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AUGMENTED REALITY TOOLS IN EDUCATION

Emphasized that augmented reality proposes unique learning features, such as support of seamless interaction between real and virtual environments. Within augmented reality in education scope different applications were checked. Key tools usage for AR like smartphones, computers, helmets, glasses, gloves and other input and output systems were discussed in the article.

Keywords: *augmented reality; education; applications; virtual environments; hardware.*

Problem's statement.

Embodied perception is the hypothesis that cognizance in the association between the physical body and the brain. While studying process, educators manage embodied cognition at whatever point they welcome understudies to collaborate with nature whether through carrying on verifiable occasions or leading science tests. This involvement helps to verify information for future as well as offer a drawing in option in contrast to customary guidance. Numerous devices exist to enable educators to make undergraduates for their understudies including games and encounters that are both simple and advanced, each taming the intensity of multi-tactile learning. Nevertheless, none of those apparatuses appears as encouraging in conveying learning through embodied cognition as the new flood of innovations, for example – Virtual and Augmented Reality innovations.

Epitomized insight endorses that both the brain and the body are operator cooperating to cause importance of our background and numerous examinations to strengthen exactly how encouraging exemplified discernment is for acquiring information. In the age where exponential technologies need to address and solve complex issues, education systems globally should undergo significant reforms. Many countries' educational policy reform is aimed at digitizing and promoting the availability and access of digital educational resources to every student and teacher. Augmented Reality can be applied for learning, entertainment, or edutainment by enhancing a user's perception and provide interaction with the real world. Augmented Interface is one of the important ways to improve learning because it enables the manipulation and study of three-dimensional virtual objects.

Numerous devices exist to enable the teachers to make their students study, including games and encounters that are both simple and advanced, each taming the intensity of multi-tactile learning. Nevertheless, none of those apparatuses appears as encouraging in conveying learning through embodied cognition as the new kind of innovations, such as Augmented Reality. Augmented Reality (AR) is a kind of technology where students can interact with subject materials in the ways never available before.

Immersing learners to real world and make them to interact with that world's concepts and features is, in many spheres, not very possible or rational. Although the natural world is three-dimensional, we prefer to use two-dimensional approaches in education which is the simplest, familiar, universal and what is the most important – cheap. But it is static and offers no dynamic content. Instead, augmented reality created by machines can be used. Such approach needed high-performance computer graphics that were far more costly, but now even an average smartphone can provide a satisfactory level or AR support.

While there could be plenty of possibilities for teaching and learning in simulated environments, it is challenging to have an

appropriate degree of realism. When people are very absorbed by Virtual Reality, they separate themselves from the actual environment. Nevertheless, Augmented Reality instead, proposes modeling on top of the existing physical environment and gives simulated and merged virtual and real environments. Despite the fact that there has been much dispute over learning styles speculations, as examined in the accompanying, making them learn condition that can envelop various learning styles could be advantageous as it would be reasonable for an a lot more extensive scope of people.

Theoretical background.

Researchers presently are progressively condemning of learning styles approaches [10], [11], expressing that, however there are numerous viewpoints, there is minimal exact proof for learning styles. Nonetheless, regardless others think of it as essential to know about fluctuating tangible modalities and learning approaches due to understudies' contrasting learning propensities and inclinations. The effect of learning styles on e-learning is additionally discussed [13], including how best to structure versatile virtual learning conditions while thinking about learning styles [8]. There are potential advantages of focusing on numerous techniques for learning inside VR, to take into account distinctive data handling. This could be not just an aftereffect of learning techniques and people's inclinations yet additionally a delineation of how various kinds of data might be preferable displayed in certain organizations over others (for example language might be best learnt with sound, though designing might be more qualified to perception).

In spite of the fact that very few exact examinations have yet been administered, AR has been contrasted with customary learning in certain territories. In one investigation a gathering of military understudies were educated with either the talk based instructing techniques that are customarily utilized for the subject material (erosion counteractive action and control) or with a vivid VR-based showing strategy [14]. They found that though the conventional learning gathering had an improvement of 11%, the VR gathering had a higher improvement of 26%.

