

Current Technological Advances in Educational Settings

Tomasz Jankowski

*Department of Mathematics
Physics and Technical Science Pedagogical University of
Krakow*

Karolina Piotrowski

*Department of Mathematics
Physics and Technical Science Pedagogical University of
Krakow*

Yulia Danilenko

*Department of Information Sciences
National Pedagogical Dragomanov University*

Abstract

In this study, we reveal and introduce new emerging technologies that gradually changing traditional educational settings. Achievements of Information and Communication Technologies in the last several decades have made the life of millions easy and due to these achievements education become more affordable for all levels of society. Education, being the base for these achievements, sees a positive impact as forward-thinking technologies as adaptive learning, Augmented and Virtual Reality has started integration in traditional education. In some of these cases, technologically assisted learning creates special learning environments that form a new kind of educational settings that are tailored to meet the learner's interest and learning habits. Due to their very nature, emerging technologies are transforming the idea of learning and aim to make the learning as affordable for the learner as possible.

Keywords: Cognitive learning, Educational technology, E-learning, Adaptive learning, Augmented and Virtual Reality, Artificial Intelligence

I. INTRODUCTION

The ability to learn and engage in different activities in order to gain knowledge is an individual's most marvelous quality. Learning is a continuous process that occurs throughout a person's lifetime which develops certain characters of an individual. In order to define learning, it is important to understand how an individual interacts with the surrounding of his habitation and what characteristics activate persons learning capacity. Being a continuous process with a direct connection of an individual's environment and habits, the learning process might get changed over a period of time producing new forms of learning.

Most textbooks define learning as a process of an individual's behavior that is due to experience [1]. Learning is an individual process and takes place in different forms based on learning experience, an individual's way of perceiving, thinking, feeling and doing. Thus learning may be defined as a change in behavior as a result of experience.

As societies get more complex, learning, in many cases, is introduced as planned, purposeful and systematic activities that increase the level of knowledge obtained by an individual [2].

There are many different learning styles and approaches to learning. To learn effectively it is important to tailor study habits that meet an individual's needs and behavior. This often means choosing learning techniques that by benefiting individual's learning habits increases the level of information acquisition. In most cases, these techniques are subject to change over a period of time due to constant changes in individual behavior and environment of habitation forming new approaches to learning [3]. The evaluation of learning techniques from time to time determines if there is a need to try something new.

II. COGNITIVE LEARNING

Cognitive learning is a type of learning that is active, constructive, and long-lasting. It engages students in the learning processes, teaching them to use their brains more effectively to make connections when learning new things. Cognitive learning first developed by a Swiss developmental psychologist Jean Piaget, is a part of cognitive science which is an interdisciplinary field of researchers from psychology, neuroscience, linguistics, philosophy, computer science, and anthropology that study human intelligence and behavior, with a focus on how brain nervous systems represent, process, and transform information [4].

Piaget's (1936) theory of cognitive development explains how individuals construct a mental model of the world surrounding them. In his study, he disagrees with the vogue idea of intelligence being a fixed characteristic to an individual. In his approach, he considers cognitive development as a process which occurs due to biological maturation and interaction with the environment [5].

Piaget's theory of cognitive development explains the role that the human brain plays in helping learners understand new and complex concepts. According to Piaget, cognitive processes such as observing, classifying, categorizing, interactivity, all play an important role in helping an individual's learning process.

What this means is that our ability to effectively absorb, understand, and apply certain concepts and theories is directly related to our cognitive abilities. For instance, if learners lack a span of attention, or can't appropriately observe an instructor conducting a teaching activity, they are less likely to grasp the essence of what's being taught or demonstrated. Because of its very nature, where time and distance often separate instructors and learners, the cognitive process plays an even more important role in e-Learning.

III. E - LEARNING

The rapid development of Information and Communication Technologies (ICT) and continuous population growth have emerged a new technology which prior were restricted to lectures, talks, and physical objects, are no longer considered to be the ultimate way of learning.

