Building a Serious VR Game for Soft-Skill Learning – Lessons Learned

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ABSTRACT

The presented game design article aims at analyzing and reporting the main features of the simulation VR game CICERO. CICERO is a serious game designed for the porpoise of teaching and learning public speaking skills in a VR environment. The game supports two modes of play practice mode and challenge mode. In the practice mode the players have to recreate the existing presentation, and in the challenge mode they can use their presentation in the game and analyze their behavior and presentation skills. Game measures sight (gaze mechanic), speaking speed, speaking sound volume and hand gestures made by the player. In the article, we discuss the optimal setting of the game in the learning process and limitations of the VR technology in learning.
Keywords*: Virtual reality, digital game-based learning, serious game design, immersion, public speaking skills*

INTRODUCTION

Advancement in IT technologies creates disturbances to the business and scientific world but also create many opportunities. On of such technologies is Virtual reality (henceforth VR). VR can create and simulate a three-dimensional (3D) interactive environments. Such technology can create an immersive learning experiences in a new and unique way (Sun, Wu & Cai, 2018). The aim of this article is to show the conclusions from the design, production and testing the serious VR game for teaching soft-skills in public teaching through a simulated scenario of a board meeting. We would also like to discuss the various learning contexts, in which such games can be used and implemented.

VR is not a new technology. Single-user Sensorama was the predecessor of the immersive VR technology and created in the 1960s (Heiling, 1962). The technology as we know now as VR was developed in the 1980s and 1990s, it was expected that VR technology would be used widely in many fields, but due to technical reasons, it was not well received by the potential users (Bracken & Skalski, 2010). The major difficulty was that graphics resolution was very low and the weight and size of devices were very high. Additionally, the costs of obtaining and maintain the devices were quite high. In the 1980s the first educational implementation of the VR technology took place (Hawkins, 1995) and since then it was applied for professional and educational training. Although, number of applications were rather low. The gaming entertainment sector was the main reason for rapid VR technologies development in the late 2000s and early 2010s. The products like Oculus Rift, VIVE and PlayStation VR created first high quality and relatively affordable head-mounted displays (henceforth HMD) with haptic VR controllers. Additionally, Google released Google Cardboard in 2014 (https://vr.google.com/cardboard/) as a low cost mass solution for users, in form of a cardboard box for your smartphone with a set of lenses; and for developers in form of the free Software Development Kit. Such availability of technology with rapid improvement in graphics quality attracted a lot of researchers and educators to the VR technology.

The capabilities of the VR technology for learning and education is potentially very broad (Hockey et all., 2010), from

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creating simulators and showcasing functioning of almost any environment possible to imagine, through supporting 3D driven design and development, up to the full function interactive virtual worlds and supporting telepresence. The VR environments, in today's from, present both intrinsic and extrinsic value to the learners (Shukla and Conrad, 2011). Although, VR technologies for learning show their true learning capabilities when are linked in interactions with the physical world (Christopoulos at all., 2018; Bower at all., 2010; Hoshi at all., 2009). Looking for synergies between serious VR game design and learner choices in the interactive environment can create very high level of engagement and increase the learning effectiveness with the educational content that is present in the virtual and physical environment.

The VR technology also has limitations. One of the major limitation is simulator sickness (Maraj et al., 2017) or as many researchers relate it to the VR implantation through HMD as cybersickness. Rebenitsch and Owen (2016:102) define cybersickness as "*the onset of nausea, oculomotor and/disorientation while experiencing virtual environments in head-mounted displays, large screens, and curved screen systems.*" Growing number of research is concentrated around the topic of sources of cybersickness, and the results are mixed. Some of the research results reported that HMD usage in VR environments could cause cybersickness (Yörük at all.,2018; Treleaven et al., 2015) and it has a negative effect on the presentence in the VR environments. However, other earlier studies indicated that walking and movements, which are in line with the natural body movement can prevent simulator sickness (Chance at all.,1998) or that presence in the VR environment is not related to the cybersickness but other external effects are causing it (Nichols et al., 2000). The topic of cybersickness is still underdeveloped and more research on this topic is still needed for the better understanding of this phenomena.

GAME DESIGN

One of the most challenging tasks in the VR application for learning is designing the environment that is both natural and immersive. The serious VR games are good at recreating existing of fictional environments with a high grade of physical fidelity. However, in simulation gaming, we use abstraction for showing high-level theoretical concepts or when dealing with complex systems. VR games present on the market so far for educational purposes are struggling in using abstraction without being perceived as silly or unprecise. Thus designing a serious VR game for management filed in the soft skills area was very challenging and uneasy task.

