNING AND GAMIFICATION

Technique	Devices Required	Examples	Benefits	Barriers
Augmented Reality(AR)	• Head Mounted Displays • Mobile Devices	• Simulations to explore heritage sites • Remote virtual laboratories • Experience virtual solar system • View scientific phenomena e.g., chemical reactions, nuclear radiation • 3D object creation for mathematics and geometry	• Promotes collaborative learning • Increases proximity to virtual objects • Enables visualizing the un- viewable processes • Promotes pervasive learning • Friendly for all age groups • Helps visually impaired learners by augmenting virtual audio objects	• Design, implementation, and integration of AR with learning systems is challenging • Requires more time& effort • Needs technical expertise with domain specific knowledge.
Adaptive Learning(AL)	• None • In special cases – sensors for eyeball tracking, facial expression etc.	• Khan Academy - customized learning • LearnSmart- adaptive eBook • Knewton - platform to provide AL applications • Smart Sparrow - course authoring tools	• Minimum student-teacher interaction • Increases productivity • Allows students to progress at their pace • Increases student engagement • Decrease student dropout rates • Improves student performance • Provides efficient learning • Better learning experience.	• Elevates initial investment • High maintenance cost • Increases complexity - algorithms and cognitive model used to predict student behaviour • Availability of confidential data to third parties • Hard to decide required level of adaptability • Requires special expertise
Gamification	• None • For simulated games devices for AR are used	• Simple.com, an online gamified banking service for managing finances • Mentira, amobile GPS and AR- based game helps to learn Spanish language • SICKO, a web based simulation game helps medical students to diagnose virtual patients.	• Develops problem solving skills • Strengthens critical thinking • Builds team working skills. • Makes routine work (doing homework) interesting • Enhances learner experiences • Spur student motivation	• Categorizing appropriate gaming elements for specific audience is difficult • User dissatisfaction arises if unsuitable game tactics or approaches are used • Demands training of teachers to integrate games meaningfully into their total curricular activities.

Three techniques have played a key role in e-learning. To cater to the need of an individual learner and support individualization a different learning method emerged, titled *Adaptive Learning* or *Intelligent Tutoring*. Also, if students are learning about un-viewable systems like solar system, photosynthesis process, nuclear reactions or historical sites; it is apparent that understanding these concepts without being able to see them in reality is a hindrance in path of extensive learning. *Augmented reality* helps create virtual objects which when blended with real world, provide an immersive learning experience to learners.[8]

Augmented Reality refers to a concept in which real world is enhanced by blending it with virtual world [13]. The real world static objects are dynamically morphed with context sensitive virtual information like video, audio, or a graphic overlay to improve user's experience [9, 10].

"Adaptive learning is a method of education that seeks to personalize learning by using sophisticated algorithmic technology to continually assess knowledge, skill, and confidence levels of students and design targeted study paths based on the resulting data" . Adaptive learning is a process that changes the instructions dynamically based on individual preference or ability.

The adaptive learning method was implemented in education in early 20th century as

educators started to look for measures to improve the student performance and learning environments .

Adaptive Learning is trading the learning toward personalization. Cognitive science and different algorithms are used to predict the learner's behavior that helps in delivering the environment according to needs of the learner. Such techniques help in understanding the student behavior and supports instructors to achieve the goal of student satisfaction.[8]

DEFINING AUGMENTED AND VIRTUAL REALITY

Augmented and virtual reality technologies are immersive technologies which can provide real as well as virtual immersive experiences. These technologies can be accessed either through electronic devices such as mobile phones, head mounted gear or a Cave Automatic Virtual Environment (CAVE). There are various companies which manufacture AR and VR hardware platforms as well as various software companies which develop accompanying software to be used on the various hardware platforms. A CAVE is a dark room which enables people to wear AR glasses and be fully immersed in the virtual world with the dark room adding an extra effect to this virtual setting [16]. Augmented Reality (AR) is the use of mobile technologies used to overlap a real world environment by visually superimposing and connecting a present view with virtual objects ([14]; [15]). In figure 1, the Microsoft HoloLens augmented reality glasses are used to supersede reality by creating a view which allows the participant to virtually move nails from one container to the other. In this image, the student is playing an educational game which requires them to pick and place virtual nails superimposed or visible on the real nail storage boxes.

