

Serious Games and Innovative Technologies in Medical Education in Bulgaria

Galya Georgieva-Tsaneva

Institute of Robotics – Bulgarian Academy of Science, G. Bonchev Str., Sofia, Bulgaria

Abstract – This paper presents the challenges faced by teachers in the process of training the students in today's innovative, technological society. Definition, overview, and concepts of serious educational games are shown. A study has been made on the introduction of modern technologies through video materials, presentations, serious games in Bulgarian. A created educational game designed for medical education is presented. The game aims to verify and enhance the knowledge and skills of the students in injecting technique. The article presents the results of a survey conducted for the use of serious games in Bulgaria.

Keywords – serious educational games, medical education, concepts of serious games, video materials.

1. Introduction

Nowadays, teachers across the globe face a radically different generation of students: students who spend most of their time in virtual reality. In this virtual reality, today's generation lives, communicates with its friends; in the virtual space participates in teams and learns in a collective spirit, races, achieves success and becomes confident, loses and learns to bear with losses. Students then transfer what they learn as knowledge and skills into everyday real life. Today's generation of students does not make a distinction between virtual and real environments - for them, these two environments are like the faces of a coin.

DOI: 10.18421/TEM84-42

<https://dx.doi.org/10.18421/TEM84-42>

Corresponding author: Galya Georgieva-Tsaneva,
Institute of Robotics – Bulgarian Academy of Science, G. Bonchev Str., Sofia, Bulgaria.

Email: galicaneva@abv.bg

Received: 24 April 2019.

Revised: 04 September 2019.

Accepted: 11 September 2019.

Published: 30 November 2019.

 © 2019 Galya Georgieva-Tsaneva; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 License.

The article is published with Open Access at www.temjournal.com

This is a generation surrounded by information and submerged in the virtual world; at any time, the student needs information quickly and easily on the Internet. Contemporary education should put in focus the new type of student, surrounded by mobile phones, laptops, creating blogs, online communities, and solving their problems through Internet technologies. The student today has rational thinking and the traditional way of presenting the teaching material is often uninteresting. Today, the methods of interaction of the students, which are very often mediated by modern technologies, differ greatly from methods of their parents and their teachers. For the first time in the history of mankind, a great deal of teachers has the task of catching up their students as far as the use of modern technology is concerned. This issue inevitably puts forward a problem that has matured in recent years: teachers have to adapt their teaching methods to the requirements and abilities of their students. There is no other way and there is no other solution: in order to be able to train an interesting, attractive and appropriate way for this new, technology-oriented generation, teachers have to bring in their training the achievements of modern technology including serious educational games.

Information technologies can be used to making creative meaningful learning environments and in the difficult and responsible medical education. Serious games can help students learn regardless of their different learning styles: visual, auditory, practical, etc., as the games combine all these features: the games have a visual, sound element, and practical action.

In medical training, it is appropriate to use different types of digital games such as simulations, virtual environments, social games, cooperative games, and more.

2. Definition of Serious Game

The traditional games known of people for centuries are physical or mental competitions, which have certain rules.

Esposito in 2005 [1] gives the following short definition of a video game: „A videogame is a game which we play thanks to an audiovisual apparatus and which can be based on a story. The main feature

of video games is that they play for fun. Video games are dynamic, in them constantly something happens, changes, occurs or disappears. An interesting feature of video games is that they are played differently from different players and even one game is played by one player each time in a different way. This is a prerequisite for the development of creativity, creative thinking and the imagination of the students playing them. Interaction between players in the game enables players to adapt to ever-changing conditions, learn and change games themselves.

Ritterfeld et al. give the following definition of serious educational games: "any form of interactive computer-based game software for one or multiple players to be used on any platform and that has been developed with the intention to be more than entertainment"[2].

The most profound definition is given in 2005 by a director of the USC Viterbi School of Engineering's GamePipe Laboratory, California Michael Zyda: "Serious game: a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives"[3].

Serious educational games use the dynamic characteristics of games in educational contexts. Play-based learning allows students to develop their skills through practice.

3. Creation and Development of Video Games

The first games were created for military purposes and later in the second half of the 20th century began to be used in business. Today, games are an independent industry, and serious games entering the field of education, research, and research.

In Bulgaria, Trivador is a popular serious game played between three players with strategy elements and a battle of knowledge and reaction speed. The game is played with questions (selectable and recognizable) and answers.