The serious VR game "CICERO" has been designed with learners of beginner or entry level of knowledge and skills in public speaking for business. The basic aim of the game is to create a realistic environment and game scenarios that will incorporate the most typical business environments and situations that require public speaking skills.

FIGURE 1
THE STARING SCREEN AND MAIN INTERFACE WITH VIRTUAL ROOM.
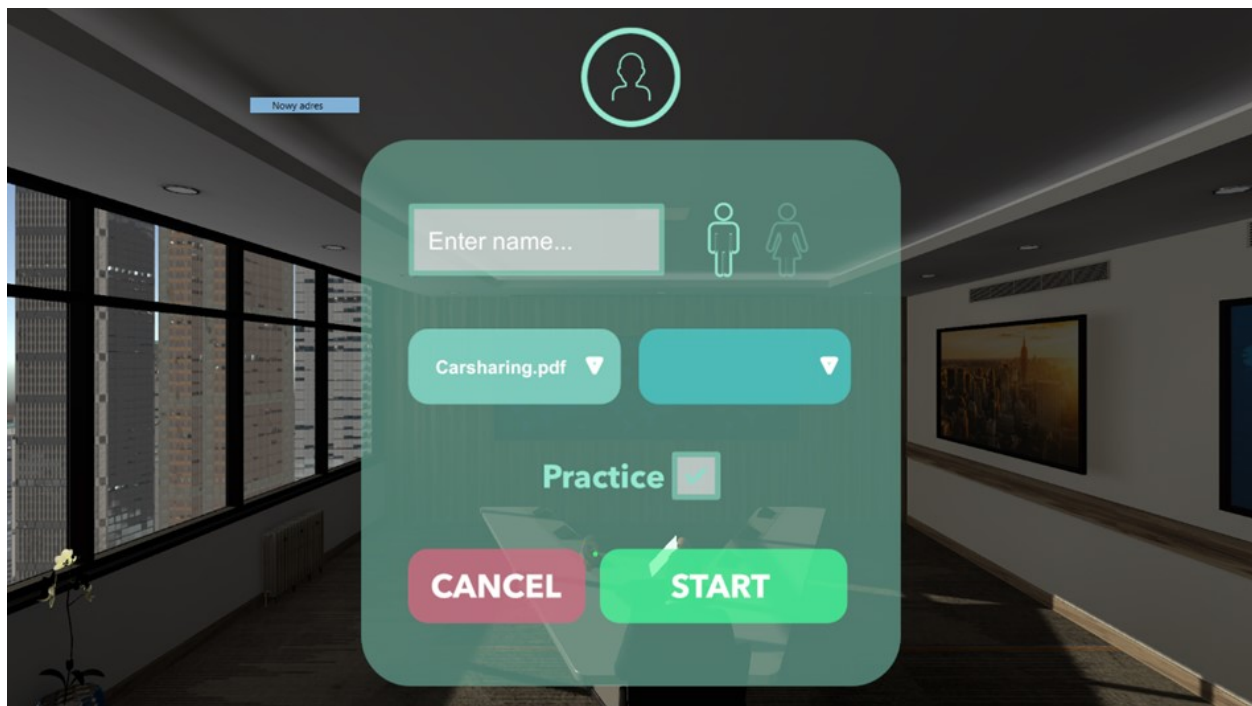
The game has been designed and build in the Unity3D engine with VIVE head-mounted displays in mind. The type of the HMD is important as they feature very different screen resolution and thus have implication for the field of vision presented to the player. The field of vision is important for the design of the CICERO VR game as we present the information on the effectiveness of the player on the edge of the field of vision.

One of the other concerns was cybersickness. Although, it is impossible to fully get rid of the cybersickness in VR, but we can decrease the probability of the cybersickness occurrence with the game design(Yörük at all.,2018; Treleaven et al., 2015; Chance

at all.,1998). In case of CICERO, the player is positioned in the natural way of a presenter standing in the brightly limited room. The movement in the game is limited to the 2-3 steps in every directions and this is in-line with the role of the presenter in the game.

GAME SCENARIO

In the process of the scenario design for the first version of the game, we have decided to use the two most common scenarios with different game modes in mind.

Scenario no 1. The first scenario is a typical boardroom setup. The story follows the situation when you are the project manager of the growing carsharing company (CarMa), and you present two variants of the project execution options to the board of directors. In this case, you will receive a prepared presentation from your "team," and your task is to present it in front of the board in a professional way.

