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Combat Tanking in Education:
The TANC Model for Playful Distance Learning in Social Virtual Reality

Stylianos Mystakidis, University of Patras, Greece*
https://orcid.org/0000-0002-9162-8340

ABSTRACT

This study examines the impact on engagement and affective outcomes of playful learning in social virtual reality (SVR) for distance and open education settings and aims to provide a practical framework for playful learning design. Three case studies in the United States and Greece were examined where playful learning was organized for e-learning. Data collection methods include questionnaires, observation of online course meetings, reviewing of course communications and chat logs records, student and instructor interviews, student coursework assessments, and reflections. Findings indicated that playful learning experiences in SVR can increase academic interest, intrinsic motivation, engagement level, satisfaction, and completion rates. Instructor genuine investment in a thoughtful, sophisticated humorous approach was vital for student buy-in. Finally, guiding principles for playful learning design in SVR are summarized in a model involving four dimensions: theme, actions, narrative, and auxiliary components (TANC).

KEYWORDS

Distance Education, E-Learning, Gamification, MOOC, Motivation, Open Education, Playful Design, Playful Learning, Stylianos Mystakidis, Virtual Reality, Virtual Worlds

INTRODUCTION

E-learning and open education are becoming mainstream modes of education to tackle increased training needs within a knowledge-based society further accelerated by emergency remote teaching imposed by the pandemic (Bozkurt & Sharma, 2020). This mode of teaching has significant differences and is often confused with distance education, online learning or e-learning. E-learning is planned and designed carefully taking in account several pedagogical, administrative, and technological variables, while emergency remote teaching is a temporary solution for instruction in crisis situations (Hodges, Moore, Lockee, Trust, & Bond, 2020). E-learning carries the potential to deliver anywhere, anytime, flexible education for all. However, this has not happened effectively yet. Current online teaching and learning practices in distance education face limitations in terms of quality and effectiveness. The enforced nature of distance teaching implementations lead to wide phenomena of cognitive and mental fatigue associated with excessive use of synchronous video-conferencing platforms (Wiederhold, 2020). One of the most crucial problems of e-learning courses historically is their high drop-out rate (Jordan, 2015). Massive Open Online Courses (MOOCs) brought distance education to the spotlight world-wide attracting millions of users. According to Palmer & Devers (2018), the average MOOC completion rate is less than seven percent. Harvard's and MIT's MOOC platforms

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*Corresponding Author

reported in 2016 that the average completion rate was four percent (Chuang & Ho, 2016). Higher, vocational, and adult education face the challenge of designing e-learning in ways that keep students engaged, motivated, and self-directed and at the same time able to overcome adversity and manage the cognitive load of learning. New e-learning models and frameworks are needed to develop and sustain learners' high levels of motivation, engagement, performance, and satisfaction. The overall goal of this evaluative case study is two-fold: First, to discover and report the effects of playful design using three-dimensional environments in Social Virtual Reality (SVR) platforms for e-learning and open education, and subsequently to develop a practical model for playful learning design in SVR.

BACKGROUND

Motivation is one of the most important affective aspects of learning because it influences the cognitive processes of learning (Schiefele, 1991). Motivational factors include goal orientation, interest, and self-efficacy beliefs (Eccles & Wigfield, 2002). Education practitioners do not always know or are able to motivate and engage learners (Mimirinis & Bhattacharya, 2007). One potential answer to tackle this deficiency is the purposeful enhancement of learners' motivation in the direction of cultivating a learning atmosphere conducive to intrinsic motivation. The self-determination theory (SDT) is a theoretical framework that looks at motivation from a psychological point of view to determine what motivates learners, how and why (Ryan & Deci, 2000). SDT postulates that intrinsically motivating actions can be enacted in learning environments that exhibit choices, direct feedback, optimal challenges, mastery of meaningful tasks, self-directed interaction, and social connectedness (Mystakidis & Herodotou, 2016; Ryan & Deci, 2008). These elements can be coded into the competency, autonomy, and relatedness virtuous triad. Ryan and Deci (2000) define intrinsic motivation as "the inherent novelty to seek out challenges, to extend or exercise one's capacities, to explore, and to learn". Intrinsic motivation is associated with in-depth learning, high performance, and learning resilience (Mystakidis, Berki, & Valtanen, 2019; Zainuddin, 2018). When people like and enjoy online learning experiences that are meaningful to them, they tend to engage, take initiatives, act, set, and achieve personal goals.

Game-Based Learning and Playful Design

Game-based learning can be an effective learning environment for sustaining students' engagement and increasing performance when using meta-cognitive strategies appealing to critical thinking skills, social problem solving skills, and decision making skills (Kim, Park, & Baek, 2009). The theory of transformational play links deliberate, academically meaningful role-playing in a game with personal development (Barab, Gresalfi, Dodge, & Ingram-Goble, 2010). Game-based approaches for enhancing intrinsic motivation include gameful design (gamification), serious games, and playful design. Gameful design or gamification is a promising method which adds an additional, affective layer to learning in the direction of the enhancement of motivation (Kapp, 2012). Serious games comprise a set of meaningful choices in a restrictive context with a primary serious, educational purpose (Mystakidis, Berki, & Valtanen, 2017b; Mystakidis, Fragkaki, & Hatzilygeroudis, 2020).