The games enable students to learn by committing mistakes (which is a natural process in learning) without these errors affecting the health of people. In the medical virtual serious games in a gaming situation the student can be trained in a safe environment for him and his future patients: when a certain situation occurs - the arrival of a sick patient, the student is able to determine his condition by appointing laboratory tests, measurements of the patient: temperature, blood pressure, pulse, electrocardiogram, etc. Depending on the presented results, the student chooses whether to prescribe medication, whether to arrange further research, whether the condition of the patient is

critical and requires hospitalization or home treatment. Thus, in more sophisticated cases, echocardiography or interventional procedures may be employed: for example, selective coronary angiography (cardiac vascular examination) to determine the severity of the disease. The game situation offers help and feedback (pop-up comments) by providing the learner with an opportunity for self-study and an individual pace of advancement: when the student progresses more slowly, it gives easier situations to solve. Virtually created situations provide an opportunity for the learner to understand the direct link between cause and effect (situation - action according to the situation - result). The game-based learning offers instant feedback: a comment or change in the status or behavior of the simulated hero. The game-based learning allows taking new action to achieve the stated goal.

4. The Concepts of Serious Educational Games

Today, the innovative technologies offer better communication among players, a more attractive storyline, with more opportunities for gameplay option. Serious educational games geared to the specific objectives of medical education must include the following elements:

- Story related to the study material;
- To be didactically based;
- Offer clear feedback;
- To be a prerequisite for increasing the interest in learning;
- To provide a visual insight into the manipulations which are studied in medical education;
- To offer alternative ways of learning the training material;
- A good practice is to give a virtual prize after a series of successes in the game.

Serious Educational Games (SEG) have several key features that determine their essence.

Main Characteristics of the SEG:

1. The number of participating players:
 - Game with two players - starts and ends with two players; usually playing a few games while one player wins two games;
 - A multiplayer game - It is played by many players; usually consists of one game.
2. Means of playing - for example, cards;
3. Rules of the game;
4. Way to start the game;

5. End of the game - a description of how to win or lose in the game;
6. Game resources and ways to acquire and use them;
7. Symbols in the game;
8. Objects in the game;
9. Properties of objects - their features, which allow them to influence the game;
10. Targets;
11. Special Actions;
12. Timing and Priority: the system of priorities at doing actions;
13. Cost - actions or payments required to take another action or to stop another action; to pay a price, the player executes instructions;
14. Life – number of available lives;
15. Damage, Counte, and others.

From a technological point of view, the game must have good Sound effects; an overwhelming Narrative story that allows immersion in the virtual environment; Surprise - a good option is the game to offer surprises, which keeps the player in a pleasant expectation.

Educational games provide a safe environment for developing skills and habits and for acquiring knowledge; they develop qualities such as self-confidence, self-reliance while acquiring experience does not endanger patients as it takes place in a virtual environment.

The Terminology Used for Today's Generation

In scientific literature, the following terminology is used in the description of serious educational games and their users:

Millennials– persons born after 1981, they prefer to deal with multifunctional tasks, want to learn quickly and only things that can immediately use and implement, communicate constantly through social networks, work well in a team; prefer to use information technology for training in classical learning [4].

Digital Native – people who have the perfect knowledge of the language of digital technology [5], [6].

Digital Immigrant – people who were born before the digital era, but use modern technology [5], [6].

Net generation, Generation Y – the people born between 1981-1991, they spend a lot of time in the virtual world, looking for quick answers and decisions, preferring to have fun, wanting to get things done easily [7], [8].

5. Serious Games for Medical Education

A detailed review of the scientific literature on the use of serious games in medical education shows the use of mostly several types of serious games (Figure 1.).Most of the serious games described in the scientific literature include simulation games (such as The Sims Online) [9], [10] where the goal is to master a certain skill or knowledge.Virtual learning 3D platform is a preferred learning tool by immersing in a virtual environment [11]. Role and strategy games develop skills for quick decision making (for example, Geriatric Medication Game) [12].