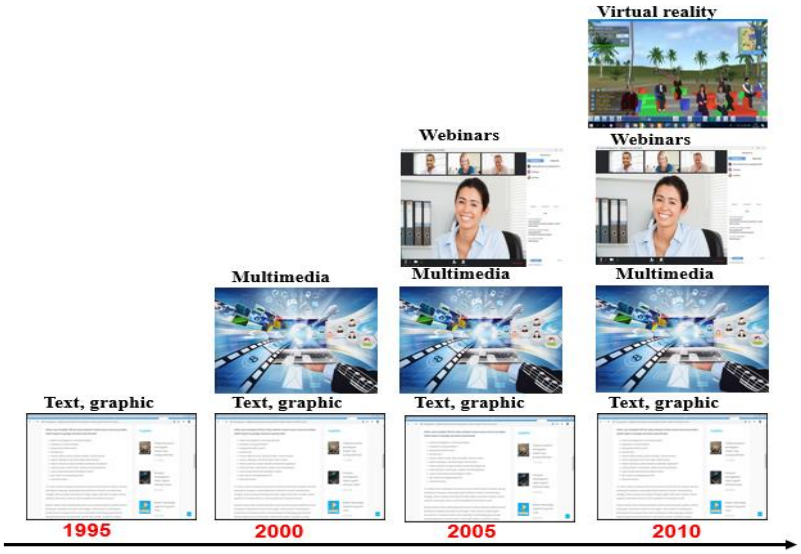

Figure 1. E-learning development tools.

2. Effective education consists of many relative statements: Immersion or Involvement, Active and interactive, Social, more practice, good experience, Student in the center, Reflective, Applied, Result or Evaluation.

Educational activities

- Problem-based learning
- Enquiry based learning
- Game-based learning
- Roleplaying
- Virtual Quests
- Collaborative Simulations (learn by simulation)
- Collaborative construction (building activities)
- Design course (internal and external artifact, game fashion, architectural)
- Virtual laboratories
- Virtual fieldwork

1.1 Negative effect of electronic (distance) learning.

Lack of real, "human" communication between students and teachers. That is, all those moments associated with an individual approach to training and education are missing. And if there

is no teacher nearby who usually emotionally stains knowledge and contributes to the perception of the material, this, of course, is a significant minus.

Several individual psychological conditions are absent in home-schooling. To obtain distance education, regular, strict self-discipline is required, and the result of training directly depends on the student's independence, abilities and self-consciousness. Constant access to the sources of educational materials (electronic textbooks, video materials, etc.) is required. This requires good technical equipment at home, but not everyone who wants to get an education has a computer and access to the Internet.

Lack of practical training necessary to consolidate the theory and better assimilation of knowledge.

There is no regular control on the part of the student, which is rather a negative sign for the person. Few people manage to overcome laziness on their own. Educational electronic programs and courses are not always well developed and satisfy all international requirements due to the insufficient qualifications of the specialists creating such textbooks, as today this is still a new and insufficiently studied direction. In distance education, training is conducted mainly in writing only. For some students, the lack of opportunities and requirements to express their knowledge orally can lead to poor learning and many other problems.

1.2 Open University.

Open University of Great Britain (OUUK), National University of Distance Learning (UNED) in Spain, International Institute of Management LINK, Moscow State University of Economics, Statistics and Informatics (MESI), All-Russian Correspondence Financial and Economic Institute (VZFEI). Developed based on the model of distance education through its modernization in the course of using modern computer and telecommunication technologies.