Bellamy and Warren directed a contextual analysis utilizing basic online intuitive reproductions which copied genuine tests [3]. Eighty-three percent of their understudies revealed that they found these online re-enactments supportive or accommodating, and their demonstrators expressed that the understudies appeared to be greatly improved readied and more ready to reply quizzing when they had done the online reproductions. These and different models advance for learning the convenience of re-enacted conditions as options in contrast to genuine situations.

Augmented Reality technology is not a very new idea in the world. It has already been used in spheres such as military; medicine; engineering design; robotic; telerobotic; manufacturing, maintenance and repair applications; consumer design; psychological treatments, etc. [2]. Augmented Reality has become a topic of numerous explorations recently. Both theoretical and experimental framework allowed receiving valuable results and proofs of beneficial use of AR technology in teaching.

Govindarajan, Singaravelu & Sivakumar, A. in the paper “Augmented reality in teaching and learning process” introduce the technology of augmented reality and its possibilities for education [7]. Key technologies and methods are discussed within the context of education. Yadav, Savita & Chakraborty, Pinaki & Kochar, Gurtej & Ansari, Deeheem discuss interaction of children with an augmented reality smartphone app [15]. The objective of this study was to determine the age at which children become capable of using smartphone apps with augmented reality. The authors developed an augmented reality smartphone app. They studied the interaction of the children aged between two and eight years to determine their interest in using the app.

Using augmented reality in education gives the possibilities to use 3D data, objects and models being inside the reality. Mark Billinghurst states that Augmented Reality proposes unique features, such as [4]:

• Support of seamless interaction between real and virtual environments

• The use of a tangible interface for object manipulation

• The ability to transition between reality and virtual reality.

In a AR imitation, a PC reproduces and shows a domain through which we can walk and cooperate with items and mimicked individuals (generally alluded to as symbols). It ought to be noted nonetheless, that there is no need that this virtual space be exactly like this present reality.

The purpose of the research. We give a concise depiction of basic AR arrangements to give a vibe for how an AR experience is supplied. Given this the purpose of the article we likewise highlight the consideration, from psychological and pedagogical research perspectives, why learning might be encouraged by intuitive multi-tangible frameworks and we give a few instances of the AR possibilities in education.

Materials and Methods

As research sources, three multidisciplinary databases were selected and used for their coverage and indexing, they were consulted and the results were cross-checked: Scopus, SpringerLink and Web of Science. The input data for the analyses were retrieved from the scientific databases regarding papers published during the whole timespan covered.

The results of the research.

Connell and his associates [6, 12], who recognize two parts of the continuation, created another persuasive model: commitment and dissatisfied examples of activity. Intelligence and criticism can be profitable for all subjects, as there are explicit advantages of intelligent learning since it advances dynamic learning rather than detached learning.

The helpfulness of AR in training may likewise rely upon the kind of learning. Learning styles hypotheses recommend that there are different approaches to learn, and a few people adapt preferred with certain strategies over others, as they have various ways to deal with data handling.

To improve natural and intuitive user experience in real time, AR attempts to extend virtual objects on the actual ones. It is an immersive world in which simulated items change real life in real time. According to Azuma, Augmented Reality needs to be characterized by three features: the integration of actual and virtual environments, real-time user interaction and applications of 3D environments [1].

A Virtual reality and Augmented reality use the same hardware technology which share features, such as computer-generated realistic images, 3D models and interactivity. The only distinction is that Augmented technology attempts not to substitute the physical world but with the expanded realism – to complement it.

Smartphones, computers, helmets, glasses, gloves and other input and output systems are the key tools for AR. Two main types of displays used in the augmented reality, which are See-through (Monitor-based displays) and Video-see through systems. Head-mounted device (glasses) is a kind of display which is worn on the head or as part of a helmet. It has that has a small display optic in front of each eye. Video-see through systems are useful when you need to experience something remote or using an image enhancement system. Optical see-through systems combine computer generated scenes with "through the glasses" image of the real world. As a result – merged reality is reflected in the user's eyes.