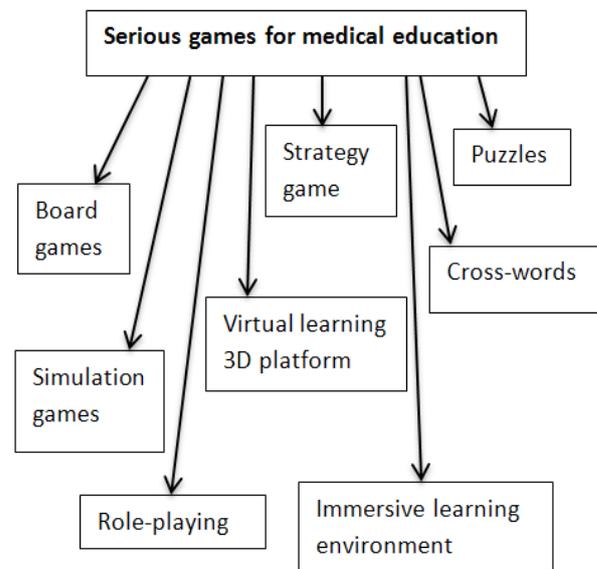


Figure 1. Types of serious games in medical education

Popular Games for the Purpose of Medical Training

Many games have been created in the field of medical education, but the following games have been particularly popular:

Uro-Island Medicine, related to Cognitive learning [13].

Geriatrics – a Role-Playing Game – [14]. The goals of Geriatrics are 1) to promote empathy to elderly patients and their healthcare providers and 2) to encourage some difficulties, dilemmas, solutions, and benefits of care for elderly patients.

Pulse!! – the medical and paramedical game, for experimental learning and practical knowledge with educational and training tool; helps develop critical thinking and practical knowledge [11].

AbcdeSIM – computer simulation game [15].

Septris (<http://med.stanford.edu/septris/>):an Internet-based game, represents "a novel approach to medical education" [16].

Path to Success – a medical game related to knowledge learning [17].

6. Investigation of the Innovative Technologies in Medical Education in Bulgaria

A survey conducted among students in Bulgaria (156 students from the first to the fourth course) shows that in the medical education in Bulgaria there are used educational presentations on subjects from the educational disciplines, videos on topics that are more complex to study and very rarely serious training games. At the same time, on the question "Do you want education games to be included in your training", a prevailing percentage of respondents (94.9%) respond with YES. Figure 2. shows a diagram of the distribution of the answers to this question: Respondents who have answered No are 1.3%; "I cannot decide" - 3.8%.

Do you want educational games to be included in your training?

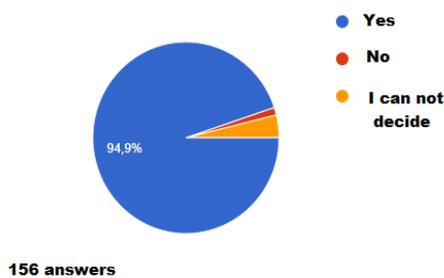


Figure 2. Exploring the interest in educational games

Video algorithms in Medical Education in Bulgaria

For the purpose of medical training, several learning video algorithms were created by Angel Kanchev University, Ruse, Department of Health Care, Bulgaria. Video algorithms have been developed by university lecturers [18], [19] to meet the students' needs for additional materials in their training in injection technology (the Nurse and Midwife specialty). Figure 5. shows photos from the video algorithm "Subcutaneous injection". Videoalgorithms are developed under the project "Development of a model for video algorithms for injection technology" and are publicly available (<https://www.youtube.com/watch?v=a4QTSo9opdQ>). Videoalgorithms are used in several medical universities in Bulgaria and are used with success by students in their training.



a) Check for air extraction from a syringe



b) Putt the injection



c) Remove the needle



d) Disposal of used materials in a safe environment

Figure 3. The spots in video algorithm "Subcutaneous injection"
<https://www.youtube.com/watch?v=a4QTSo9opdQ>
 (published with the author's permission)

7. Results. Creating a Medical Educational Game and Studying the Students' Opinion about the Serious Games in Medical Education in Bulgaria

An educational game for the purpose of medical training (the Nurse and Midwife specialty) has been created. The game aims to test and improve the learning of medical students about the injection technique. The game is in the form of questions and suggested responses to the action steps when applying a particular injection. There were created menus with a total of 28 questions, on each question being offered one true and three wrong answers (Figure 6.).

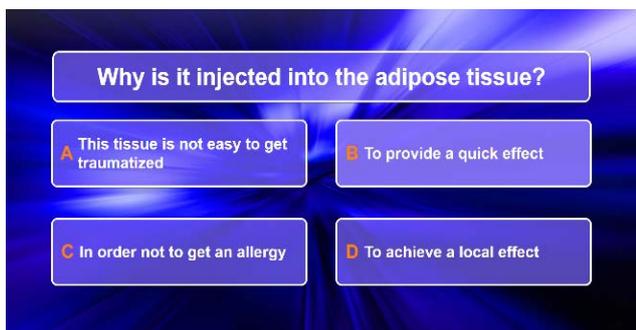


Figure 4. Game menu with one question and four optional answers

If the answer is correct, the selected field is green (Figure 7.) and the game offers the next question. If the answer is wrong, the field is illuminated in orange (Figure 8.) and the correct field is green. The game stops and offers a chance to start over. Reaching the end of the game and depicting a stimulating sentence is gotten if true answers to all the questions in the game are given.