The university of distance education differs from the traditional university in that its only task is the provision of distance education services. This task determines its specific organizational structure. The teaching staff, technical, educational support, administrative staff of the university of distance education in its tasks, functions, content of work differs significantly from those characteristics of a traditional university.

The implementation of the principle of openness led to significant organizational innovations that became feasible precisely thanks to the introduction of new technologies for storing, processing and transmitting the information. So, for example, in the 90s a new model of distance education appeared based on teleconferencing technologies.

1.3 Virtual university.

California Virtual University (USA), Virtual University of Berlin (Germany).

We consider this form of organization of the educational process as a new, just outlined model of education.

A virtual university is collaborating administrators, course developers, teachers, technologists, distance-separated students who work together and study using modern distance education technologies.

In this model, those potential opportunities for restructuring the education system that has the technology of teleconferencing used for educational purposes are fully realized. These technologies allow groups of students and individuals to communicate with teachers and among themselves, at any distance from each other. Such modern means of communication are supplemented by computer training programs that replace printed texts, audio and video films

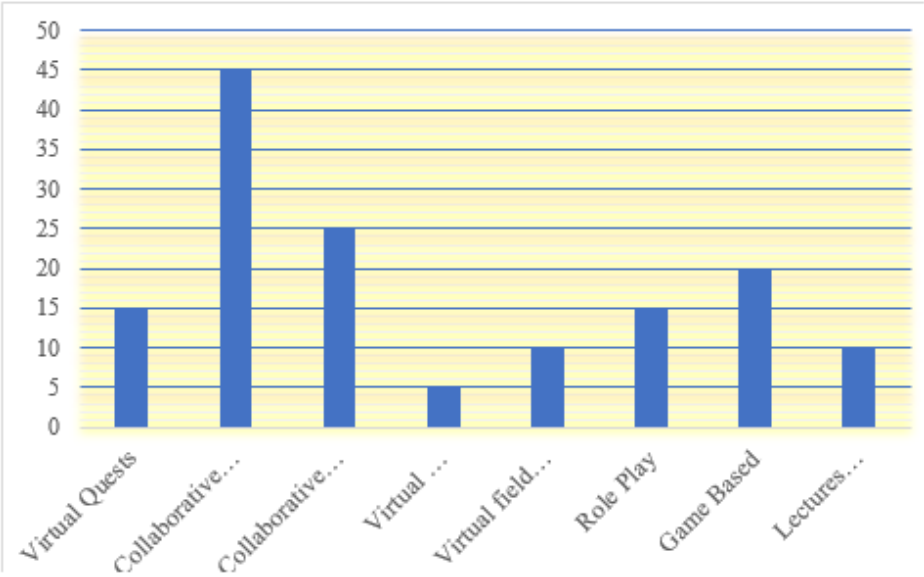

Figure 2. Summary of the educational activities in the reviewed literature.

Attractions of simulations

- ❖ Prediction
- ❖ Understanding
- ❖ Explanation
- ❖ Exploration(in a safe environment)
- ❖ Virtual worlds are created by the participants and the world emerges from the interaction of participants
- ❖ Individuals can project their views and values on topics through their avatar and receive the feedback of others in the system.

Attractions of simulations

- Economy(they are cheaper to run than the real-life situations);
- Visibility(they can make a phenomenon more accessible and clear to the researcher);
- Control(the researcher has more control over the simulation than in the real-life situation);
- Safety(researchers can work on a situation that may be too dangerous,sensity, ethically questionable or difficult in real life natural situations);
- Practice(they can be used for training);

As mentioned earlier, one of the criteria for final list selection was the rank of HEI where the course or programme was delivered. Table 2 presents list of universities and theirs places in QS World University ranking, Times Higher Education World University Rankings, and Academic Ranking of World Universities in order to demonstrate their rank. An only university, which is out these criteria is University of Bradford. However, we decided to include it as the provide BSc (Hons) in Virtual and Augmented Reality