Handheld devices are another kind of tools that use video-see-through technology, used to superimpose images over the real world. They are small electronic tools that can be held in hands by the user. With the modern computing power modern smartphones and tablets are almost the only affordable mass handheld AR devices.

Spatial displays are presented in video-projectors, optical elements, holograms, radio frequency tags, and other tracking technologies to display graphical information directly onto physical objects without requiring the user to wear or carry the display [5].

Pinch gloves with multiple sensors signal its position and orientation for the main

computing devices and widely used in augmented reality. Pinch is a pair of stretch-fabric gloves, which contains sensors in each fingertip that detect contact. A remarkable system used gestures for a wide range of control and interactive functions.

The variety of devices and interaction of systems between the user and the virtual content of augmented reality is defined by systems user interface. There are four main ways of interaction in augmented reality: tangible, collaborative, hybrid and multimodal interfaces.

The potential of utilizing smartphones and AR in education is massive. AR may provide students with additional digital knowledge in any topic in various ways and promote comprehension of complex information.

While doing homework, students may scan certain elements of a book and receive text, audio or video tips from teachers. Or they may find useful information about the course, a teacher or other students which could lead to better communication.

Concept learning, practical skills training, quiz solving etc. lead to having a better knowledge of every class. For example, medical simulations can be one of the ways human anatomy is studied and discussed in a much greater depth.

Augmented Reality implies contact with 3D models, basically. The rotation, transparency, colour scheme, styles etc. can be described. Finally, realistic animations can be rendered using special devices such as holographic lenses rather than smartphones.

Theoretical knowledge is already not enough in technical fields for the learning of proper skills. Students should not be just listeners or passive observers anymore. Technical specialities students need professional and practical experience in their fields. Unlike VR, AR technology will contribute to a virtual practice through interaction, with enhanced tutorials, digital modelling and imagery. It is no secret that students who are inspired and dedicated understand and learn a subject better.

As AR innovation has as of late turned out to be progressively open and moderate, inquire about in the past utilizing AR in instructive and educational settings was over the top expensive and long to execute. Our study aims to take into account not just test execution (utilized as a proportion of adapting) but in addition different results of utilizing AR for schooling.

Within augmented reality in education, we can find different apps. Here we present just some the most profound examples.

Arloon Plants

With this app, students can explore interactive plants to learn about structure and parts.

Metaverse

Recommended for younger teens, this free platform (website and app) allows users to create and share interactive content in augmented reality. Educators can use the tool to gamify learning through warm-up exercises, review games or formative assessments.

Elements 4D is an app for studying chemistry. It allows combining different elements as the simulation, to see how they would react. This app lets students combine different elements to see chemistry in action. Teachers can print out and assemble blocks that become trigger images for an AR experience.

Anatomy 4D is best suitable for medical students. By scanning printed targets, the application shows 3D models of a human body and allows to interact with it. Users may change and adjust any part of the human body, learn more about parts, joints, functions etc.

Human Heart 3D app with less content, but more specific is made to explore human heart in detail. 3D model of a heart completed with various animations and textual tips about it is presented.

Amazing Space Journey, Star Walk. All of them have one purpose which is to study the space with all its features. It allows to learn more about stars, constellations, planets of the Solar System, galaxies, etc.

Augmented Reality can also be used to enhance group tasks. Augmented computer interfaces by merging virtual and real worlds enhance face-to-face and remote collaboration.

These augmented reality applications are more similar to natural face-to-face collaboration than to screen based communication [9].

Web and Internet technology are common everywhere in the developed world, but many people still prefer reading books rather than facing screens. The Virtual Reality textbooks have another important application of this technology.

Using 3D objects and views, miscellaneous and imaginative media, simulations with different types of interactions is the easiest ways of connecting the two isolated worlds.

Conclusion. Despite the increased use of the Augmented Reality in education it remains still new and unresolved in many points. While AR's teaching / study possibilities are excellent, new learning methods are implemented not very intense. Teachers can attract and inspire students more, as students are presented with new resources to imagine and develop realistic skills in their subjects and complex concepts. In addition, even parents will benefit from it by engaging children to develop themselves in playful applications.