Playful design is the simplest way to integrate basic game elements or aesthetics in a non-gaming educational context so as to attract attention and interest (Borges, Durelli, Reis, & Isotani, 2014). The application of playful design principles in an external context can be also called playification (Campo, Baldassarre, & Lee, 2019; Davis, 2018). One example of playful design in website design was Twitter's funny error page called "Fail Whale". In cases of servers' overload, instead of landing to a typical error message page eliciting emotions of boredom and frustration, Twitter users viewed an aesthetically pleasing, metaphorical image of a whale drawing being lifted by dozens of small birds. The birds represented the bulk of Twitter users who created a massive digital load causing the malfunction. In this instance, the playful approach turned a negative experience into a pleasant surprise that alleviated the service outage. Moreover, playful design can be used for the positive reinforcement

and encouragement of desirable behavior. Playful work design advocates for the willing transformation of work conditions by employees to promote enjoyment and challenge (Bakker, Scharp, Breevaart, & de Vries, 2020). Piano stairs turned subway station staircases into giant, outdoors pianos that produced actual sound each time one stepped on them (Peeters, Megens, van den Hoven, Hummels, & Brombacher, 2013). The experiment demonstrated how walking the stairs instead of taking the esclator evolved from a tedious burden into a fun recreational activity in which an increasing number of people were willing to participate frequently with the extra bonus of a positive impact on health.

In the context of formal attendance-based, blended, and distance education, playful design can be applied with the intention to arouse students' positive emotions such as attention, interest, and curiosity applying multiple instructional strategies (Deterding, 2016; Ferrara, 2012). Playful learning can involve various game mechanics, dynamics, and aesthetics (Mystakidis, 2019; Hunicke, Leblanc, & Zubek, 2004). Playful design in education can applied with the use of a story that unifies learning activities under a compelling narrative where curriculum sections and activities can be framed playfully with appropriate linguistic metaphors and aesthetic elements (Mystakidis & Berki, 2018).

Playful design differs from gamification and serious games in its systemic outlook, level of freedom, and implementation complexity. Gamification turns a system or process into a game with a comprehensive strategy where users have to achieve concrete goals following specified rules. For instance, a gamified distance education course turns assessment into a multiplayer game (Mystakidis, 2020; Sheldon & Seelow, 2017). A serious game is a usually costly, self-contained digital entity where learning takes place while engaging in its context. Playful learning in contrast adds a layer of playfulness on top of the actual educational activity with minimal systemic interference where teachers and students are encouraged to exercise their creative agency (Nørgård, Toft-Nielsen, & Whitton, 2017).

Social Virtual Reality

One promising technology that can address potentially the aforementioned challenges and limitations of e-learning is Social Virtual Reality (SVR). SVR features three-dimensional computer-generated spaces that facilitate the psychological immersion of participants (Girvan, 2018; Mystakidis, Berki, & Valtanen, 2021). The psychological immersion complements sensory immersion that can be achieved with devices such as VR head-mounted displays; it involves the voluntary suspension of disbelief and is associated with social, actional, and symbolic factors (Thomas & Brown, 2009). In the literature several other terms are used such as 3D virtual worlds, 3D Virtual Immersive Environments, and Multi-user Virtual Environments.

SVREs combines affordances of different nature in comparison to omni-present, two-dimensional, web-based synchronous, and asynchronous online learning platforms. First, they enable a superior sense of self and agency since the participant possesses a virtual body, controlling his or her avatar (Ma et al., 2016). Avatars' characteristics can be customized and modified with great detail to reflect each learner's preferences of self-expression; they can appear in human-like or completely fictional form. The embodied digital identity, and the ability to engage with the environment and virtual objects in multiple points of view, such as the third-person perspective, creates the psychological sense of being in a space, experiencing presence. Presence is the perceptual illusion of non-mediation, the notion of being in a space and not in a video call (Lombard & Ditton, 1997). Interpersonal interactions in physical spaces carry great pedagogical and social value. SVR offers a rich alternative in online settings; when meeting at the same time in a shared, persistent 3D virtual environment with other digital personas leads to experiencing co-presence (Bulu, 2012; Lambropoulos et al., 2012). In these environments avatars can engage in rich, embodied, interpersonal interactions. Students and educators can communicate not just in voice and text modes (e.g. private, public and group voice, or text chat messages) but also through non-verbal channels such as movement, gestures, and virtual body language. Further, virtual reality environments allow the exercise of agency; avatars are free to move and navigate in the virtual space. Also, these environments are flexible and adaptable; avatars with sufficient rights

can construct, modify and control the parameters of the space; if given this opportunity, learners are not passive spectators in a pre-defined sequence, they can adopt the role of active participants who can co-create, manipulate or share objects and co-shape the learning experience.