In this scenario, the game works in the mastery mode. In this mode, the task of the learner is to be as close as possible to the perfect presentation pattern, i.e. master. The mastery, in this case, is established by two public speaking professionals – male and female, who present the same presentation in an instructional video. Also, the leaner have a virtual card in one of the hands with useful hints and tips, which can work as a form of a virtual teleprompter. In the master mode, the internal scoring system counts the deportations of the learner from the "perfect" master presentation and displays the positive and negative scores in the form of the visual aids every time the learner switches the slide in the game. The presentation has around 12 slides (with starting and the closing one) the whole scenario has been designed to be played around 15 minutes to minimalize cybersickness occurrence probability (Yörük at all.,2018; Kolasinski, 1995). In this scenario, there are also around 16 questions with a different level of complexity. In the classroom playthrough live audience can vote with a specially designed companion web app on the up to 4 question that can be assigned to be asked by one of the avatars anytime in the game.

Scenario no 2. The second scenario describes a situation of the business idea pitch to the potential investors. In this case, the learner can provide their presentation in PDF form, and it will be implemented into the game by the instructor. Thus the learner can see and interact with own presentation. In this, scenario game works in the challenge mode. In the challenge mode, the game does not show any scores on the player's performance but records the presentation and all designated parameters.

Both scenarios feature some elements and measures for gameplay and learning effectiveness. The first and one of the mechanics of the most important game is the four dimension measure system. The game measures and in the mastery mode scores following four elements:

- Sight direction – where the players look during the gameplay, measured in seconds by object or avatar;
- Speaking speed – how fast is the player speaking, measured by the number of words per minute;
- Speaking sound volume - how loud is the player speaking and if it modulates the voice, measured by decibels per millisecond – approx. Ten times per second.
- Gestures – how often a player is gesticulating, measured by the distance between HMD and haptic virtual controllers in the player's hands.

FIGURE 2
THE ROOM SETUP FROM THE SPECTATOR POINT-OF-VIEW WITH AVATAR POSITIONING.
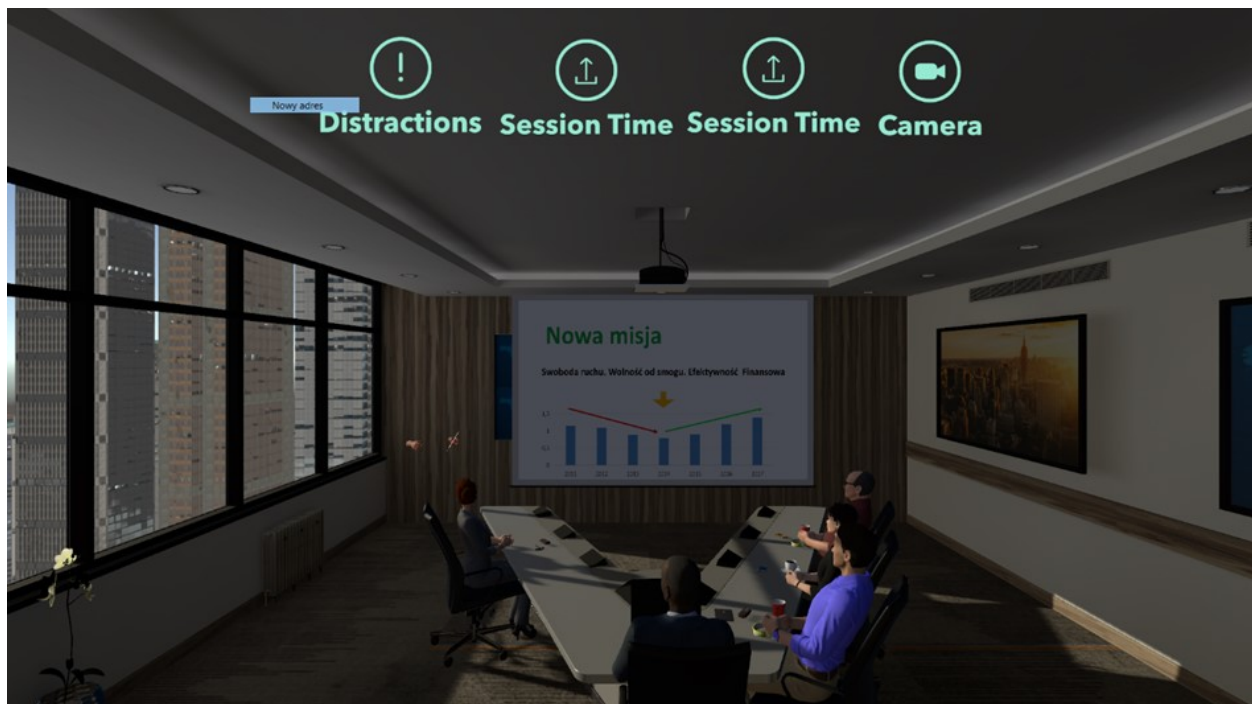
The virtual room setup and interactive avatars are the common features of both scenarios. The room setup, table placements, and avatar positioning pattern are the key factors in this design area.

