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# EDUCATIONAL FUNCTION OF VIDEO GAMES

***Summary:*** Academic world and schools entered the ICT era long ago. Educational video games and virtual learning surroundings became a standard and brought new dimensions to the field of education. In order to achieve its purpose and justify the work and money invested, contemporary teaching has to adapt to trends, to make itself capable of introducing new information technologies and adapt a more attractive teaching form suited to the students with new demands. Authors in this paper point to significant possibilities of increasing level of teaching and learning efficacy by application of contemporary educational video games and virtual learning surroundings. Educational games, other than entertaining function, can crucially affect the learning process itself and influence psychomotor, sensory, cognitive abilities and social development, logic, thought, as well as other diverse skills and abilities. Such methods have good results in increasing of concentration and motivation of students, so it is desirable to apply them to achieve improvement of education as whole. School authorities should adopt a positive attitude to this way of gaining knowledge, and application of technology as a companion form of education to traditional education.

***Key words:*** Video games, education, gamification, learning, technology

## Introduction

Usage of video games in teaching and education is not new. Even in early 19th century in Prussia a tabletop variant of strategy game *Kriegspiel* was used in military schools, a game developed by Georg von Reisswitz[1]. The essence of this game was to create a real battlefield situation in the classroom for education of young officers, that was supposed to give them basic knowledge of military skills before they leave the training. According to Prussian sources, *Kriegspiel* became an important factor of German military successes. The game was one of the first documented examples of usage of games in the educational process.

Appearance and usage of video games as electronically generated images brought to creation of new form of educational gaming activity – interactive educational

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[1] Georg Heinrich Rudolf Johann von Reisswitz (1794-1827), a Prussian army officer regarded by many as the father of wargaming

entertainment. Still, despite new possibilities that were increasing on a daily basis, possible approaches to implementation of function of learning by using video games and gaming remained unchanged, and they are mostly based on modelling of events and imitating situations that arise in the real world at certain times.

## Gamification of education

Gamification of education, or gamification of learning is a contemporary educational concept and approach that tries to improve level of students' engagement by using systems and design elements of video games. It relies on application of those elements of video games that are fun and create longer dedication to the game in educational context and teaching plans, which positively affects behavior of the students with goal for them to become more active and motivated and to make teaching more fun.

First studies on use of video games in educational process appeared in the United States of America in 1970s. Over the school course of history and sociology, the students could play a computer game about life of the pioneers of American West, called *Oregon Trail*[2], set in 19th century. The students played the game where they led large virtual caravan of settlers along with baggage and livestock on a road 3,500 kilometers long. Based on legendary real-life Oregon Trail[3] expedition of Lewis and Clarke, the students could relive the experience of life on that trying quest. The game allowed students to master rational approach to different problems – if buffaloes moved faster, they would arrive to the destination earlier and earn extra points. Since the real-life route went over the American North, it was important to pass the area before the harsh winter arrived. But at the same time, increased speed meant the carriages were broken more often, or horses or buffaloes would die due to overworking. Another challenge young players faced was rational distribution of food among the caravan members. If the food was distributed too fast, there would be nothing left before the travel ended, but at the same time, undernourishment and hunger led to diseases of people and livestock. At the destination, the game calculated points students earned, based on number and health condition of surviving members of the caravan, remaining goods, livestock and money. Wide usage of video game *Oregon Trail* in American schools and the gain students had from playing it made video games to be looked at as an educational tool[4] for the first time in their history, and the game itself became exemplary and an icon of educational video games.

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[2] https://playclassic.games/games/adventure-dos-games-online/play-the-oregon-trail-online/, retrieved 21.05.2019

[3] The Oregon Trail is a 2,170-mile (3,490 km) historic East–West, large-wheeled wagon route and emigrant trail in the United States that connected the Missouri River to valleys in Oregon. The eastern part of the Oregon Trail spanned part of the future state of Kansas, and nearly all of what are now the states of Nebraska and Wyoming. The western half of the trail spanned most of the future states of Idaho and Oregon.