Furthermore, SVR offers sophisticated programming capabilities of resources under certain conditions, e.g. avatar proximity (Okutsu, DeLaurentis, Brophy, & Lambert, 2013). Owing to SVR flexible development affordances, practitioners can build fictional or artistic environments or accurate recreations of existing sites and objects. Unlike in web-based systems, phenomena such as "Zoom fatigue" have not been observed in SVR platforms. On the contrary, people with diverse disabilities have formed durable communities experiencing a sustainable liberating sense of freedom owed in part also to inclusive education practices (Sheehy, 2010). Based on the literature, we hypothesized that the affordances of SVR render it an effective platform for motivation enhancement through playful design in distance education.

METHOD

The main research question defined was: "What is the impact of playful design in e-learning using social virtual reality on engagement and affective outcomes?" In this post-hoc study we analyze and report results from three case studies on the effects of game-based learning application in distance online education. The methodological frame is of qualitative nature and is grounded on the evaluative case study paradigm. Case studies provide opportunities for in-depth exploration of specific learning activities. An evaluative study includes descriptions, explications and judgements (Merriam, 2009). A qualitative study's analytic benefit is substantial when two or more cases are studied (Yin, 2009). For enhanced external generalizability of findings and recommendations, we adopted a multiple-case study approach and examined three cases where the author played a principal role in their design, development, and delivery. To increase the validity and reliability of the study, multiple methods of data collection were applied (Stake, 1995). Applications in all three cases were examined by the observation of online course meetings, review of course communications and chat logs records, interviews of students and instructors, and student coursework assessments and reflections. Data was analyzed in multiple stages during the implementation of the cases using the taxonomy of student engagement (Bangert-Drowns & Pyke, 2001). This validated tool for classifying student engagement in computer-supported educational contexts categorizes students' engagement in terms of its complexity and its relationships with intrinsic motivation, volition, and self-regulated learning (Kucirkova, Messer, Sheehy, & Fernández Panadero, 2014). The taxonomy distinguishes seven levels of increasing engagement from Disengagement to Literate thinking. Jabbar and Felicia's guidelines and classification of learning experiences outcomes were adopted for the assessment of the playful designed activities impact on affective learning outcomes (Abdul Jabbar & Felicia, 2015). The classification discerns two affective learning phases; knowledge anticipation and reflection linked with emotional experiences, e.g. interest, curiosity, readiness, motivational outcomes, and behavior change. After review of all data sources, a list of common themes was produced related to playful design in SVR. Next, we provide the research contexts, descriptions of the three cases for a better understanding of issues and challenges related to the design and application of playful design in e-learning with SVR and its impact of engagement and affective outcomes.

Case Study 1

This study implemented playful learning experiences arranged in a virtual museum on the ancient Maya civilization (Hill & Mystakidis, 2012). The study took place in the University of Washington in Seattle, USA between 2012 and 2014. It explored the effect of playful design of immersive learning experiences in a 3D virtual world. The University of Washington's Virtual Worlds Certificate was a fully online postgraduate programme offered world-wide that took place entirely in 3D virtual world environments. Its duration was one academic year. It consisted of three sequential modules. In these

Figure 1. Maya Virtual Museum 3D environments: Aerial impression of the Maya virtual museum (upper left), avatars in role-playing costumes (upper right), Maya science exhibit (bottom left), Maya Ball Game Stadium (bottom right)

modules, participants learned to understand, design, build and program virtual worlds. In the last module, four diverse, international and interdisciplinary teams designed and built a joint educational project in nine weeks, in this case a Virtual Museum in Second Life. The particular SVR platform was selected due to its popularity so as to maximize the global dissemination potential of the project.

The UW Maya Virtual Museum featured four sections: Maya Medicine, Maya Science, Maya Mythology Triathlon and Explorer's Cove. Each section featured several immersive playful learning experiences including serious games and simulations (see Figure 1).

Playful design was applied in multiple facets of the virtual museum. Indicatively, part of the Mythology Triathlon section of the Museum was the Mayan Ball Game, dedicated to the world's first team sport; a combination of today's football (soccer) and basketball. The objective of this playful experience was to facilitate learning appreciation about the history and the mythological roots of the sport, associated with the eternal battle of good versus evil. According to a Mayan myth, this sport was gifted to humanity by the Hero Twins, two demi-gods and exceptional ball players who outplayed the dark gods of the underworld. Each user that visited the Maya ball stadium received a notecard with the rules of the game and was invited to move around, aim and throw the ball through

the circular, vertical hoop to score in the simulated court. Once s/he is successful, s/he is invited to receive a prize, a medal, but then suddenly players were challenged to follow the footsteps of the mythological forefathers of the game; they were invited to prove their abilities in a more complex and difficult game by teleporting to a perilous territory, namely Xibalba, the Mayan underworld. There, they could explore a barren, terrifying land with human skeletons and streams of flowing lava. The game consisted of a single-player challenge to throw the ball through a smaller hoop, a dozen meters above the virtual ground while a non-player character (NPC) in the form of a demon was defending it, deterring shots as a goal-keeper. After some failed attempts, another NPC offered advice on how to weaken the opponent by collecting and casting spells. Spells could be earned in surrounding monuments and sculptures by answering correctly questions about the Mayan Ball Game. The overall experience consisted of also immersive, contextual soundscapes with sounds and music, teleportation portals, and panels with integrated learning material about the studied subject such as texts and videos. Once the participant won the game, another teleportation gateway appeared allowing the return to the stadium on earth.

