Approaches and Models for Application of Gamification Techniques in v-Learning

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Abstract. Nowadays, the effectiveness of technology integration into teaching and learning approaches is widely recognised, mainly, in those pedagogical practices where students are the centre and co-constructors of their knowledge process. Specifically, the authors underline the potentialities of combining the gamification techniques and 3D virtual environments to design innovative learning settings through the description of two projects, TALETE and AVATAR, funded by the European Commission.

Keywords: Gamification Concept, Virtual Reality, v-Learning, e-Tivities Model.

1 Introduction

The paper discusses the application of gamification in different educational contexts as a powerful tool for attracting students' attention for a long period of time, for stimulating desired behaviour and learning in a new way to achieve specific learning goals and results. Some approaches and models for applying the general game theory principles and game-design elements to support and improve learning in virtual environments (v-learning) are explained based on two case studies described in the last two sections.

2 Gamification Approach in Education

The Oxford Dictionary defines gamification as “the application of typical elements of game playing (e.g. point scoring, competition with others, roles of play) to other areas of activity, typically as an on-line marketing technique to encourage engagement with a product or service”. From the educational perspective, the gamification of learning is

an educational approach to motivate students to learn by using game design, gamification techniques and game elements in learning environments (Kapp, 2012). Some gamification techniques do not involve playing games at all, but they are based on the concepts of applying game-design thinking to non-game contexts (Freitas, Lacerda, Calado, Lima, & Dias Canedo, 2017). The game-based concept is applied to meet specific learning objectives, to attract students' attention for a long period of time and to stimulate desired behaviours. Whether applying the gamification concept in eLearning truly helps learners learn is broadly discussed in scientific, academic, and educational societies. Several organisations do not consider the "gamification" in eLearning as a viable approach, especially for a longer time for development and higher costs. There are variety of gamification strategies which do not seem to be equally effective. This depends on their real capacity of engaging the audience in the learning process; that is, when learners find these strategies interesting and appealing. Below are described some key components and success factors that should be carefully considered during the development of a gamified environment:

- Engaging learners in interactions (competition or cooperation) – many modern game-based educational environments let students learn together, stimulating peer-to-peer interactions. To consider an appropriate reward for the competition winners and leaders of cooperative actions has high importance.
- Aesthetics of the learning environment - a pleasant and beautiful environment visually designed with proper engaging elements brings positive emotions and motivates people to interact with the product.
- Learning aims and objectives have to be clearly communicated. The rules have to be set to ensure an effective learning environment.
- Challenges and tasks for reaching the learning goals have to be concluded with feedback, which helps learners understand the issue and go to the next level of competency. Moreover, according to Flow Theory, challenges and tasks have to be appropriate to learners' skill level.
- The different learning paths and choices available for learners create uncertainty and increase their excitement in the activities and tasks to be carried out and be solved. They become autonomous to decide which path is more suitable freely, to construct and re-construct hypotheses based on the consequences of their actions.
- The game story/scenario, e.g. context, has to be adequate and corresponding to the learners' age level and background who play a role. It has to be appealing, exciting and bringing the motivation and engagement to the highest level.
- Game strategies relate to kinaesthetic experience (implementation tasks and practice), facilitating understanding and comprehending new information by additional sensory channels.
- Reward system in the learning process is a very important component. Many mechanisms could be used, such as badges or credits (points), exposing the learner's development, or showing their progress bars as badges and points are the simplest to think about because they became the most popular one. The rewards and efforts have to be appropriately connected considering the

complexity of the context and the artefacts' situational use to create an enjoyable, engaging and fun solution that stimulates desired behaviours.