Socially assisted learning environment. Technology has changed the possibilities of teaching and learning. Classes, since the mid-1980s there is a recorded significant evolution of Computer-Assisted Learning (CAL) and Computer-Assisted Instruction (CAI) that slowly transform the process known as traditional learning courses [6]. E-learning is the process of extending learning or delivering instructional resource sharing opportunities, to locations away from a classroom, building or site, to another classroom, building or site by using video, audio, computer, multimedia communications, or some combination of these with other traditional delivery methods [7].

In other words, E-learning is the act of engaging in an educational course by utilizing electronic technologies to access and utilize educational curriculum outside of a traditional classroom.

E-learning courses can exist in a variety of forms, using a range of technologies. Commonly used in organizations like schools and corporations, e-learning can help learners complete education and training objectives with greater ease and flexibility than they can with traditional classroom-based learning. E-learning courses can use a variety of techniques, including audio and video recordings, other forms of multimedia technologies.

In most cases, technology-assisted learning creates communities that are dedicated to a process of learning, through specialized distance learning programs and consists of users, instructors, and platforms where both users and instructors can share and gain information related the learning program [8].

IV. ADAPTIVE LEARNING

Students enter a particular instructional setting possessing a wide variety of abilities, skills, knowledge, attitudes, and values. Some students possess the abilities necessary for success in the instructional setting; others do not. They physically and mentally are different, so do their preferences. Thus, adaptation to these differences in the educational environment is a necessity [9].

Based on Allen's study, adaptive learning is a discipline of adaptive management where it is characterized as a formal iterative process of resource management that acknowledges uncertainty and achieves management objectives by increasing system knowledge through a structured feedback process [10].

The term adaptive learning refers to a method of online instruction that involves providing personalized learning experiences resulting from a data-driven approach to curriculum design. This method builds on customized learning paths derived from algorithms, course analytics, assessment data, and feedback from students and can be used both to provide remediation and to help learners achieve mastery of content [11]. In contrast, a standard course is typically more linear and does not include customized learning paths for students. Support for adaptive learning has been seen recently across higher education. According to a survey of 338 chief information officers and senior campus information technology (IT) officials, adaptive learning technologies have great potential for improving student outcomes [12]. Additionally, the fact that eight universities received funding from the Association of Public and Land-grant Universities to develop projects for the Accelerating Adoption of Adaptive Courseware Initiative further indicates support for the use of adaptive learning methods in higher education.

Students and faculty have reported both advantages and disadvantages of adaptive learning. Adaptive learning allows students to apply prior knowledge, gain information they need to know more quickly, and create a customized learning plan. This method can ensure that students reach mastery before moving on and helps educators avoid "teaching to the middle," a strategy that fails to account for advanced students or those who are lagging [11]. In an adaptive learning pilot project at the University of Central Florida, students indicated that they spent more time on adaptive coursework as compared to work for a traditional course, but they overwhelmingly suggested that they would take another adaptive course and that they spent their time valuably by participating in the adaptive course [13]. There are advantages for instructors as well, as they can more easily monitor which students need assistance, measure curriculum performance, and maximize learning outcomes, in addition to having a better sense of content areas in which students are struggling [11]. Challenges to adaptive learning include high costs of implementation, inadequate support, need for training, and inability to manage extensive amounts of data [13]. Implementing adaptive learning also requires time for creating detailed curriculum mapping and content that supports learning objectives [11].

During teaching process, instructors observe that students react differently to the education system and so teaching methodologies must adapt different teaching techniques according to the differences between students [14].

V. MULTIMEDIA TECHNOLOGIES

Multimedia is defined as any combination of text, graphic, sound, video, and animation. Multimedia can be delivered to the user via electronic or digital manipulated means. In order to create a good multimedia project, the integration of creative emerging technologies is critical [15].

When the user is allowed to control what and when these elements are delivered, it becomes interactive multimedia. Interactive multimedia can be called hypermedia. This happened when a user is provided with a structure of linked elements for the use of navigation which triggers and enhances the cognitive thinking skills of learners [16]. With the advancement of technology in this world, an emerging technology known as Virtual and Augmented Reality transforms the idea of traditional multimedia settings in educational with a new emerging form of experience in which the real world is enhanced by computer-generated content.