[4] Lussenhop, J. Oregon Trail: *How three Minnesotans forged its path*. January 19, 2011. URL: http://www.citypages.com/news/oregon-trail-howi-three-minnesotans-forged-its-path-6745749, retrieved 24.05.2019

Basis of every video game is gameplay – component responsible for interaction of game and player. Today there are two basic approaches of studying and creating video games: ludology aspect, based on theory of game, and narratology aspect, based on narrative theory. Both approaches offer their answer to question what is the basic element of a video game? Ludology insists on supremacy of game mechanics, while narratology insists on story-driven games, where the task of gameplay is to help to tell the story with inner gaming tools. On the other hand, presence or absence of relation between the gameplay and the narrative brought to creation of two concepts in game design[5]: endogenous and exogenous. Endogenous video games are designed in such way that narrative or story is directly connected with gameplay. With exogenous games gameplay and narrative do not overlap in any way, and the story is but an additional element in the game that does not reflect activities of players within the game in any way[6].

Based on endogenous and exogenous approaches to creation of video games, all educational video games can be divided to following groups:

**Direct education** (endogenous games), within which goals and expected results of the teaching process are clearly set. These are high-budget games dedicated to direct education, and entertainment and gaming aspects are there to attract the players and provide commercial success of the game. The bulk of these video games are serious video games, although there are many small narrative games directly dedicated to education process. The best example for serious games is various simulators, like *Microsoft Flight*, used for training of real-life pilots. Numerous armies in the world use video games for simulation training, and one of the most important functions of video games in soldier training is desensitization of killing of another human being[7].

The other example are games that offer introduction and explanation of known natural and social systems, such as *The Oregon Trail,* or studying of laws of physics in video game *Supercharged!*[8] The third example might be miniature video games for school children that interactively help in learning certain school courses (foreign languages, mathematics, biology, physics, etc.)

**Background education** (exogenous games). The vast majority of video games belong to this group, and the general association on video games are games from this group. Their basic purpose is – playing them in its elementary meaning and essence. A player will entertain himself when playing these games, but naturally he will learn something while playing as well. During playing of these games, the players are not given detailed explanation of what is happening, but the learning process happens, nonetheless. In such games a player usually becomes involved in certain events, gathers personal experience and forms a personal view of the world. For instance, pseudo-historical video games, such as games from Assassin's Creed[9]

[5] Rouse R. Game Design: Theory & Practice. Plano: Wordware Publishing, 2004.
[6] Squire K. From content to context: Videogames as designed experience // Educational Researcher. 2006. No. 35 (8). P. 19–29.
[7] Filipović, Aleksandar: *Paradigma kulturološkog pozicioniranja video igre*, doctoral dissertation, FDU, Belgrade, 2016
[8] http://web.mit.edu/mitstep/projects/supercharged.html, retrieved 24.05.2019
[9] https://assassinscreed.ubisoft.com/game/en-us/home, retrieved 24.05.2019

franchise can provide relatively general information on historical events and people from that time and can create interest in players to research the time period when the game is set. Other games can in similar way to create initial and basic knowledge on global-scale relationships and mechanisms they are formed, to interpersonal relationships, or models of behavior in certain situations.

**Internal education** (both endogenous and exogenous games) is the learning of the rules of a game. The knowledge itself in necessary within the game and useless outside it. Here we talk about various tutorials, educational and introductory missions at beginning of a game. Every high-budget game has such element. Internal learning allows lowering the threshold of skills needed to start a game, without learning complete game mechanics at one, but offered in parts accompanied by explanations, commentary or examples.

Generally, researchers state that endogenous games are the most efficient type of video games to realize direct education of educational games[10]. In such games the content is directly connected with game mechanics that allow better assimilation of specific information and the form of necessary skill for deeper in-game immersion.

One of the good examples of smaller video games that can have important educational and civilization role is educational ecological game „Homo Ludens - Igrač kao čistač"[11] (Homo Ludens – Player as a Cleaner) of Serbian author Jovana Mirković, that treats the problem of waste disposal. The goal of the game, that combines photography, animation and game is introduction to current European standards on gathering, sorting and disposal of secondary materials. In that way a civilizational need of ecological education of population is promoted through a video game. „In formation of ecological culture of contemporary man a system of ecology education has significant role, where ecological consciousness about basic characteristics of the environment is formed and developed, as well as to environment itself, its protection and preservation, rational usage of natural resources, with mandatory development of critical positions about permanent degradation of the environment"[12].