3 Virtual Reality and Gamification Techniques for Education

The first definition of "Virtual World" was reported in an interview to Jaron Lanier, titled "A Portrait of the Young Visionary" of 1988 (http://www.jaron-lanier.com/vrint.html). Virtual world (VW) is described as a technology used to synthesise a shared reality. Each our relationship with the physical world is re-created in a new way. This has only an influence on how we perceive reality by senses. Afterwards, Loomis (Loomis, Da Silva, Fujita, & Fukusima, 1992) distinguishes between physical and phenomenal worlds, stating that the phenomenal world is the result of the mediation with the physical world. It is built by our senses. Virtual Reality (VR) aims to persuade users to be in a "reality" to act naturally and carry out the assigned tasks. In this way, users are supposed to believe that the virtual world where are immersed keeps the real world's expectations. VR refers to generating a virtual environment or projection which creates a realistic experience but does not exist in reality. There are different types of virtual reality technology, and as the most influential could be pointed out (Evans, 2017) (Sultan, 2021): Non-immersive VR; Fully Immersive VR; Semi-Immersive VR; Augmented Reality, and Collaborative VR

VW developers combine various tools and approaches to create an engaging computer-based on-line community environment, where the individuals interact in a custom-built simulated world. There are many different types of purpose-built virtual worlds addressed to different users (Girvan, 2018). According to the revenue models, VWs could be paid (users pay a subscription fee) or free to play. Another important characteristic of one VW is the users' age (children, teenagers, or adults). Virtual worlds also have different technological requirements. Especially in case of fully 3D worlds, the user will need appropriate computer hardware and the installation of a standalone software client (application). Most advanced virtual worlds also require a broadband internet connection on the user's side.

The use of VR is very useful when the activities to be carried out by users, in reality, are too expensive, difficult and dangerous. That is why it allows the users to explore the space relationships which would be impossible to go over in the physical world, such as molecular modelling and astronomical simulation. In effect, the use of simulators in VR permits people being trained by cutting down possible risks met in real training. This is useful, especially for soldiers, pilots and surgeons. Another example is in Architecture. Users can get over in real-time a 'real' 3D architectural environment. Finally, in Art, users can rebuild virtually artworks or artistic environments (damaged by ages) to favour their conservation. The systems, which can support these structures, are formal virtual learning environments (VLE), where learners can fulfil, organise, and manage learning courses. VLE is a space inside the Network where users can work together through various tools and informative resources to achieve common learning objectives in problem-solving activities (Galliani, Luchi, & Varisco B.M., 1999).

Knowledge is considered as a set of meanings, characterised by metacognitive processes through the interaction with an environment, including tools and resources. V-learning promotes learning by encouraging the use of various techniques and increases students' level of commitment to study the subjects and personalise and customise their learning process. Full immersion in the virtual environment supports multisensory transmission among trainees. V-learning provides learners with an example of integration between usual web functions of e-learning platforms and 3D virtual environment. Virtual worlds represent effective training tools, providing users an immersive graphic climate and supporting learning based on experience with better opportunities for teachers, trainers, and tutors to adapt and customise the educational models for learning through virtual interaction and work. They set up the potential for learning by doing and problem-based learning and offer the learner control through exploratory learning experiences (Saunders, R. L., 2007). There are different types of educational VRs, but two of them are the most important. The first type is characterised by users' access and interaction with the virtual environment through specific tools like helmet, glasses, and gloves. This represents the result of several studies aiming at producing and developing a cyborg body, a union between human being and machine. The second one allows users to build an alter ego with a new body and go into the virtual world. This 'alter ego' is identified in an avatar, which lives in the new virtual world interacting with the other virtual bodies.

4 Combining Gamification with VR: Case Studies

The virtual worlds' use ensures a drastic reduction of logistics costs and better accessibility and interactivity. It is very suitable for simulations and offers a high level of immersion. As a learning environment VR allows users to develop training paths exploiting the potentialities of both 2 and 3 dimensions. In the virtual environment, the learner activity is structured based on comparative analysis on the problems. That means that each learner acts as a member of a specific group providing an individual contribution in the dynamic interactions with the others inside the virtual reality. These processes will favour their organisational learning through knowledge sharing. Finally, the 3D virtual environments support the development of knowledge through "learning by doing", especially through the combination the playful-fantastic dimension and the social one (Parpet & Harel, 1991). The Gilly Salmon's Five Stage Model (Salmon, n.d.) and "e-tivities" concept can be used to identify the typical activities tutors may be involved in at different stages of the students' learning processes (Figure 1.). Practical usage of this model put in focus the following issues:

- Provision of technical support to enable student participation - the student has to succeed in setting up their access to the on-line system to be able to learn via it. The on-line tutor has a very important role in this process either at the level of providing the student with technical support from help desks or by maintaining high learning motivation.