A. Virtual and Augmented Reality

Virtual Reality (VR) is a term used for computer-generated environments that allow the user to enter and interact with alternate reality known as Virtual Environment (VE). Based on [17],[18]. Virtual Reality is a technology that combines the Real-time interactive graphics with three-dimensional models with a head-tracker, multi-sensory display technology that allows users to immerse into a totally synthetic environment.

Augmented Reality (AR) is a variation of Virtual Reality (VR) technologies. With the use of VR technologies, a user gets completely immersed inside a synthetic environment. While immersed, the user cannot see the real world around him. In contrast, AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. In Augmented Reality computer-generated digital information (sound, video, graphics or GPS data) overlaid onto live direct or indirect physical real-world environment, thus enhancing user's perception of reality [19].

Because of their very nature, AR and VR technologies have found a wide applications in different industries including but not limiting advertisement and marketing, Architecture and construction, Medical and surgical, Military and Defence as well as Educational and training [20].

Augmented Reality, in particular, shows positive outcomes in such disciplines as Natural Science, including Biology, Chemistry, and Physics, where the learner is required to use his cognitive thinking skills the most [21].

According to [21] AR/VR technology implementations into educational and training settings have found greater interest among governments as France, China, USA etc., particularly AR technology being under the spotlight due to its ease of implementation.

VI. ARTIFICIAL INTELLIGENCE

Artificial intelligence is a branch of computer science that aims to create intelligent applications that give machines the ability to learn and improve without the help of humans or new programming. Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks [22].

Some of the activities performed by artificial intelligence include Speech recognition, Learning, Planning, Problem-solving. Proposed by Adam Turing in the 1950s, "systems designed by a human can be intelligent", Artificial Intelligence develops rapidly and involves accounting database, computer games, hospital inpatient care etc [23].

Abandoned features and potentials provided by AI technology set both startups and established companies seek to integrate AI into marketable products such as the educational domain. Educational tools enabled by AI have the potential to improve education quality and enhance traditional teaching and learning methods. Applications of AI based education technology include the following [24]:

Tutoring. Intelligent Tutoring Systems (ITS) engage students in dialogue, answer questions, and provide feedback.

Personalizing Learning. ITS and adaptive tutors tailor learning material, pace, sequence, and difficulty to each student's needs.

Testing. Computer adaptive assessments adjust the difficulty of successive questions based on the accuracy of the student's answers, enabling more precise identification of a student's mastery level.

Automating Tasks. AI can perform routine tasks such as taking attendance, grading assignments, and generating test questions. Artificial intelligence is currently progressing at an accelerated pace, and this already impacts on the profound nature of services within higher education. For example, universities already use an incipient form of artificial intelligence, IBM's supercomputer Watson. This solution provides student advice for Deakin University in Australia at any time of day throughout 365 days of the year (Deakin University 2014)[25]

VII. CONCLUSION

From ancient times through modern societies of the 21st century, education was and will be a powerful tool that aims to transform the lives of millions. Like any other industry so the learning and knowledge delivery sector has gone through an indescribable transformation. Human achievements in modern ICT systems have allowed development of such technologies that assist learners to acquire knowledge as in traditional learning environments as well as creating a new learning society where learners can access knowledge for ease of the convenience. To this date, the implementation of emerging technologies into learning environments shows a positive outcome that has a beneficial impact on the global economy in general.