The key features of this room setup are the professional office setting for better immersion, the boardroom is in the high floor in the inner city, and from the windows, you can see other buildings. In the room, you find. V-shaped table of the furniture and decoration, the position of the table and other elements in the room is designed with gaze positioning in mind, so no other object comes in the way. In this way, we achieve the ability to monitor the position of the players gaze without disturbing the game flow and immersion.

Second common design elements are interactive avatars. In total, up to 5 avatars spawn at the beginning of every each around the V-shaped table. The basic rule to the spawning point is an only non-obstructive view to each avatar so it can be seen clearly and the gaze mechanic measurement system can work seamlessly. The avatar models have both male and female versions.

FIGURE 3
THE BASIC AVATAR MODELS USED IN THE GAME.

The avatars can have different skin tones, hairstyles, eye color, and ethnic resemblance. The algorithm spawning the avatars randomizes the gender and ethnic origin with diversity in mind. It creates up to 5 avatars and places them at the table. Their clothes are always business casual, but cloth colors and details can vary. The avatars have assigned a fixed set of animations that can be applied both indecently (player independent reactions) and as visual feedback to the presenter (player dependent reactions). Each one of them also can ask the question, female and male versions of the questions audio has been recorded for this purpose.

The last common design mechanic in the game for both scenarios are distraction mechanic. Distractions are a series of audio-visual incidents that can be administered to the virtual environment by the instructor at random. There are two types of incidents. The first group is incidents based only on sound, e.g. a sudden fire alarm or police sirens. The second group is audio-visual incidents, e.g. a flock of loud birds are flying outside the window or someone opens the door and looks inside the room quickly etc. The role of the incidents are twofold. The first role is to create a distraction. The second is to create stronger immersion by stepping up the environment fidelity and prepare a player for such distractions in the real public speaking environment.

LEARNING MODULES AND STRATEGY

The VR technology has significant potential for learning, but it is critical how the game is positioned within the learning experience and how it mixes with physical reality for better learning effectiveness (Christopoulos at all., 2018; Bower at all., 2010; Hoshi at all., 2009).

Four different combinations of technology and learning can be pieced together: learning about technology, learning from technology, learning with technology and learning in technology (Schrader, 2008). This approach is very similar to the traditional placement of simulation gaming placement within the learning space represented by Klabbers (2006) or Duke & Geurts (2004). In case of the VR game in this particular scope is critical how player communicates with the game. Players can move and move within the virtual space (Herbet et al. 2012; Hockey et al. 2010) they can speak, gaze and use hand gestures (Carter, 2012; Hockey et al. 2010).

The optimal setting for the course has been designed with people who are beginners in public speaking or have little experience. The basic aim of the game-based learning program is to give the students basic knowledge of the public speaking and the necessary skills. The whole course is organized in the experiential learning methodology (Kolb & Kolb, 2005). Before the beginning of the course, students receive two pages of instructions with information about the course and the game. In the instruction, they also find a link to the closed YouTube channel with video material. The video material contains seven video materials. First, two contain the presentation from the scenario no 1 performed by two professional public speaking experts (male and female). In the third and fourth video, they explain the presentation techniques they have used in the presentation. The fifth and sixth video material is devoted to the most important aspect of public speaking and their view on the presenter's style and charisma. The last material is a short tutorial on how to play the CICERO VR game. Altogether, it is around 1h of video material divided in the short videos of 7 to 15 minutes long. The students are asked to review this material before the game with special care to the presentation itself and the

VR game tutorial. The instruction also contains the link to the copy of the presentation so they can train it before the game session.

The gaming session can be organized in the synchronous or asynchronous version. Each student should play the game at least two times (once in each scenario) but they can play as many times as they want and time allows. In the classroom setting, students present in the virtual environment and with the live audience that can follow the in-game events on screen and can vote on questions with the companion web app. In the asynchronous learning style, students can make appointments in the VR Lab. Every gameplay can also be video captured and stored for review. In the future, we plan to develop a google cardboard version for people to train in their own time.