- Students Management - Different learners, may be at different stages in the process of development. The tutor must manage and support students in the same group who may be at different stages in the e-tivities Model.

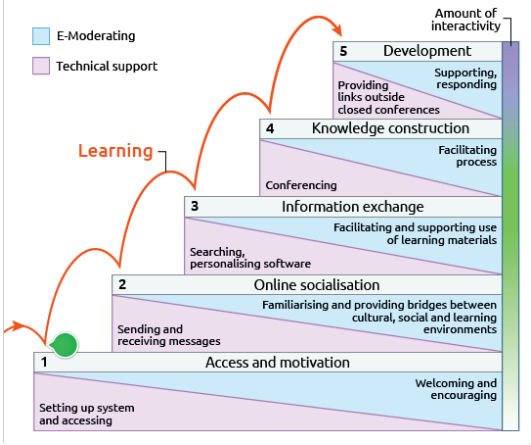

Fig. 1. Gilly Salmon's Five Stage Model of e-tivities

The learning philosophy and instructional design integrated into the model are key factors regarding the students' progress and achievements. This model was adapted to two different learning methodologies developed in the framework of the two international projects – TALETE (TALETE, n.d.) and Avatar (Added Value of Teaching in a Virtual World, n.d.). Due to the use of these virtual worlds, Web 3D offers a great opportunity of creating an educational environment where learners, from different places, start jointly and synchronously tactile or kinesthetic activities within the game such as in TALETE project or in massively multiplayer on-line role-playing game platform Second life (SL) such as in Avatar. The 3D of virtual worlds encourages the creativity development of the learners more than those in 2D. These are defined as communicative environments, which can amplify the cognitive capacities, called "multiple intelligences" by H. Gardner. Therefore, interaction with simulated reality permits learners to represent the knowledge's contents as a game to compare and verify real situations (Boulos, Hetherington L. & Wheeler, 2007). In this context, learners re-create their educational path according to their individual learning styles, favouring a real comprehension.

Both projects mentioned above were focused on the usage of the virtual worlds for education. The baseline from the methodological point of view for both TALETE and Avatar was the broadly accepted five-stage model and the "e-tivities" and gamification concepts. Still, there is a significant difference between them from the learning philosophy, instructional design, target groups, subject domains, technological solutions, and environments designed.

The main aim of the TALETE project was to improve the training and learning of Mathematics in secondary schools (with a focus on Geometry) by the development of: i) innovative pedagogical tool making the study of Mathematics more interesting and creative, transforming a possibly tricky situation into a simpler, more dynamic, flexible,