Despite the rising use of Augmented Reality in many areas of the modern era, the possibilities of AR in teaching/studying are not used wide enough. Augmented Reality can change the experience with our interaction with different gadgets and provides seamless combination of the real and virtual worlds. Augmented Reality is in power to change the whole idea of world perception and its advance in education is just at the start. AR gives more captivating condition to learning, uses intuitiveness and intelligent learning, connects with different faculties. Simultaneously we should consider a few inconveniences: AR use can be costly and tedious to set up, may at times bring about recreation infection, students may feel disorientated, have devotion issues and feel the absence of authenticity.

The scope of topic that might be instructed is tremendous; ranging from technical disciplines and science to history, archaeology and social legacy. It is essential to coordinate a team of specialists to advance augmented reality solution in educational system of Ukraine. In order to achieve realistic solutions, we need to design and coordinate multi-disciplinary research project to enhance content and environments. Educators must work with researchers to develop local Augmented Reality interfaces. Software and hardware technologies play an important and key role to produce Augmented Reality applications. Future prospects are to verify with the help of the experiment the positive influence of AR tools on students' learning and engagement outcomes.

References

1. Azuma R. T. (1997). A Survey of Augmented Reality. Teleoperators and Virtual Environments, 355-385. (in English).

2. Azuma R., Baillot Y., Behringer, R. & Feiner, S. (2001). Recent advances in augmented reality. Computer Graphics and Applications. IEEE, 21(6), 34 47. (in English).

3. Bellamy M. & Warren A. (2011). Using Online Practicals to Support Lab Sessions, Unpublished, Edshare.soton.ac.uk. (in English).

4. Billinghurst M. (2002). Augmented Reality in Education. Seattle WA: New Horizons for Learning - Technology in Education. (in English).

5. Bimber O., Raskar, R., & Inami, M. (2007). Spatial Augmented Reality. SIGGRAPH 2007 Course 17 Notes. CSM. 2011. Augmented Reality. Retrieved from Colorado School of Mines Division of Engineering. (in English). Retrieved from: http://engineering.mines.edu/research/sensing-comm-control/project/?pid=44

6. Connell J. P. and Wellborn J. G. (1991). Competence, autonomy, and relatedness: a motivational analysis of self-system processes. In M.R. Gunnar and L.A. Sroufe (Eds.), Self-processes and development: Minnesota Symposium on Child Psychology (Vol. 23). Chicago: University of Chicago Press, 1991. (in English).

7. Govindarajan Singaravelu & Sivakumar, A. (2020). Augmented reality in teaching and learning process. Mukt Shabd Journal Volume IX, Issue IV, APRIL/2020 P.3504-3518. (in English).

8. Kanninen E. (2008). Learning Styles and e-Learning, Master of Science Thesis, Tampere University of Technology, vol. 12, s. 1-76. (in English).

9. Kiyokawa K., Billinghurst M., Hayes S., Gupta A., Sannohe Y., & Kato, H. (2002). Communication Behaviors of Co-Located Users in Collaborative AR Interfaces. IEEE and ACM International Symposium on Mixed and Augmented Reality (ISMAR 2002) (pp. 139-148). Darmstadt, Germany: IEEE Press. (in English).

10. Pashler H. et al. (2008). 'Learning styles', Psychological Science in the Public Interest, vol. 9, no. 3, s. 105-119. (in English).

11. Riener C. & Willingham D. (2010). 'The myth of learning styles', Change: The Magazine of Higher Learning, vol. 42, no. 5, s. 32-35. (in English).

12. Skinner E., and Belmont M. J. (1993). Motivation in the classroom: reciprocal effects of teacher behavior and student engagement across the school year. Journal of Educational Psychology, 85, s.571-581. (in English).

13. Truong H. (2016) 'Integrating learning styles and adaptive e-learning system: current developments, problems and opportunities', Computers in Human Behavior, vol. 55, s. 1185-1193. (in English).

14. Webster R. (2015). 'Declarative knowledge acquisition in immersive virtual learning environments', Interactive Learning Environments, vol. 24, no. 6, s. 1319-1333, 2015. (in English).