In scenario no 1, players learn by example and by repeating the masters. In a scenario no 2 the players learn from feedback analysis of their performance. The game measures four player actions and gives visual feedback in the game and also presents all data in the performance report produced in the PDF file on the end of the gaming session. The sessions should be separated in time so the simulator fatigue will not increase the chance of cybersickness.

TABLE 1
VISUAL FEEDBACK ICONS IN CICERO VR GAME.

Player actions	Visual feedback icon	Measurement unit	Scoring in the mastery mode
Sight direction		Seconds per object or avatar;	The player scores the points by looking at the different avatars and presentation and not on objects, windows, etc.
Speaking speed		Number of words, words per minute, average words per minute;	Scoring is made by the departure from the optimal value corridor.
Speaking sound volume		Voice loudness in decibels per millisecond;	Players need to talk loud enough to be heard (in decibels) but should modulate the voice;
Gestures		A number of hand gestures measured by the distance between HMD and haptic virtual controllers in the player's hands.	There are a set number of specific gestures that the player should perform during each slide;

The icons presented in table 1 appear with color code in the bottom of the HDM vision every time the player changes to the next slide. The color-coded icons show how a player did in the previous slide; they glow red or green for few seconds. Players also control the pace of the presentation. Second, the feedback system is avatar behavior. As mention in the game design section, each avatar comes with two sets of behavior displayed by the animation. First set is player independent and give the basic set of behavior that purpose is to increase immersion and bring the avatars more to live, e.g. following the player with eyesight, looking at the phone of out the window, etc. Second, a set of behavior is player performance specific. Basically, the avatars will pay less attention and will be distracted more often.

After the game has been finished, the system automatically creates a PDF file with generated data from the measurement and scoring system, and it can be sent to the player's email (see Appendix 1).

Each playthrough should be accompanied by a debriefing session with the instructor. In the classroom setup player, group and instructor can analyze the data and talk about the performance of the players. In the asynchronous learning setup, students can schedule a debriefing session with instructor or peers and distribute their data report and link to the gameplay. After the gameplay analysis instructor assigns the players with reading, other exercises activities and lectures but in this setup can individualize the learning program based on the gathered data and gameplay video.

CONCLUSIONS

The VR game design process and implantation into learning experience produced a large number of interesting insights into the specific aspects of the VR technology, as well as, questions about effective implantation of the VR gaming technology in the curriculum (Shen at all., 2018).

VR technology allows game designers to create an environment they desire or need for the particular setup. In serious game design, we want to use this feature with player and purpose in mind (Duke, 1972). In this particular setup, the author chose to use VR technology in the way of mimicking the reality with additional gaming layer and by creating a safe space environment for users to play with (Kriz, 2003).

Every technology comes with some limitations. The VR technology comes with limitations to hardware nature in the form of cybersickness when using HMD, while designing the serious game we have to keep in mind safety of the players and incorporate safety design and procedures while testing and playing. Instructors have to undergo safety training and follow the procedure of decreasing the potential for cybersickness. The soft limitation is the ability of the game to immerse the players and deliver the meaningful experience. This limitation works with the notion, that so far the VR technology is rather weak in transferring highly theoretical or complex knowledge and systems. However, we expect this to change in the coming years, as much more good quality games and solutions will appear on the market and in the research.

In the end, authors support the statement that serious VR games work in a most effective way in connection with the physical world (Christopoulos at all., 2018; Bower et al. 2010; Hoshi et al. 2009) through interactions and meaning. Giving the ability to include the player's own presentation into the virtual environment was designed with that statement in mind.

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VR Presentation Skills training
Student: MR X

Your results:

	Volume points	7
	Word speed points	10
	Look points:	5
	Sign points:	2
	OVERALL:	24

Detailed report

Session's time was: 10 min 12 sec

Student had observed following objects:
1. Shelves had been observed for: 5.9 sec
2. ludekF had been observed for: 6.7 sec
3. Screen had been observed for: 49.5 sec
4. ludekA had been observed for: 4.7 sec
5. ludekC had been observed for: 6.1 sec
6. Door had been observed for: 1.5 sec
7. Boss had been observed for: 9.7 sec
8. Picture (right) had been observed for: 0.6 sec
9. ludekD had been observed for: 0 sec
10. Picture (left) had been observed for: 0.1 sec
Student's average volume was: 0.2 sec