REFERENCES

- [1] Lachman, S. J. (1997). Learning is a Process: Toward an Improved Definition of Learning. *The Journal of Psychology*, 131(5), 477-480. doi:10.1080/00223989709603535
- [2] Sicilia, M. (2006). Semantic learning designs: Recording assumptions and guidelines. *British Journal of Educational Technology*, 37(3), 331-350. doi:10.1111/j.1467-8535.2006.00609.x
- [3] Michie, S., & Johnston, M. (2012). Theories and techniques of behaviour change: Developing a cumulative science of behaviour change. *Health Psychology Review*, 6(1), 1-6. doi:10.1080/17437199.2012.654964
- [4] Willingham, D. T., 2010. Have technology and multitasking rewired how students learn? *American Educator*, Summer 2010, 23-28.
- [5] Cronbach, L. J. (1961). *Handbook of Research Methods in Child Development*. Paul H. Mussen, Ed. Wiley, New York, 1960. 1061 pp. Illus. Science, 133(3465), 1699-1699. doi:10.1126/science.133.3465.1699
- [6] Andrews, R., & Haythornthwaite, C. A. (2007). *The Sage handbook of e-learning research*. Los Angeles: Sage Publications.
- [7] Funding higher education in England: How HEFCE allocates its funds. (2005). Bristol: Higher Education Funding Council for England.
- [8] Tsoukalas, I., & Tsoukalas, I. (n.d.). An Introduction to e-Learning Communities. Retrieved from http://www.academia.edu/6544022/An_Introduction_to_e-Learning_Communities
- [9] Anderson, L.W. "Adaptive education", *Educational Leadership*, pp. 140-141, 1979.
- [10] Allen, C. R., Fontaine, J. J., Pope, K. L., & Garmestani, A. S. (2011). Adaptive management for a turbulent future. *Journal of Environmental Management*, 92(5), 1339-1345. doi:10.1016/j.jenvman.2010.11.019
- [11] Educause 2017. 7 things you should know about adaptive learning (n.d.). Retrieved from <https://library.educause.edu/~media/files/library/2017/1/eli7140.pdf>
- [12] Green. *Campus Computing 2016: The National Survey of E-Learning and Information Technology in American Higher Education*. (n.d.). Retrieved from <https://kenneth-green-pln7.squarespace.com/content/2016/11/21/the-2016-campus-computingsurvey>
- [13] Freda, B., Clearing the hurdles to adaptive learning. (n.d.). Retrieved from <https://universitybusiness.com/clearing-the-hurdles-to-adaptive-learning/>
- [14] Corno, L. (2008). On Teaching Adaptively. *Educational Psychologist*, 43(3), 161-173. doi:10.1080/00461520802178466
- [15] Vaughan, T. (2001). *Multimedia: Making it work*. New York: Osborne/McGraw-Hill.
- [16] Using Audio As a Teaching Tool. (n.d.). Retrieved from http://ccnmtl.columbia.edu/enhanced/primers/audio_as_teaching_tool.html
- [17] Earnshaw, R. A., Gigante, M. A., & Jones, H. (1994). *Virtual reality systems*. Londres: Academic.
- [18] *Research Directions in Virtual Environments - Report of an NSF Invitational Workshop March 23-24, 1992 University of North Carolina at Chapel Hill*. (n.d.). Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.41.9813>
- [19] Azuma, R. A Survey of Augmented Reality. *Presence: Teleoperators and Virtual Environments*, Volume 6 (Issue 4), pp. 355-385, Cambridge, MA, 1997.
- [20] Yuen, S. C., Yaoyuneyong, G., & Johnson, E. (2011). Augmented Reality: An Overview and Five Directions for AR in Education. *Journal of Educational Technology Development and Exchange*, 4(1). doi:10.18785/jetde.0401.10
- [21] Mayilyan, H., Poghosyan, S., & Avetisyan, H., (2018) Educational augmented reality systems: Benefits of implementation and government support. *Proceedings of 4th International Conference of the Virtual and Augmented Reality in Education, VARE 2018, Vol 1., 23-27.*
- [22] RUSSELL, S. N. (2018). ARTIFICIAL INTELLIGENCE: A modern approach. Place of publication not identified: PEARSON.
- [23] Flasiński, M. (2016). Application Areas of AI Systems. *Introduction to Artificial Intelligence*, 223-234. doi:10.1007/978-3-319-40022-8_16
- [24] Lu, J. J. & Harris, L. A. *Artificial Intelligence (AI) and Education*, report, August 1, 2018; Washington D.C.
- [25] Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1). doi:10.1186/s41039-017-0062-8\