	HEI* organization	**Country of Original**	**QS#**	**THE #**	**ARWU #**
	Aalto University	Finland	101-150	99 (190)	401-500
	TU Wien	Austria	51-100	126-150	101-150
	TU of Munich	Germany	64	41	50
	Trinity College Dublin	Ireland	88	117	151-200
	University of Cambridge	UK	5	2	3
	NUS	Singapore	15	22	9

					1
	City University of Hong Kong	China	49	119	201-300
	KTH	Sweden	98	173	201-300
	Carnegie Mellon University	USA	47	24	80
0	Cornell University	USA	16	19	13
1	Johns Hopkins University	USA	17	17	16
2	University of Califonia Berkeley	USA	27	18	
3	University of Bradford	UK	601-650	601-800	
4	Tilburg University	Netherlands	357	195	
5	Columbia University	USA	18	14	8

3. Evaluation of virtual reality

Virtual reality is the term used to describe a “three-dimensional, computer generated environment” which can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions.

Definition of VR: Inducing targeted behaviour in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.

Four key components appear in the definition:

1. Targeted behaviour: The organism is having an “experience” that was designed by the creator. Examples include flying, walking, exploring, watching a movie, and socializing with other organisms.

2. Organism: This could be you, someone else, or even another life form such as a fruit fly, cockroach, fish, rodent, or monkey (scientists have used VR technology on all of these!)

Artificial sensory stimulation: Through the power of engineering, one or more senses of the organism become hijacked, and their ordinary inputs are replaced by artificial stimulation.

4. Awareness: While having the experience, the organism seems unaware of the interference, thereby being “fooled” into feeling present in a virtual world. This unawareness leads to a sense of presence in an altered or another world. It is accepted as being natural.[1]

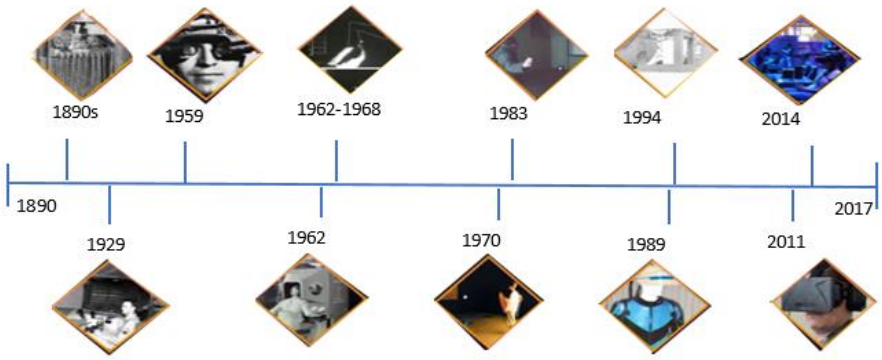

Figure 3. Evaluation of virtual reality step by step in the world.

E-books, YouTube and MOOCs all just bring same content out to more students. The teaching method is still the same as 50 years ago. No real innovation there. We could instantly give millions of students access to cutting-edge laboratories at almost no cost!

Applications for VR and AR in Education.

Open Simulator, Second Life, Active Worlds, Project Wonderland and Open Cobalt are some Virtual World platforms that can be applied in any educational procedure. In the following paragraphs we examine their main characteristics and perform a qualitative comparison. Open Simulator platform development originated as soon as Linden Labs Inc distributed their Second Life client software under GNU LGPL license, making it widely available to users and programmers. Some preliminary efforts resulted in a freely available, open-source project named Open Simulator (OpenSim). An Open Simulator installation can host simulated virtual environments, much the same with Second Life due to the adoption of its messaging protocol. This characteristic makes OpenSim accessible through the most popular SL viewers. User registration and account creation are free.

International

The leaders in the global market of "3D for education" technologies are American companies IBM, Microsoft HoloLens, Google, Samsung. Currently, teachers and researchers mostly use virtual education services from Google and Microsoft. Moreover, Google provides many free services for teachers: Codeingame.com, vAcademia.com, fun-mooc.fr and others.