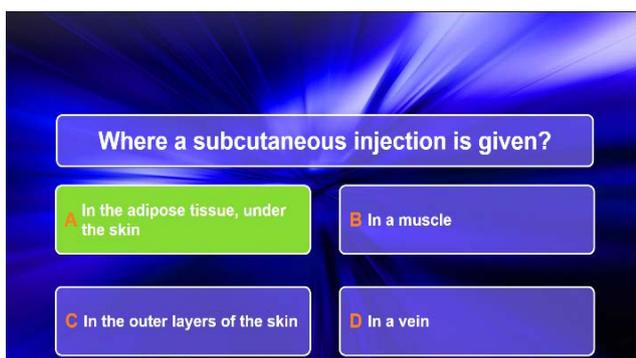


Figure 5. Coloring the right answer in green

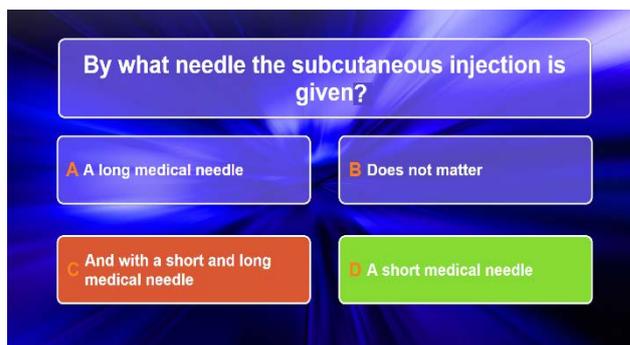


Figure 6. Coloring the wrong answer in orange

The created game is a means by which students will have the opportunity to consolidate and improve their knowledge through different, interesting, entertaining and stimulating learning curriculum. The game was created with the Serious Learning Games tool LearningApps.org. The game is useful for students with low Information and Communication Technology skills, friendly-use on PC, Laptop, Mobile Phone, Interactive board, and Tablet. Through this game, students can check their knowledge, for example before the manipulation "Subcutaneous injection" or before the student exam. Studied is the opinion of students in Bulgaria on the question: with what technological device they prefer to play serious educational games. Conducted investigation shows that students want to use all the modern technological means to start the game (Figure 7.- the question allows for more than one answer). The Phone is the most preferred device – 57.7%, followed by the interactive game (52.6%). The results presented in Figure 7. show that students are eager to use games in any of their free time (phone, tablet, etc.) and during the learning process (an interactive board).

8. Conclusion

In this paper, serious educational games are shown. Nowadays, the SEG are entering the education system and should be properly integrated into the learning process. Definitions, concepts, and use of SEG in the education process are presented. The conducted survey shows a significant interest of the respondents (94.9%) towards the introduction of serious educational games in the training. A preferred tool for playing serious educational games in Bulgaria are the phones, followed by the interactive board and other technological information tools. A training medical game has been set up to improve the knowledge and skills of medical students in the field of injection technique (Nurse and Midwife specialty). Serious educational games and other innovative technological methods are yet to enter significantly in the training of medical students in Bulgaria, but the beginning is already in place.

I think it's good to play educational games on:

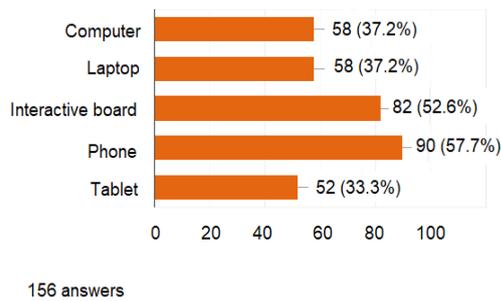


Figure 7. Exploring the technologies for games using

Serious games in medical education have the potential to develop non-standard thinking, to create future physicians confident and capable.

Serious games are a parallel way to create a new generation of individuals who can confidently and creatively build their future. The games have the ability to build strong characters; the games change thinking, break old ideas and create new ones; they are a force, that if used properly, well-intentioned is capable to build a new and better future: the future in which our children will live.