In other exhibits, students had the opportunity to dress as an indigenous citizen, explore authentic Mayan villages, lifestyle, typical everyday activities such as agriculture, fishing, pottery-making, play the traditional percussion instrument Marimba, and engage in ancestral group rituals, dance and spiritual healing practices. One floating island was dedicated to the explanation of the history, practice of Mayan astronomy, associated with the creation and structure of the Mayan calendar. Overall, the museum visualized a big number of Mayan lifestyle facets allowing history to become alive and visitors to become active actors in stories and face playful challenges in different Museum sections.

This playful learning environment won two international awards at the Virtual Worlds Best Practices in Education conference. More importantly this resource became a valuable supplement for K-12 and higher education classes. Learning went viral; over 5,000 visitors in 12 months from all over the world explored the open-access museum. Also, qualitative comments from twenty five educators who used the virtual museum as a resource in their classes recorded an improvement of student learning efficacy. Additionally, it provided inspiration to distinguished museums to develop similar projects and virtual experiences. Finally, it opened up new cooperative research opportunities with research institutes that reached out and proposed ideas to expand the concept with the integration of high-fidelity 3D models of Maya structures and objects.

Case Study 2

The second research context explored SVR in a playful storytelling learning experience in the University of Patras, Greece between 2012-3 (Mystakidis & Berki, 2018; Mystakidis, 2021b). It explored the effect of story using 3D immersive learning environments in a playful learning experience. Utilizing the affordances of desktop-based VR for visualization and simulation, as well as the appeal of storytelling, a playful blended experience was created on the history of the book, titled "From the Ancient to the Modern Tablets". Utilizing the visualization and simulation affordances of Social Virtual Reality, and the appeal of storytelling, the gamified blended experience enabled problem-based learning.

Students participated in an interactive playful digital storytelling experience. They were invited to assist a digital agent, in the form of an avatar, like an online tutor, on the quest through a series of 3D Virtual Immersive Learning Environments in Second Life. Learners traveled back in time and visited simulated 3D virtual environments. The abundance of open, relevant 3D historical sites and representations were the main reasons for the selection of the particular medium. The realistically constructed virtual environments allowed students to immerse themselves experiencing aesthetics, architecture, clothing and the culture of that time. Moreover, the students explored cyber-spaces, observed online historical samples and experimented with interactive objects related to the respective studied technological advancement or milestone. At the same time, a soundscape, a soundtrack timed with precision was woven into the story to enhance the emotional depth and feeling of immersion.

At each stop, students were encouraged to demonstrate their (updated) knowledge, conceptual understanding, and critical, creative and reflective thinking skills related to each milestone through individual and group challenges. Individual challenges had the form of critical questions and problems related to each milestone and era in the history of the book. For instance, in the modern era, students faced the problem to devise methods to store an ever increasing number of published books in a finite library space and make them accessible to multiple, geographically-dispersed audiences. Group challenges consisted of collaborative activities where students convened, conversed and decided on tasks, such as building correspondence of letters in the Phoenician and Latin alphabets. Up to seventy attending participants were divided into teams with various ways, e.g. according to their school, class or by gender.

This student-centered programme has been popular among local and visiting schools. The programme's high engagement level created enthusiastic students' responses and positive learning behaviours. This project also became known and well-accepted among teachers. More than 1,500 primary (elementary) and secondary (middle, high) school students, accompanied by over eighty teachers, participated in innovative learning ways and advanced their knowledge and skills through active edutainment where education is combined with entertainment (Charsky, 2010). Twenty-eight teachers evaluated very favorably cognitive, social and affective aspects of the student learning experience such as engagement, motivation, interest, learning and collaboration.

Case Study 3

The third case study focused on a playfully designed massive open online course (MOOC) using SVR in the University of Patras, Greece between 2012-3 (Kostopoulos, Giannopoulos, Mystakidis, & Chronopoulou, 2014; Mystakidis, Berki, & Valtanen, 2017a). Open Education is a distance learning approach that has been strategically proposed well before the covid-19 outbreak to encourage cost-effective training, upskilling and reskilling of large population groups and workforce with speed and flexibility (Mystakidis & Berki, 2014). Specifically, the MOOC was called "Open Workshop on Information Literacy" (OWIL). Playful elements were introduced holistically into its instructional design model and communication strategy. The MOOC featured weekly online meetings next to asynchronous activities. These meetings would take place either in a stand-alone SVR platform, based on the Opensimulator software, or in an existing social virtual world (Pellas, Mystakidis,

Figure 2. Two 3D learning stations on the history of the book: Lascaux cave (left), Ancient Egypt (right)