At first sight, the scientific challenges regarding the virtual reality that has to be addressed in our project. Moreover there already existing virtual reality platforms. They certainly suffer from limitations but without a deep study of the limits of these existing systems. There exists an online course on the french MOOC platform: FUN (https://www.fun-mooc.fr/) (in french alas) on virtual reality and innovative teaching practices. They're also working in this area Haptics and virtual reality laboratory in Korea. Haptics covers a diverse range of topics, including the understanding of human sensorimotor ability, mechanics and electronics principles required to build haptic interfaces, and computational algorithms for modeling and rendering haptic environments. (http://haptics.khu.ac.kr/)Microsoft Xbox packed provides many applications for game study field education, medicine and architecture.

Watch full talk to see Labster’s virtual laboratories.bit.ly/vr-labs. Labster’s virtual laboratories are proven to significantly increase learning impact over traditional methods

It is variously called the "learning pyramid," the "cone of learning," "the cone of experience," and others. It's often attributed to the National Training Laboratory, or to educator Edgar Dale.You won't be surprised to learn that there are different versions out there with different percentages and some minor variations in the ordering of ac. Certainly, some mental activities are better for learning than others. And the ordering offered here doesn't seem *crazy*. Most people who have taught agree that long-term contemplation of how to help others understand complicated ideas is a marvelous way to improve one's own understanding of those ideas--certainly better than just reading them--although the estimate of 10% retention of what one reads seems kind of low, doesn't it?

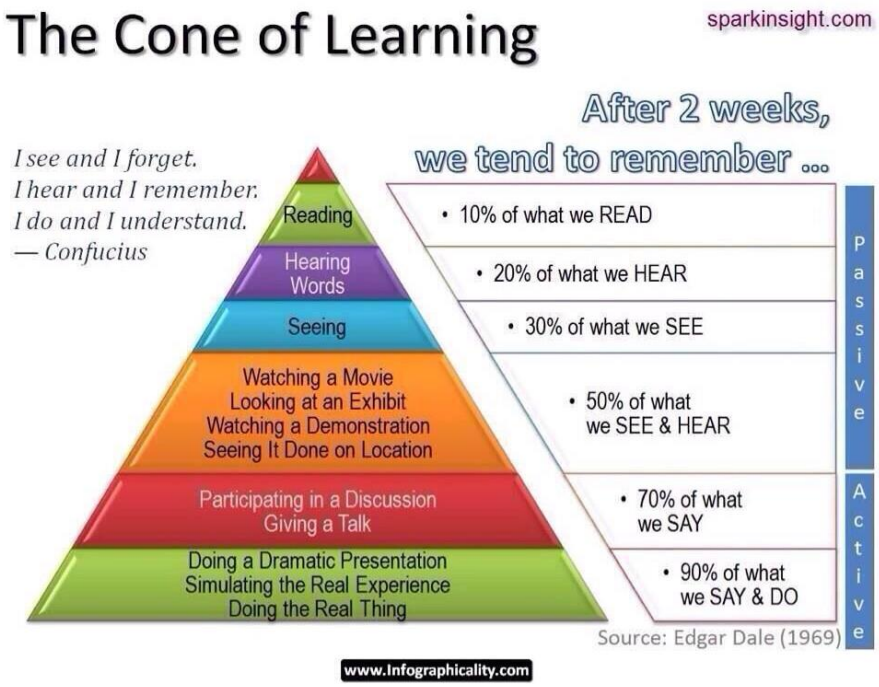

Figure 4. Why VR is useful for education?

Virtual objects (artifacts)

What is possible only in Virtually:

✓ You can simulate the environment
✓ You can simulate events
✓ You can simulate joint actions

Further training or retraining of teachers involved in virtual learning can be achieved by increasing the level of their training. To solve these problems, it is necessary, first of all, to revise the existing regulatory legal acts on virtual education and develop standards and rules necessary for the implementation of virtual education. Also, it is necessary to analyze the current technical condition of existing computer networks, increase their speed and take measures to strengthen their material and technical base.