Here another important aspect of educational function of video games shall be taken into consideration. Video games are currently the most lucrative business of creative industries[13]. Video game industry consciously creates an ideological discourse through militarism present in video games, that creates narrative, parallel history and help to form opinions of young generations. The cult of war visible in the best-selling video games has not been seen since the rise of fascism between the WWI and WWII. Such openly militaristic ideology does not seem out of the ordi-

[10] Squire K. From content to context: Videogames as designed experience. Educational Researcher, 2006, no. 35 (8), pp. 19–29

[11] http://www.seecult.org/vest/homo-ludens-igrac-kao-cistac, retrieved 24.05.2019

[12] Bjelajac, Željko, Počuča, M., & Marković, M. (2012). *Politika EU u oblasti zaštite životne sredine s osvrtom na krivino-pravne aspekte i ulogu porodice u razvoju ekološke svesti*. Strani Pravni život, *56*(3), 525-543. Retrieved from https://www.stranipravnizivot.rs/index.php/SPZ/article/view/372, retrieved 24.05.2019

[13] Filipović, Aleksandar: *Video-igre kao najozbiljniji biznis kreativne industrije na početku 21. veka*, „Megatrend revija" vol 10 (2) 2013, Beograd, p. 177

nary nonetheless, as armed conflicts are rationalized and present in form of global latent „War on terror". Militarism that is present in video games has young adults as their target group and represents an alternative educational frame to official educational system[14].

Citizens of aggressive Western countries were subjected to an avalanche of information for years that had a goal to convince the citizens that aggressive militarism is the only feasible strategy for maintaining „our way of life". After a short quiet after the Vietnam War ended, a strong residential campaign began in the United States, with a message that the USA keeps and saves the world, and by that its way of life. And the means to keep it that way is the army. Not knowledge, not science, not culture, not even the money, but with raw military force[15].

Video games like *Mortal Combat* or *Ultimate fight* teach close combat, *Wolfenstein, Quake, Doom* or *Perfect Assassin* show the conflict of individuals in the situation of real armed combat. For other organizational types and potential future managers or soldiers there are gaming franchises like *Command & Conquer: Generals, Tiberian Sun, Generals, Age of Empires, Civilization, Caesar*[16].

The Pentagon publicly funds Institute for Creative Technologies[17] at University of Southern California[18]. There is no data about projects the institute developed for the American army but at the Institute's website it was published that the contract value for 2011 was 135 million USD. Divna Vuksanović states that American *Defense Advanced Research Projects Agency*[19] „currently lists around 40 games made directly for military use, around 25 deemed useful but not made directly for military use, as well as several modifications, and all of them can serve the needs of military-industrial complex.[20] "

## Educational games

Regardless if the game is played in nature, on a tabletop or on electronic device and despite not having educational purposes, there is always learning while playing – new information is learned, new skills are adopted, social skills are ways of thinking are developed. Various games help in protection of emotional development of young people. On the other side we have lack of free time and accelerated living that often causes stress, anxiety and sometimes depression. Game stimulates imagination and creativity. People enjoy playing, which motivates them to cooperate

[14] Kristian Lukić: *Kritičke perspektive umetnosti digitalnih igara – prilog istraživanju fenomena*, http://www.bos.rs/cepit/evolucija/html/14/igre.htm#_ftn1, retrieved 24.05.2019

[15] Not counting NATO, the USA has 737 smaller and larger bases around the world in 63 countries, with 325,000 members of military personell.

[16] http://www.bos.rs/cepit/evolucija/html/14/igre.htm retrieved 24.05.2019

[17] http://ict.usc.edu/news/press-releases/usc-institute-for-creative-technologies-receives-135-million-contract-extension-from-u-s-army/ retrieved 24.05.2019

[18] http://www.usc.edu/ retrieved 24.05.2019

[19] Defense Advanced Research Projects Agency, http://www.darpa.mil/ retrieved 21.05.2019

[20] https://dzonson.files.wordpress.com/2011/07/filozofija-medija-ii-finalna-verzija.doc. retrieved 21.05.2019

and participate. Competent researches shown that the game is most entertaining form of learning for pupils and students. Knowledge gathered through a game is much more durable than knowledge gathered otherwise[21].