surprising, engaging, intriguing one to foster the student's curiosity based on the advanced ICT solutions and Serious Games Theory; ii) methodology was developed by participants from Italy, Bulgaria, Greece, Turkey, and UK on the base of OCSE PISA (OECD PISA, n.d.), IEA TIMSS (IEA TIMSS, n.d.) and National Curriculums of partner countries. The core of the educational model was the concept of mathematisation, i.e. constructive, interactive and reflective activity of using the everyday contexts expressed in mathematical language and concepts for solving real problems using mathematics (Blum & Borromeo-Ferri, 2007). The international experts' group selected relevant challenges (specific mathematical problems covered by the topics of the National Curriculums) which were developed as separate but linked in a common scenario, 3D mini-games integrated in the virtual environment. Under the project was conducted training of teachers in Math to make them familiar with the v-learning principles and competent to use the developed virtual environment in the classroom. Afterwards the trained teachers tested the innovative methodology and tools with their students who were separated in experimental and control groups. The two main components of the TALETE training environment were: e-learning platform for the teachers and a 3D environment for teachers and students. The e-learning platform (based on open-source Claroline software platform) was developed to deliver the teachers' e-course, web seminars, and social area. The learning content was produced in the form of the learning objects by using Adobe Presenter software. The 3D virtual environment was developed based on the Unity 3D software platform and games' scenarios were integrated inside (Figure 2). The virtual environment is a fully explorable 3D space, viewed by the user in first-person shooter camera mode. Students can watch videos, explore (independently or with the guidance of a teacher) the space and play interactive games as part of a lesson plan and directly in their web browser. Each student's scores are recorded in a database that the teachers can access to evaluate performance.

Fig. 2. 3D scenarios for TALETE games

On Figure 3 are presented: 3D environment start screen and a mini-game screenshot with the following areas: 1 - Area for visualisation of the context and visual feedback, enabling learning by doing and exploring techniques; 2 - Area for the textual representation of the context, problem, tasks and questions; 3 – Area for answering; 4 – Feedback area and 5 – Navigation area.

Avatar project's main objective was to improve the quality of teaching and learning in secondary schools, mainly in Europe, through the production of an innovative v-

learning environment. The development of Avatar v-learning environment (AvE), educational methodology and resources allowed an expansion of the traditional classroom education, adding to it e- and v-dimensions and opportunities. The tools and functionality for conducting v- training in different subject areas provided the possibility of applying different educational strategies and techniques and promoting active students' participation and involvement in the learning process.

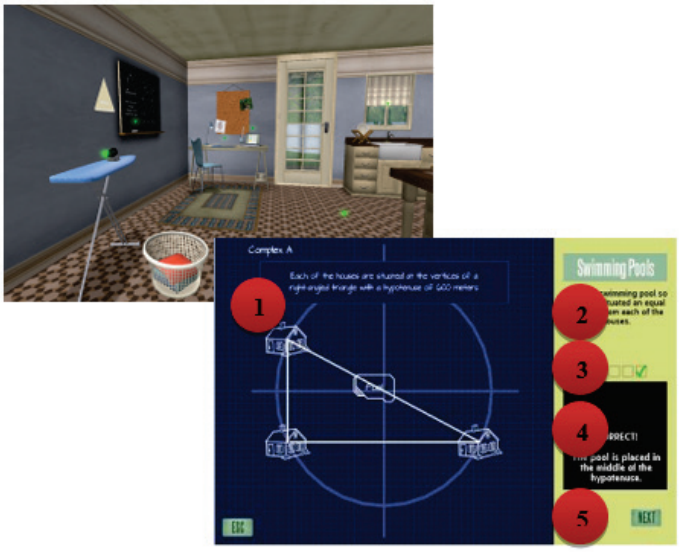

Fig. 3. TALETE 3D environment and mini-game screenshot

AvE was designed as a hybrid environment comprising e-learning platform and a v-learning environment established in the game platform Second Life (SL). The e-platform provided all needed arsenal of tools and functionality to support the process of e-learning: calendar of courses; resource centre with open educational resources that can be reused and shared in changing pedagogical context; modular educational curriculum, covering a distinct logical sequence of lessons and tasks to be performed; chat; forums, Wiki, notice board; frequently asked questions section and so on. To trainees were delivered self-assessment forms containing a list of competencies that the participant can acquire by completing the module tasks and questions that give feedback from the participants concerning their experienced outcome of the module, including assessing their own learning process. AvE was established in the virtual world of SL, including the following training spaces:

- SL conference hall for virtual meetings and seminars – support of the high-quality audio, voice communications, import and shared use of multimedia documents; opportunity for video recording of events. (Figure 4 a)
- Auditorium and learning playground where the v-learning sessions in charge of the proven experts in v-learning and 3D design and construction were held. The trainees improved their knowledge and practical skills to construct and edit 3D objects, and their behaviours supported by on-line tutors (Figure 4 b).