The 3D Auditorium - trainers giving lectures in the 3D Auditorium will be able to load specific presentations from the VLE or even upload their slides.

Classrooms/Meeting Rooms - these rooms can serve as meeting areas for project partners and as classrooms for small groups of students as well.

We will review this example model of University and some students choose their subjects where they learning his timetable. Students can now experience the topics they are learning about. The use of virtual reality technology has been shown to increase student engagement and focus, while the immersive and interactive environment encourages the students to become active learners.

Adaptive Social learning

Collaborative lessons

Real-time changes to optimize learning

Cognitive load theory :

• Reduce destruction
• Emphasize effort on learning not just doing
• Learning is enhanced by pointer & guided exercise
• Worked example and ‘faded example’ are better than full problem solving

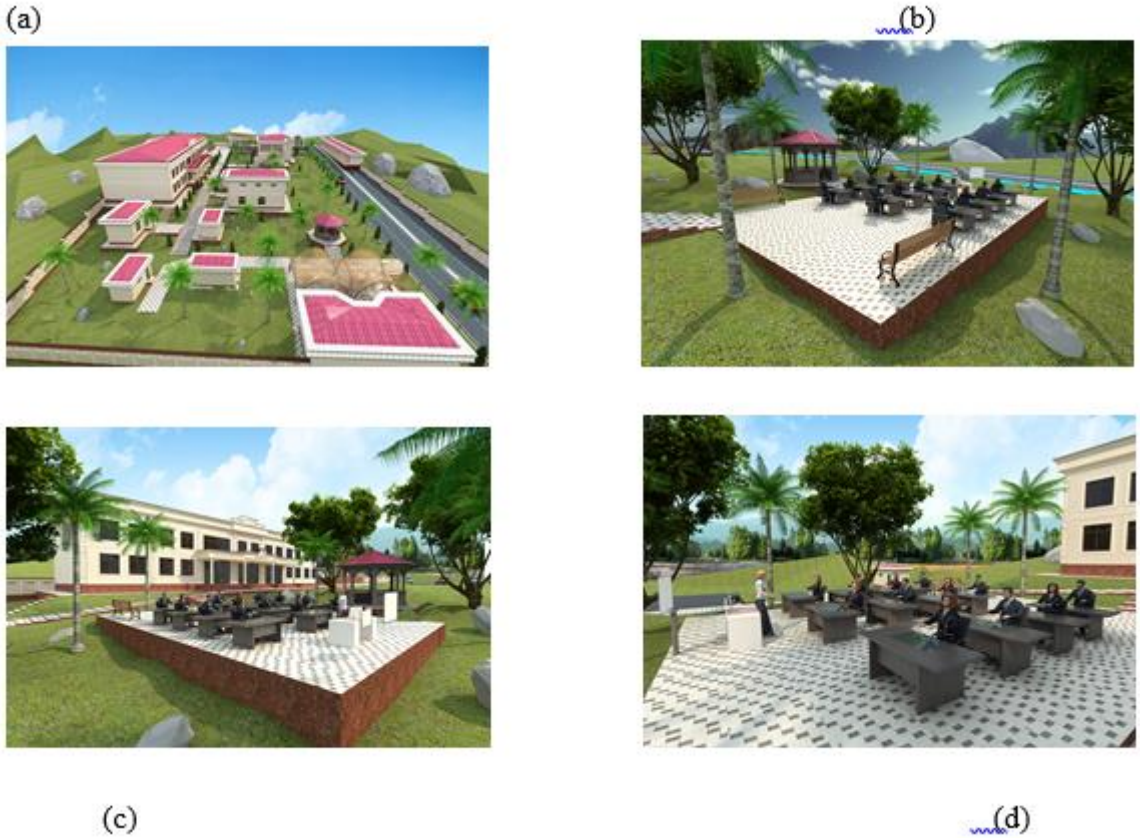

Figure 3. Some of the steps of the construction works process that presented at the BC/VR Software.