& Christopoulos, 2021). Given the profile of all participants and the open nature of the MOOC, Second Life was chosen to promote interest-driven self-directed learning beyond the formal course assignments. Meetings took place initially in a medieval alchemist's laboratory acting as a visual metaphor of the 'workshop' concept (see Figure 3). Progressively, online sessions were hosted frequently in other context-specific simulated indoor and outdoor spaces. A free, open, online, problem-based and practice-oriented course was designed to address especially the learning needs of postgraduate students and PhD candidates. It featured five modules around Information Literacy. Its total duration was eighteen weeks. Three hundred eleven participants from twenty-three different departments and scientific backgrounds attended in two instances of the course. The course was followed by a mixed method study on the quality of learning as well as the impact of the playful design on attrition.

Figure 3. OWIL MOOC 3D meeting space (Alchemist Lab)

FINDINGS

Three core issues were identified in all contexts when playful design was used in SVR and are presented in the following sections.

Affective Outcomes and the Role of the Instructor

The playful character of the environment and the overall experience appealed to participants and captivated their attention in the phase of knowledge anticipation. Students were highly emotionally involved in stories and connected immediately with playful virtual human and non-human characters. For instance, in the OWIL MOOC case, questionnaire responses in five-level Likert scale revealed that participants liked the course and they would recommend it to their peers with scores of 4.14 ± 0.70 and $4.29 \pm 0{,}88$ respectively. In the book history case, students would yell whenever the avatar entered a potentially hazardous situation in the virtual environment and intervene to offer suggestions and solutions to solve problems. They were curious and invested in the character's quest. When role playing aspects within a theme were kept to a reasonable level, e.g. pirate avatar appearance, scenery props and some relevant lingo, they added fun without increasing cognitive load (Mutlu-Bayraktar, Cosgun, & Altan, 2019). The overall result of the SVR experiences was high levels of satisfaction, interest

and positive motivation and disposition towards the studied subject, knowledge area, and skills. In the book history case study, this was documented by the teacher perceptions survey, student behavior observation, and student work assessment (Mystakidis, 2021b). The survey consisted of twenty-nine items organized in three sections, focusing on the formative assessment of the experience, the assessment of the impact of used technologies on students in the cognitive, affective and psychomotor domain, and teacher demographics. In the MOOC case study, this was evidenced by student surveys and interviews (Mystakidis, Berki, & Valtanen, 2017a). The questionnaire consisted of fifty-six predominantly closed, five-level Likert scale questions organized in three sections: evaluation of the participants' experience, impact of the used methods, and demographics. In the reflective phase of learning students personalized content and regulated their learning to produce their own insights. It was also affirmed that the learning experience added to the students' positive mentality towards literacy and appreciation for the studied subject e.g. Mayan civilization.

It is worth noting here that the learning experience does not consist only of digital elements, pixels and voxels in the form of static elements, objects and environments that can be pre-arranged to safeguard a desired outcome in a mechanistic manner. The human aspect in the form of the instructors was critical for the effectiveness of the approach. Playful teaching was heavily influenced by emotionally invested trainers that felt comfortable not to rely on their serious, elevated, academic status and enjoyed a more joyful role in the educational procedure. In the OWIL MOOC case, we noticed that module instructors that embraced the playful ethos but strived to orchestrate comprehensive experiences were evaluated by participants higher than average (Kostopoulos et al., 2014). Even more important, certain academics valued the overall experience highly and attended consistently other modules voluntarily. These persons became community cornerstones that lead by example. One of them is actually present in Figure 3. Can you guess which avatar is a tenured university professor?

Their thoughtful, enthusiastic leadership by example created excitement and convinced the students to join the educational adventure. Participants in all instances appreciated the sophisticated humorous and kind-hearted attitude not only of the virtual environment but also of the e-learning instructors themselves. The tone of voice, the avatar appearance, the body language (gestures), the teaching style, the technical aptitude, e.g. avatar movement or 'catching' and commenting public or private chat messages were crucial for the overall instructor's performance. For instance, in the OWIL MOOC, playful design was applied consistently apart from the 3D environment components also in the written communication language and the accompanying multimedia so as to relay fun metaphors. Each module had a playful logo based on the course's logo (see Figure 4), the owl, an ancient Greek symbol of wisdom and a linguistic reference to the course's acronym (OWiL). In the same fashion, sessions with group presentations were labeled as "EduTalent shows". In the book history case, the guided avatar's clothes and accessories would correspond to the instructor's physical appearance to facilitate a make-believe time travel. In the Maya museum, once students teleported to the Maya underworld, the instructor avatar would change shape into a scary deity and apply software transformation filters to distort his/her voice accordingly. Indeed, excellent teaching in virtual worlds can adopt theatrical performance elements (Kapp, 2012). It is argued that the adoption of this playful spirit should be genuine and coherent in all communication facets and outlets, both 3D and 2D. In this way, course meetings participation can become a pleasant, stress-free activity, albeit linked to serious, challenging individual and group academic work. Students sense intuitively instructors' positive and negative feelings such as excitement, passion or indifference. This effect was observed in the MOOC case where multiple educators and guest speakers with distinct teaching and presentation styles were actively involved. Whenever playful activities would lose their spontaneous, joyous and free character, they could backfire, be seen as gimmick and discourage learners. This has serious implications for the professional development of trainers. Interested educators should be trained experientially, by designing and implementing their own playful scenarios and receive critical feedback from peers and more experienced teachers (Mystakidis, Fragkaki, & Filippousis, 2021).