- Personal plots for trained teachers – spaces in SL where every involved teacher builds his/her learning space (building(s), labs, experimental playground, studio, and so on) where tested own v-learning projects with their students.

a) b)

Fig. 4. a) Virtual conference hall in SL and b) Auditorium and learning playground

The experiment included initial training of secondary school teachers from Italy, Bulgaria, Great Britain, Austria, Denmark, and Spain and subsequent training of students of these teachers aged 16 to 18 years. In the 4-month course were provided 100 hours of individual studies and group work. Teachers were trained to work in SL - to design and build basic and complex objects and script their behaviour and create v-learning products/projects. At the next stage of the experiment, the trained teachers passed on their knowledge and experience to their students, testing the developed v-learning products and projects. The training aimed to improve the knowledge, skills and competences of secondary schools' teachers and students to use VR for educational purposes in different subject domains. The survey was conducted among the involved 110 secondary school teachers. The obtained study results give the possibility of making some generalisations and conclusions about the state of the use of VR in secondary education in Europe and defining some general guidelines and trends. According to the survey results', only 4% of the teachers regularly use virtual worlds for training in their work in terms of virtual worlds. 19% declare that they benefit from such platforms only in the conduct of certain lessons and 77% of teachers do not use such platforms in their work. 123 teachers enrolled in the Avatar course, 65 teachers attended the training, 55 dropped out and 3 acted as observers. The reasons for dropping out can be summarised in the following groups: lack of time, lack of interest, technical problems, insufficient technical background. Post-course on-line questionnaires were distributed among the participants in the experiment – the teachers and their students gained experience of using virtual worlds. In general, the teachers' attitudes are positive. Teachers share the opinion that SL is good for simulations and virtual tours, offering an interactive teaching method and an appropriate training platform for students with age over 16. The results show that the students are stimulated to be active part in the learning process. They are engaged in a new way of learning, increasing their motivation and interest to participate in emotionally-driven activities. SL allows valuable teaching activities that

supplement real-life teaching contributing for “better visualisation of the subject for better understanding of the matter”. The students can better realise the real value for the training course and understand that what they are learning adds value to their lives. Both groups of participants in the experiment share the opinion that this is a good platform for development of new improvement of existing skills and competences (e.g. in communication, foreign language proficiency and use of ICT) by participating in activities which are inherent in traditional teaching and learning as well as in activities which are not possible in real educational process, i.e. teleportation and travelling in distant virtual places. Apart from these positive aspects, some disadvantages also were documented. According to the involved teachers the VW technical requirements are high for the majority of secondary schools and the establishment of the environment is consuming too much time and efforts. The platform is very useful in some subjects and learning activities but not in general.

5 Conclusion

Using the gamification approach and techniques in the virtual learning environment effectively supports students learning process, mainly dealing with real-life scenarios and challenges in a safe environment.

In the case studies described, the results achieved underline how these emerging and innovative pedagogical tools and approaches, such as gamification techniques and the immersive 3D virtual worlds, are relevant to improve their students' learning capacity.

These methodologies and tools can allow students to understand the usually considered complex topics or seem not interesting, such as mathematics and science.

The introduction of these new digital learning environments into the learning activity and teaching uses the latest devices available, but it determines adopting a new perspective and didactic methodology that combines new roles for teachers and learners.

Besides, the students/players' motivation and engagement grow even more if their performances and results are made public and recognised through a system of awards and rankings, which completes the training process, generating positive socio-emotional reactions that facilitate deep learning.

VR joined to gamification techniques is becoming the mediator of a profound transformation in the way people learn regarding the enhancement of school involvement, the fostering of situated learning, or the formation of transversal skills such as systemic-abstract reasoning empathy but even concerning the way the educators teach.

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