Acknowledgements

This work was supported by the Bulgarian Ministry of Education and Science under the National Research Program "Young scientists and postdoctoral students" approved by DCM # 577 / 17.08.2018 and NSF of Bulgaria under the Research project № DM 12/36/20.12.2017, "Investigation of Mathematical Techniques of Analysis of Physiological Data with Functionality for People with a Visual Deficit."

References

[1]. Esposito, N. (2005). A short and simple definition of what a videogame is. In *Proceedings of DiGRA (Digital Games Research Association) conference: Changing views – Worlds in play (Vancouver, British Columbia, Canada, 16–20 June 2005) DiGRA'05, University of Vancouver, BC.*

[2]. Ritterfeld, U., Cody, M., Vorderer, P. (2009). *Serious Games: Mechanisms and Effects.* Routledge, London.

[3]. Zyda, M. (2005). *From visual simulation to virtual reality to games.* Computer, sept 2005, IEEE Computer Society, 25-32.

[4]. Nevin, C. R., Westfall, A. O., Rodriguez, J. M., Dempsey, D. M., Cherrington, A., Roy, B., ... & Willig, J. H. (2014). Gamification as a tool for enhancing graduate medical education. *Postgraduate medical journal, 90*(1070), 685-693.

[5]. Oblinger, D., Oblinger, J. L., & Lippincott, J. K. (2005). *Educating the net generation.* Boulder, Colo.: EDUCAUSE, c2005. 1 v.(various pagings): illustrations.

[6]. Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the horizon, 9*(5), 1-6.

[7]. Boctor, L. (2013). Active-learning strategies: The use of a game to reinforce learning in nursing education. A case study. *Nurse education in practice, 13*(2), 96-100.

[8]. Kron, F. W., Gjerde, C. L., Sen, A., & Fetters, M. D. (2010). Medical student attitudes toward video games and related new media technologies in medical education. *BMC medical education, 10*(1), 50.

[9]. Cowan, B., Sabri, H., Kapralos, B., Porte, M., Backstein, D., Cristancho, S., & Dubrowski, A. (2010). A serious game for total knee arthroplasty procedure, education and training. *Journal of CyberTherapy & Rehabilitation (JCR), 3*(3), 285-298.

[10]. Bergeron, B. P. (2008). Learning & retention in adaptive serious games. *Studies in health technology and informatics, 132,* 26-30.

[11]. Dunne, J. R., & McDonald, C. L. (2010). Pulse!!: a model for research and development of virtual-reality learning in military medical education and training. *Military medicine, 175*(suppl_7), 25-27.

[12]. Chen, A. M., Kiersma, M. E., Yehle, K. S., & Plake, K. S. (2015). Impact of an aging simulation game on pharmacy students' empathy for older adults. *American journal of pharmaceutical education, 79*(5), 65.

[13]. Boeker, M., Anel, P., Vach, W., & Frankenschmidt, A. (2013). Game-based e-learning is more effective than a conventional instructional method: a randomized controlled trial with third-year medical students. *PloS one, 8*(12), e82328.

[14]. van de Pol, M. H., Lagro, J., Fluit, L. R., Lagro-Janssen, T. L., & Olde Rikkert, M. G. (2014). Teaching Geriatrics Using an Innovative, Individual-Centered Educational Game: Students and Educators Win. A Proof-of-Concept Study. *Journal of the American Geriatrics Society, 62*(10), 1943-1949.

[15]. Dankbaar, M. E., Alsmas, J., Jansen, E. E., van Merriënboer, J. J., van Saase, J. L., & Schuit, S. C. (2016). An experimental study on the effects of a simulation game on students' clinical cognitive skills and motivation. *Advances in Health Sciences Education, 21*(3), 505-521.

[16]. Evans, K. H., Daines, W., Tsui, J., Strehlow, M., Maggio, P., & Shieh, L. (2015). Septris: a novel, mobile, online, simulation game that improves sepsis recognition and management. *Academic Medicine, 90*(2), 180.

[17]. Kanthan, R., & Senger, J. L. (2011). The impact of specially designed digital games-based learning in undergraduate pathology and medical education. *Archives of pathology & laboratory medicine, 135*(1), 135-142.

[18]. Serbezova I. (2018). *Optimize training in health care through video methods,* Mediatech-Pleven (in Bulgarian).

[19]. Serbezova I. (2013). Video films in the training of medical and healthcare professionals. Ruse University "Angel Kanchev" (in Bulgarian).