Figure 4. Playful logos of two modules in the second iteration of OWIL MOOC on innovation and academic writing featuring two owls as mascots and an appropriate module icon, a light bulb and feather quills respectively

Engagement, Participation, and Performance

In these three cases, high levels of sustainable learner engagement were recorded. This was established based on observation of student online behavior, meeting recordings, chat logs, appraisal of student work, and teachers' feedback. Teachers in the book history case were amazed by their students' intense concentration, participation and active cognitive engagement. Student work assessment in the OWIL MOOC according to the taxonomy of student engagement revealed high levels of creative thinking and innovative adaptation, indicators of critical and literate thinking. This effect was not temporary as it was reflected also in quantitative indicators related to attrition. For instance, OWIL MOOC participants recorded sustainable high completion rates of over thirty-two percent involving three hundred eleven participants, more than four times higher than the average open online course. The comparatively lower drop-out rate was observed consistently in both delivered iterations of the course. This result could have been influenced also by the decision to adopt a blended e-learning mode. MOOCs usually rely almost entirely on flexible, asynchronous learning activities. The OWIL MOOC demonstrated that the effective use of SVR for rich, synchronous learning, both formal and informal, in the form of periodical practice-oriented workshops can enhance significantly MOOCs.

In the case where an open space was available with multiple exhibits and venues, such as the Maya Virtual Museum, the phenomenon of returned visits outside class hours was observed. More specific, by examining log files, chat records, and unstructured interviews with educators it was recorded that students enjoyed the environment and used it for their informal and study meetings. Other user groups that discovered hidden environments did not hesitate to visit and hold their meetings on several occasions. The thematic, open layout of SVR spaces (see Figure 5) with a variety of cognitive synchronous and asynchronous e-learning activities was appreciated by participants who expressed high levels of satisfaction on instructional and social aspects of the playful courses.

A context-aware, voluntary role play was often an indicator of user involvement. Engaged students personalized their avatar and undertook optional activities, visiting the learning environment

Figure 5. Themed and playful design of 3D environments

frequently outside class hours as evidenced both in the Maya ball game and the OWIL MOOC case. The mysterious, hidden environment of Mayan underworld became viral; students spread the word among colleagues and peers and teleported them in the space. There, they took selfies with their avatars and created memes by posting them in social networks with funny, accompanying captions. Specifically, in the OWIL MOOC we noticed that over 70% of successful participants had performed significant personalization additions and modifications in their avatars. In contrast, a generic, common avatar and indifference to community's customs and culture was at times an indication of low interest that could lead to drop-out.

Teachers' and students' perceptions regarding the learning effectiveness of the SVR were very positive. OWIL MOOC participants confirmed new skills achievement and their willingness to apply what they learned with average scores of 3.58 ± 1.29 and 3.90 ± 0.86 accordingly. This was also ratified by the assessment of the produced artefacts and assignments that constituted the MOOC's project-based evaluation method. In the Mayan and book history cases, SVR was regarded as very useful for facts recalling and history understanding. High, active engagement throughout the OWIL course lead to effective collaboration and performance in the case of reading literacy. Learners' produced digital artefacts revealed high degrees of creativity, agency, expressive aptitude and enthusiasm as judged by one internal and two external experts who were invited to express their assessment on the openly published student products. This effect reached its peak in the MOOC module on Innovation. In this part of the course participants worked in groups, collaborated from a distance in SVR to design and

present concrete innovative solutions to tackle an existing challenge applying the taught method. The overarching playful ethos and the granted freedom of choice lead to rigorous engagement with academic content, intense collaboration and creative artifacts production. Students took ownership of their learning, enjoyed their active role, cared for the end result and invested in the project-based outcome. In other OWIL MOOC modules on topics such as quantitative data analysis methods participants asked explicitly for additional study material, an indication of self-directed learning, intrinsic motivation and inherent interest in their learning. In summary, the playful design of the course helped to maintain an academically defined space that was mentally challenging yet relaxed with a friendly community atmosphere. Participants reported the achievement of their learning goals, the acquisition of new skills, the experience of a virtual community of practice resulting in the overall appreciation of open and distance learning. Here are some indicative OWIL MOOC student reflections (Mystakidis, Berki, & Valtanen, 2017a):

I enjoyed the weekly meetings, they were informative and fun even though I couldn't always attend. The video recordings were very helpful.
Posting my assignments openly so that everyone could see them pushed me to spend more time to produce something of high standard.
I had great conversations with my team members with different studies than mine.
I appreciated the enthusiasm of everyone in the course, professors, and participants.