Figure 3. Some of the steps of the construction works process that presented at the BC/VR Software.

Testing models created with virtual reality applications. (a), the main view of the educational building, (b) laboratory room's project, (c) main entrance, (d) schedule table.[3, 4]

5 Conclusions

This paper presents new way of review in this example model of University and there are students choose their subjects where they learning his timetable. Students can now experience the topics they are learning about. Use of virtual reality technology has been shown to increase student engagement and focus, while the immersive and interactive environment encourages the students to become active learners.

We will produce the following results:

- Operation is faster when it is installed in the national domain;
- Preparation of appropriate instructions for launching and operating the created virtual 3D University;
- Presentations, demonstrations of existing VR models

Development of specific models for tutors to use VR and 3D modelling in the built environment curriculum;

Initial perception of 3D and VR technologies by tutor;

- Tutors' requirements after the initial integration with 3D and VR technologies;

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References

[1] Steven M. LaValle, (2017) 'Virtual Reality', University of Illinois Copyright, Cambridge University Press, pp.1–7. http://lavalle.pl/vr/

[2] Fei GAO. (2012), "Design and Development of Virtual Reality Application System", Tsinghua Press, pp.44- 55.

[3] Tore Hoel & Jon Mason, (2018), 'Standards for smart education – towards a development framework', Hoel and Mason Smart Learning Environments (2018) 5:3 ,2-25 https://doi.org/10.1186/s40561-018-0052-3

[4] Grover, S., Cooper, S., & Pea, R. (2014). Assessing computational learning in K-12. In Paper presented at the proceedings of the 2014 conference on innovation & technology in computer science education.

[5] Barbara Buck, Ph.D.1 , Matt Genova1 , Brandt Dargue1 and Elizabeth Biddle, Ph.D.2, 'Adaptive Learning Capability: User-Centered Learning at the Next Level', Intelligent Tutoring Systems Conference 2018 Industry Track Proceedings, pp. 3–11 (2018). http://ceur-ws.org/Vol-2121/Preface.pdf. Accessed 19 Feb 2019

[6] Dirk Rodenburg ; Paul Hungler ; S. Ali Etemad ; Dan Howes ; Adam Szulewski ; Jim Mclellan (2018), 'Dynamically adaptive simulation based on expertise and cognitive load', 2018 IEEE Games, Entertainment, Media Conference (GEM), https://doi.org/10.1109/GEM.2018.8587618

[7] Monica Ciolacu ; Ali Fallah Tehrani ; Leon Binder ; Paul Mugur Svasta,(2018), ' Education 4.0 - Artificial Intelligence Assisted Higher Education: Early recognition System with Machine Learning to support Students' Success, 2018 IEEE 24th International Symposium for Design and Technology in Electronic Packaging (SIITME), https://doi.org/10.1109/SIITME.2018.8599203

[8] Jyoti Chauhan, Shilpi Taneja, Anita Goel,(2015) , 'Enhancing MOOC with Augmented Reality, Adaptive Learning and Gamification', *,2015 IEEE 3rd International Conference on MOOCs, Innovation and Technology in Education (MITE), https://www.researchgate.net/publication/282798098*

[9] H. K. Wu, S. W. Y. Lee, H. Y. Chang, and J. C. Liang. "Current status, opportunities and challenges of augmented reality in education", Computers & Education, vol. 62, pp. 41-49, 2013.

[10] Nuraliev F.M., Giyosov U.E,(2019), 'Integration of virtual reality and 3D modeling use of environments in education', International Conference On Information Science And Communications Technologies ICISCT 2019 Applications, Trends And Opportunities, 4-6 November 2019,Tashkent Uzbekistan, https://ieeexplore.ieee.org/xpl/conhome/ 8982113/proceeding.