For modern generations of pupils and students video games are a natural environment that draws them into virtual worlds with their dynamics and activity. Educational video games might motivate and activate current generations of pupils, as a bridge between traditional way of teaching and future approaches to that process. Even in 1980s and 1990s an awareness of fantastic possibilities of usage of computers in teaching and learning. Large countries massively equipped classrooms in schools and universities. There were almost no scientists who would claim that computers, and later hypermedia, cannot be used as teaching tool. Many of them lobbied, gave presentations, and were showing in broad strokes a myriad of other potential gains when learning is supported by computers. Learning through digital games can be applied as an additional option to classroom lectures. The intention of learning through video games is to develop new ways of design of lectures with help of information and communications technologies and simultaneously allow students to gain skills and abilities they will later use in business world. With help from video games, and educational video games in particular, students should be able to apply knowledge of facts, learning on demand and gain experiences in virtual world that can later shape their behavior and directly influence their thinking[22].

One of the early video games used for educational purposes was created in 1980s for NASA's training of astronauts and pilots. Examples of realization of teaching curriculums through video games and simulations are numerous and present at many universities and schools round the world. Students of the University of Ohio in the United States of America learn helped by a software called CASE, which stands for „computer-assisted simulation of clinical cases, and in that way, they more easily research reactions of human bodies to various types of treatment and healing.

Some video games that are suitable for educational purposes follow:

– *Environmental Detectives 02*, developed by MIT (Massachusetts Institute of Technology) and Microsoft, project of learning through a game where conceptual prototypes for next generation of interactive educational entertainment are developed,
– *Scavenger hunts*: students are divided into teams with task to find terms related to topics teached on the Internet and to compile a HTML document with found links,
– *TopSIM 02*, *TERTIA Edusoft* : various business games used in business education and expert studies,
– *MonkeyWrench Conspiracy 99*: this game brings approach to learning as discovery that can include any combination of performances and tasks, with support of necessary referential manuals and videos
– *UniGame - Social Skills and Knowledge Training framework*: offers a possibility to interested lecturers to apply their teaching. The lecturers define various topics and cus-

[21] Maravić, J., (2008.). Škotski primer korišćenja kompjuterskih igara u nastavi, http://www.skole.hr/nastavnici/ucionica?news_id=920, retrieved 21.05.2019

[22] Pivec, M.,(2006.). Igra i učenje: Potencijali učenja kroz igru, Edupoint časopis: http://edupoint.carnet.hr/casopis/49/clanci/1#top , retrieved 21.05.2019

tomize the game according to their needs. Students work on their assignments, cooperate, exchange ideas and learn in that way,

– *Immune Attack, Federation of American Scientists FAS*: The goal of this game is to save the patient suffering from bacterial infection,

– *Sir Isaac Newton*: students can test their knowledge related to various complicated formulas related to movement.

## Contemporary approach to implementation of education in video games

One of the widest accepted principles of implementation of education in video games is the „immersion" model. The „immersion" is a very popular term dedicated to video games in scientific and popular science literature. Immersion in video games is often understood as a state of consciousness, often artificial, where the consciousness of the subject about his physical condition are diminished in reality, while the feeling of full presence within given virtual space increases in contrast[23]. Due to constraints we cannot widely elaborate on this phenomenon, but we can stress that these worlds are meta-worlds in meta-reality, which are much more desirable for the player than the real world. The „immersion" concept is thoroughly used in education. Foreign languages in many countries are learned based on video game world immersion principles: basic communication is reduced to a minimum, and teaching is conducted only in the language student learns. Therefore, there is an immersion into new linguistic surrounding[24]. In the middle of the video game immersion theory is a concept of presence in the game and involvement in the game. The player not only must believe in everything that happens on the screen, he has to become interested to play by it.

According to Ernest Adams, video game developer and consultant, immersion can be divided in following categories[25].

**Tactical immersion:** This kind of immersion occurs when the activities demaning great skill are performed. The players feel „shocked" when they perform activities leading to success. During this kind of immersion, the player identifies with his avatar and feels more like it than as the person in front of a display.