In the book history case, some teachers' comments were quite revealing (Mystakidis & Berki, 2018):

I have never seen my class so quiet and concentrated as when they attended this program.
You exceeded teachers' and students' expectations; you have captivated children's interest and they enjoyed the program greatly. The whole visit to the Library was so alive.

Design of Playful Learning in Virtual Reality: The TANC Model

A review of 194 game-based learning (GBL) practices by Nadolny et al. (2020) revealed six primary, and fourteen associated secondary characteristics. The primary GBL characteristics were Learning Support, Assessment, Learner Control, Immersion, Interaction, and Narrative. Playful learning design introduces a less rigid approach in comparison to gamified education and serious games. Playful learning, as evidenced in the included three cases, studies combines the GBL prime attributes of Immersion, Interaction, Narrative, and Learner Control. Therefore, playful design for learning experiences in SVR can be organized around a model with four essential dimensions: Theme, Actions, Narrative, and Components (TANC). The dimensions of the TANC model and their correspondence to the aforementioned GBL attributes is depicted in Table 1.

1. **Theme:** The theme is an appropriate, common semiotic domain, e.g. science fiction, fantasy, a historic period, a cultural reference or art work. The theme should be consistent across all used platforms and environments and thus inform the language and other course-related 2D visual elements. The theme should correspond ideally both to participants' interests and educators' experiences. As it was experienced in the OWIL MOOC, if an instructor is not truly invested in a domain and familiar with its discourse, nuances, and idiosyncrasies, the theming implementation might be superficial.
2. **Actions:** The design of playful learning activities has been effective when game elements are aligned with learning mechanics (Arnab et al., 2015). Academic learning tasks can become individual, group or class quests. Quests can rely more or less on the spatial identities of SVR; instructors can organize scavenger hunts in appropriate environments as implemented in the

Table 1. TANC Model for Playful Design in SVR

TANC Model Dimension	Indicative categories	GBL Design Characteristics (Nadolny et al., 2020)
Theme	Mystery, Drama, Historic, Cultural, Popular art, Military, Fantasy, Science fiction, Alternate history	Immersion
Actions	Choice, Movement, Communication, Discovery, Competition, Cooperation, Quests	Learner Control, Interaction
Narrative	Role play, Episodic layout	Narrative
Components	Avatar, Visual realism, Soundscape, Virtual goods, Badges, Teams	Immersion, Interaction

OWIL MOOC case around the six stages of the Big6 problem-solving model of information literacy: define, search, access, extract, synthesize and evaluate (Eisenberg and Berkowitz 1990). Practitioners are especially encouraged to think of concrete ways to foster students' ownership of the space by allowing them to gradually become co-creators and active contributors. This can be implemented by giving students' the freedom of choice in their coursework. For instance, in the book history case, students had complete autonomy to negotiate, decide, design and develop collaboratively their final creative project. Additionally, in SVR, users can roam the environment, observe, discover, and be granted the rights to edit and co-shape the shared space, a tactic employed in the second iteration of the OWIL MOOC. This is a fundamental shift from hermetically closed, institutional platforms where "what happens in the course stays in the course" or teacher-controlled conferencing software. This potentially open character of the environment and of education is an added advantage that can be enabled by the technical affordances of SVR platforms. In the right contexts, such as courses with longer duration (see OWIL MOOC), learners can progress, earn rights and ascent to leadership roles based on their proactive, supporting behavior towards their peers and the community. Alternatively, they can have their own individual or group space where they have total freedom to express themselves creatively and experiment.

3. **Narrative:** An overarching narrative or story can introduce a mystery, challenge, or drama that learners have to solve. In the Mayan ball game experience, players' virtual practice was transformed through narrative into a risky endeavor when were invited to experience a simulated version of the sport's mythological origin story by competing with deities in the underworld (see Figure 6). In this case, learners assume a new identity or professional property as the main actors, the heroes who embark on an epic journey (Goldstein, 2005). Storytelling methods and lessons learned can be used to setup the stages and beats of the story: the context, the call to action, challenges, temptations, mentors, helpers, grave danger, transformation, final trial ("boss" fight), and return. Themed role play relaxes learners through familiarity while new themes can ignite students' curiosity.
4. **Components:** Components are instantiations, technical aspects or structural elements associated with the previous three dimensions; Theme, Actions or Narrative. For instance, visual realistic 3D virtual spaces, virtual goods, and accessories can be procured or constructed to serve a themed role play. Moreover, sensory immersion can be enhanced with the use of soundscapes, landscapes of ambient sound. In the Maya case, items such as Maya-themed avatar costumes and accessories were provided to visitors. The three-dimensional layout of the SVR environments renders them superior to 2D equivalent in terms of visual fidelity and ambient immersion.

The analysis of the three included playful case studies across the four dimensions of the TANC model is provided in Table 2.