15. Yadav Savita & Chakraborty, Pinaki & Kochar, Gurtej & Ansari, Deeheem. 2020. Interaction of children with an augmented reality smartphone app. International Journal of Information Technology. 10.1007/s41870-020-00460-6. (in English).

Резюме

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ТЕХНОЛОГИИ ДОПОЛЕННОЙ РЕАЛЬНОСТИ В ОБРАЗОВАНИИ

В статье рассмотрены возможности дополненной реальности в образовании, которая предлагает уникальные возможности обучения, включая бесшовное взаимодействие между реальной и виртуальной средами. В рамках дополненной реальности в сфере образования были рассмотрены различные приложения. В статье обсуждается использование ключевых инструментов для AR, таких как: смартфоны, компьютеры, шлемы, очки, перчатки и другие системы ввода-вывода.

Ключевые слова: *дополненная реальность; образование; приложения; виртуальное пространство; аппаратное обеспечение.*

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ТЕХНОЛОГІЇ ДОПОВНЕНОЇ РЕАЛЬНОСТІ В ОСВІТІ

Вступ

Стаття присвячена проблемі доповненої реальності (AR) як ефективного способу навчання важких понять для учнів в умовах реформування освітньої системи та впровадження сучасних освітніх інформаційних технологій. Існує безліч пристроїв, які дозволяють уможливити цей процес просто та інноваційно. Доповнена реальність. (AR) розглянуто як різновид технології, за допомогою якої учні можуть взаємодіяти з предметними матеріалами абсолютно новими способами, а саме: це уможливлює їх взаємодіяти з концепціями та особливостями цього світу у змішаному форматі, накладаючи віртуальний контент у реальну обстановку, що уможливлює отримання знань в багатьох сферах які без додаткової реальності є наочно технічно практично неможливими.

Мета статті

Надати стислий опис основних можливостей доповненої реальності, розглянути з точки зору психологічних та педагогічних досліджень можливі механізми того, як навчання може заохочуватися інтуїтивними багатовимірними структурами, надати кілька прикладів можливостей доповненої реальності в освіті.

Методи дослідження

В якості джерел досліджень було відібрано три мультидисциплінарні бази даних, які використовувались для теоретичного аналізу: Scopus, SpringerLink та Web of Science та ін.

Наукова новизна та практичне значення результатів дослідження

Обговорено, що застосування доповненої реальності в освіті надає можливість використовувати тривимірні дані, об'єкти та моделі, що знаходяться всередині цієї реальності. Підкреслюється, що доповнена реальність пропонує унікальні характеристики, такі як підтримка безшовної взаємодії між реальним та віртуальним середовищем; використання відчуттєвого інтерфейсу для маніпулювання об'єктами; можливість переходу між реальністю і віртуальною реальністю. В рамках доповненої реальності в освіті було перевірено ряд сучасних застосунків: Arloon Plants – для вивчення будови рослин, Anatomy 4D – для вивчення анатомії людини; Human Heart 3D – застосунок з меншим вмістом, але більш спеціалізований для детального вивчення людського серця; Amazing Space Journey, та Star Walk з метою вивчення космосу з усіма його властивостями та інші.

Висновки та перспективи подальших досліджень

Можливості викладання / навчання з AR є перспективними, нові методи навчання впроваджуються не дуже інтенсивно. Вчителі можуть більше залучати та надихати учнів, пропонуючи нові ресурси для розвитку знань та навичок у реалістичних умовах. Доповнена реальність залучає дітей до саморозвитку в ігрових умовах тим самим стаючи потужним мотиватором. Результати цього теоретичного дослідження можуть бути корисні для управлінців освітніми закладами, для вчителів та психологів як опис нових можливостей привертання уваги учнів та мотивування їх за допомогою кращої візуалізації різних предметів та складних понять, а також можливостей зміни всієї парадигми інтерактивності в освіті. Перспективою подальших досліджень може бути експериментальна перевірка вплив застосунків AR на результати навчання учнів.

Ключові слова: *доповнена реальність, освіта, застосунки, віртуальний простір, апаратне забезпечення.*

МУКАЧІВСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ

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