**Strategic immersion:** Intellectual activity related to solving of various problems. For instance, chess players go into strategic dive when they have to choose the right solution in wide array of possibilities. In this kind of immersion a mental concentration of the player is required as they have to see themselves as a person who plays and has abilities necessary for making the right solution.

**Narrative immersion:** The player is inspired with graphics and gameplay into immersion. This is similar to immersion people experience when reading a book

[23] McMahan A. Immersion, engagement and presence: A new method for analyzing 3-D video games // The Video Game Theory Reader. New York: Routledge, Taylor & Francis Group, 2003. P. 67–88.

[24] Baker C. Foundations of Bilingual Education and Bilingualism. Bristol: Multilingual matters, 1993. 343 c.

[25] Adams E. Postmodernism and the Three Types of Immersion. July 9, 2004. URL: http://www.designersnotebook.com/Columns/063_Postmodernism/063_postmodernism.htm, retrieved 21.05.2019

or watching a film. Similar to the first kind, the key aspect is identification, but not only with the avatar but with whole world of video game. By immersion the player becomes a part of the surrounding within the display while playing the video game he exchanges real life surrounding for the one dictated by the game narrative. Similar to Alice[26] jumping in the mirror, or when teenagers enter the game Jumanji.[27]

## Educational aspects of video games

Video games slowly but steadily become a substitution for weaknesses of official education system. Whether that weakness was initiated by devastated school system or degraded family, video games have obvious capacity to fill the void and save something from uncertain future of young people.

„With appearance of television as the fourth significant paradigm the availability of various information was increased like never in history, but the possibility of interest-based influence on wide population as well. The next, and probably the most important manifestation is appearance of easily obtainable computer technologies, which, combined with the launch of the Internet allowed global, free and cheap exchange of information of every kind"[28].

Educational aspect of majority of video games inevitably includes two-dimensionality[29]. Education is looked as a determining factor, but as a consequence of doing this activity as well. Education is a determining factor of the game, as it determines the choice, its kind and the approach strategy. Every individual chooses what they will play, among other things, and based on own „educational predeterminism" and enters all of his educational properties in the playing process. Our own pre-knowledge, computer literacy, level of abilities, practice, skills etc, are direct factor of personal choice – do I play, what I play, how I play and why I play video games? Educational effect relates to all those knowledge, skills, abilities, positions, emotions, values and other things that are consequence of playing video games. In other words, educational function of video games is reflected to educational determining factors of choice, but to educational results of playing.

Every activity that includes educational effects carries in itself a difference of activity sphere of educational content and educational intensity. In regard of context of educational goals, video games are developmental means in different spheres. They can bring development of strategic thinking, planning skills, communications, application of numbers, negotiations, group decision making, use of information,

[26] Alice's Adventures in Wonderland is a novel from 1865 written by English writer Charles Lutwidge Dodgson under nome-de-plume Lewis Carroll.

[27] Four high-school children discover an ancient game they never heard before. Since that moment they will become drawn into the entertaining world of jungle and become avatars of their own choice – from geek researchers to fierce warriors

[28] Milan Počuča: Uloga porodice i škole u afirmaciji bezbednosne kulture, Kultura polisa, god. XIV (2017), posebno izdanje, str. 119-131

[29] Nada Kačavenda-Radić, Tamara Nikolić-Maksić, Bojan Ljujić *Igra odraslih: Da li kompjuterska igra obrazuje u slobodnom vremenu,* Filozofski fakultet, Univerzitet u Beogradu Andragoške studije, issn 0354-5415, broj 2, novembar 2011, str. 147 -170

discovery of learning strategies, problem solving skills, use of computer, development of intellectual, visual and motor skills, as well as player's interactivity. Although there are very different specifications of benefits from playing educational video games, one research outlined following concrete skills developed through video games, whether the game is endogenous or exogenous[30]:

– *Engagement in sustainable reasoning*– relates to involvement in solving of problems that lasts for several days and demands inclusion of various resources, and many games, especially simulation games, are designed in this fashion;
– *Management of complexity* – implies carrying with complex and unpredictable systems (virtual epidemics, ecological issues etc.);
– *Solution testing* – demands the user not only to participate in problem solving, but to find solutions they would test in order to find the most suitable one;
– *Overcoming of problems arisen from application of wrong solutions* – solutions the users choose are not always correct or best;
– *Organizing and navigating information structures and evaluation of information*;
– *Collaboration*;
– *Addressing other users* – necessary for announcing individual results and work on possible collective solution;
– *Expecting the unexpected* – an important skill often tied to functioning in complex systems, often related to risk taking and planning;
– *Anticipation of changing technologies* – although technology is not in explicit focus of video games, users shall know that usage of various technology, like message exchange, modern forms of communication, spatial navigation, gathering, analysis and visual presentation of data;
– *Abstract thinking of new technologies*– the focus is not on technologies themselves, but on the way they are used[31].

## Final remarks

Pupils or students, meaning persons who are educated, or just play, develop their mental and psychomotor faculties through video games. Video game seems to be the best form of learning through entertainment. It allows and increases creativity, thinking, logical deduction, solving of certain obstacles to arrive to the goal. The generation that is coming is the ICT generation, and they are young or not so young but new and different people. „They are digital indigenous population, multitaskers adapted to simultaneously use Facebook, play online games, send text messages, download music and films from the Internet. They communicate over keyboard rather than live, they sent a text more gladly than they voice call, because it is quicker and safer. The process of their separation and coming of age is now taking place under the watchful eye of the ICT"[32]. They are a generation that does not read

[30] Klopfer, E. (2008). *Augmented Learning – Research and Design of Mobile Educational Games*. Massachusetts Institute of Technology (MIT Press).
[31] Nada Kačavenda-Radić, Tamara Nikolić-Maksić2, Bojan Ljujić *Igra odraslih: Da li kompjuterska igra obrazuje u slobodnom vremenu,* Filozofski fakultet, Univerzitet u Beogradu Andragoške studije, broj 2, novembar 2011, p. 147 -170
[32] Terkl, Šeri: *Sami, zajedno*, Clio, Beograd, 2011

from paper and has no library. They do not carry large bags full of books and notebook to school, they bring tablets instead. If we take in consideration that the textbooks are decreasingly popular these days, it was necessary to create something that will be interesting to the new generation of digitally literate youth.

Contemporary people learn best when they use a computer and the Internet, and by playing video games. Nearly every game now has some sort of educational properties and allows people to learn by playing. The greatest step towards the modern education are educational video games and educational software that are more and more present in kindergartens and schools. Educational games and software allow students to learn by using computer, which is their natural environment. Numerous researches shown that children of this century learn more efficient through the games. Educational games are imagined as an addition to teaching curriculum, and in some cases as a companion material for teaching.

Modern video games offer unique tools that allow integration into the teaching process. Users can enter the interaction with educational programs in various field in an interesting form. Still, that requests more detailed studies of specificity of approach to development of educational video games, that would equally be interesting and entertaining to the user and would motivate him to succeed in the game, education and life.

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## НАСТАВНО-ОБРАЗОВНА ФУНКЦИЈА ВИДЕО ИГРЕ

***Сажетак:*** Школски и академски свет је одавно ушао у еру ИКТ. Едукативне компјутерске игре и виртуелна окружења за учење постали су стандард и донели нове димензије пољу едукације. Да би постигла своју сврху и оправдала намену и уложени новац, савремена настава мора да се прилагоди трендовима, оспособи се за примену нових информационих технологија и усвоји атрактивнији облик, прихватљивији ученицима нових захтева. Аутори у овом раду указују на значајне могућности подизања нивоа ефикасности учења и наставе применом савремених образовних компјутерских игара и виртуелних окружења за учење. Едукативне игре, осим што служе за забаву, могу битно утицати на сам процес учења и у великој мери утицати на психомоторне, сензорне, когнитивне способности и социјални развој, логику, мисаоне активности, спретност, различите способности и вештине. Овакве методе имају запажену улогу у повећавању концентрације и мотивације ученика, па их је пожељно примењивати у циљу унапређења образовања. У будућности је потребно радити на томе да школске власти усвоје позитивни став према оваквом начину стицања знања и примене нове технологије као пратећи вид образовања уз традиционално учење.

***Кључне речи:*** Видео игре, едукација, гејмификација, учење, технологија