Table 2. Analysis of the included case studies according to the TANC Model

TANC Model Dimension	Case Study 1: Maya Ball Game	Case Study 2: History of the Book	Case Study 3: OWIL MOOC
Theme	Historic (Maya)	Science Fiction (Time travel)	Alternate history (Steampunk)
Actions	Choice, Movement, Discovery	Competition, Cooperation	Quests, Cooperation, Communication
Narrative	Role play	Role play, Episodic	Episodic
Components	Avatar, Visual realism, Soundscape	Avatar, Visual realism, Soundscape, Teams	Avatar, Virtual goods, Teams

Playful learning relies on agency, freedom, creativity, intuition, flexibility, agility, and free flow. Moreover, playful learning depends on make-believe elements such as a theme or narrative. Playful learning design starts with reflection; can a course, a module or an assignment be framed, renamed and linked metaphorically to a shared interesting reference? Do students have the freedom to influence the individual or collective experience? Can a course be transformed into a narrative with multiple episodes, quests or even branches? Does the introduction of fictional entities or characters contribute to the construction of a convincing plot? Where will course meetings take place, in a virtual lecture hall or in a more interesting venue such as a floating island or an underwater archeological site? What other visual or auditory elements can improve immersion and interaction?

CONCLUSION

Two-dimensional e-learning platforms have limitations that can influence negatively the overall quality of semester-long distance education courses. Social Virtual Reality can support durable, deeper conceptual and procedural learning (Mystakidis, 2021a). According to the blended model for deep and meaningful e-learning in SVR, several critical success factors need to be considered related to technology, learners and instructional design (Mystakidis, Berki, & Valtanen, 2021). In

Figure 6. Snapshots from the Maya Ball Game experience; Call to action - invitation to the underworld (left), Mayan underworld challenge and environment (right)

terms of technology, practitioners are advised to ensure that participants have access to i) above-average laptop or desktop computers equipped with external graphic cards of sufficient VRAM and ii) high speed internet, preferably over a tethered Ethernet connection. Notwithstanding, emerging SVR platforms provide additional capabilities combining flexible, ubiquitous access through multiple device classes: handheld devices (e.g. smartphones, tablets), computers, and head-mounted displays (Pellas, Mystakidis, & Kazanidis, 2021). Moreover, students' technical skills have to be developed and verified in the pre-course phase so as to remove any demotivating distractions and technical barriers to learning. Finally, instructional design decisions driven by teaching perceptions and epistemological foundations are key quality determinants to the extent that faculty members are the sole responsible actors in the course's design. SVR does not ensure better e-learning unless its unique affordances are taken into account. Ineffective, monotonous teaching approaches could be replicated with minimal benefits regardless of the technological medium. As research findings of the current study indicate, apart from the content side, equal emphasis must be placed on the social and emotional aspect of e-learning. One way to do this is to enhance intrinsic motivation and social interaction using strategies such as creative play to transform learning. Especially in higher education, learning is more about inspiration, empowerment and meaningful cognitive discourse than mere information transmission.

Playful design based on the TANC model can support relaxed, nuanced, humorous, aesthetically pleasing environments, inducing positive feelings of enjoyment, satisfaction, and positive reinforcement. Playful learning is simpler, easier and quicker to design and implement in comparison to game-based learning. When executed appropriately, this strategy does not subtract from the

Figure 7. TANC Model for Playful Learning in SVR

seriousness of learning and academic rigor, in contrary it deepens motivation by liberating students' locus of control, freedom, initiative and creativity.

The TANC model can be perceived as a potentially powerful yet peaceful weapon in educators' arsenal in the front-line battleground for student motivation, engagement, performance, and satisfaction. If we would illustrate the model in the form of a tank (Figure 7), the *theme* could be envisioned as the center and observation station that oversees and controls a plethora of armament that can unleash *actions* through its turret. The *narrative* is the vessel that unifies all elements, the theme's basis and engine. Finally, *components* are the tightly connected rotating tread wheels that ensure the narrative's maneuverability, flexibility, and progress beyond any obstacle or gap.

In an era where education is disrupted by the pandemic and social distancing, the results from this study can accelerate the reconceptualization of distance education and the improvement of e-learning quality by emphasizing the profound human experience that learning is transformative and lasting when it is appealing, meaningful, and enjoyable. Teacher development and the pedagogically–

informed integration of technologies such as SVR can assist the world-wide necessity to transition from emergency remote teaching to deep meaningful online learning for large audiences to mark a shift towards true digital education.

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Stylianos Mystakidis is an education innovator, project manager (PMI/PMP) and researcher at the University of Patras, Greece, and a Professor-Counselor at the Hellenic Open University, Greece. He holds a Ph.D. in Cognitive Science from the Faculty of Information Technology at the University of Jyväskylä, Finland (2019), a Master of Arts in Education in Virtual Worlds at the University of the West of England Bristol, United Kingdom (2016), and a Master of Science in Mechanical Engineering at the National Technical University of Athens, Greece (1998). He is actively involved in interdisciplinary projects, European policy, and international research. His professional practice, teaching and research focus mainly on e-learning, distance education, open education, blended learning, game-based learning, virtual and augmented reality.