USES OF THE VIRTUAL WORLD FOR EDUCATIONAL PURPOSES

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Abstract: *Virtual worlds (VWs) provide sensory immersive experience, exploratory hands-on learning, collaborative social interaction, experiential learn-led activities and active role-play that go beyond the traditional classroom setting. Therefore these immersive environments and applications are very important tools in modern education practices. This paper focuses on the uses of virtual worlds and gamification strategies in the field of education. VWs provide excellent opportunities for an effective distance and online education through the support of groups or communities bringing together subject domain experts, teachers and students from different countries or locations.*
Consequently, the development of new collaborative e-learning approaches is facilitated. The article presents educational models and gamification strategies developed and tested during the activities carried out in two successful international projects. Some piloting results, lessons learnt, generalizations and conclusions for improvement the v-Learning effectiveness are described and analyzed in the last section.

Key Words: *Virtual Worlds, v-Learning, e-tivities model, Gamification concept*

Introduction

Virtual world is defined as a synchronous, persistent network of people, represented as avatars, and facilitated by networked computers. VWs can really enrich learning and empower the learners mainly because they have the potential to support multimodal (using different senses) communication among all participants in the educational process.

The first example of visual environments can be found in the early online games of over 40 years ago, such as Dungeon (MUD) games which were developed in the 1970s [2]. During the next 20 years fully graphical multimedia MUD Object Oriented systems have been developed along with Multi Player Online Games (MMOGs). Nowadays MMOGs (like World of Warcraft) are very popular with tens of millions active subscriptions.

Traditional Learning system has been developing towards new teaching and more dynamic environments. These are more and more connected to constructivist knowledge. Actually both informative and cognitive dimensions become future challenges for society where ICT technologies are changing learning and teaching approaches. One of the main results of the 3D Web-based technologies evolution is the development of Multi-user Virtual Environments (MUVEs) such as Second Life and Active World (www.SecondLife.com and www.activeworlds.com).

MUVE gives multiple participants the opportunity of accessing virtual contexts at the same time through their own avatars. This allows them to interact with digital artefacts, communicate with other users, and recreate experiences providing them the capacity to solve problems similar to those met in real life [5]. The MUVEs attracted not only people who enjoy exploring on-line VWs, but also business world representatives and academic researchers.

The number of users in both personal and enterprise virtual world grows daily. This phenomenon can be understood by analyzing of statistical data. Analysts forecast they will become a mass market product from two to five years and just in 2017 the users will reach one billion, ensuring their constant development[1]. Actually, use of the Internet has already grown to over 3,079 billion worldwide (Internet Usage and World Population Statistics for Dec 31, 2014) with penetration (% of population) at about 70% in Europe and Australia, 87% in North America, 50% in Near East and Latin America, 35% in Asia, and 28% in Africa[2]. Taking into account these data can be concluded that any improvement in online educational methodologies and models, connected to the use of VWs and MUVEs, will have a high impact on the world-wide on-line population.

1. Virtual Worlds and v-Learning

A first definition of “Virtual World” was reported in an interview to Jaron Lanier, titled “A Portrait of the Young Visionary” of 1988. On the base of his words, virtual world is indicated as a technology used in order to synthetize a shared reality. Each our relationship with physical world is re-created in a new way. This has only an influence on how we perceive the reality by senses.

Afterwards Loomis [11] distinguishes between physical and phenomenal worlds, stating that the phenomenal world is the result of the mediation with physical world. Actually it is built by our senses.

On the other hand, Virtual Reality aims to persuade users to be in a “reality” so as they can act naturally and carry out the tasks assigned. In this way users are supposed to believe that virtual world where is immersed keeps the expectations of a real world.

Virtual world developers combine a variety of tools and approaches to create engaging virtual environments. There are many different types of virtual worlds that serve a different purpose and are made to appeal to different types of users[3].

On the basis of their main purpose the VWs could be classified in the following basic types:

- *Social VWs* focus on enabling conversation among users and are often compared to 3Dchatroooms;
- *Casual gaming VWs* are very similar to social virtual worlds with the difference that they also focus on users playing smaller, casual games within the virtual world;
- *Role-Playing VWs* or MMORPGs (Massively multiplayer online role-playing games) encourage players to assume a role in a themed world and progress through the game by competing with or against other players in a variety of quests in the fictional environment.
- *VWs for content creation* enable users to create their own content and in some cases also sell it to other users.
- *Educational VWs* aim to educate their users about a certain topic. Most often these worlds offer similar features as the casual gaming virtual worlds.
- *Interest focused VWs* are focused around users’ real world interests, such as sports, music, etc.

[1] http://www.strategyanalytics.com/default.aspx?mod=PressReleaseViewer&a0=3983
[2] http://www.internetworldstats.com/stats.htm
[3] http://www.scribd.com/doc/5570819/Introduction-to-virtual-worlds#scribd

- *Branded VWs* are created around a certain real life brand and can include elements of other types of virtual worlds. All of these encourage users to buy real products of the given brand and some of them require a real purchase to be done for VW account registering.
- *Mirror worlds* are built to mirror the real world. They can be used as 3D maps.
- *VWs platforms* are software frameworks that enable users to create their own virtual worlds and some of these platforms (mainly open-source ones) enable users to host their worlds on their own servers.

According the *revenue models* VWs could be paid (users pay subscription fee) or free to play. Another important characteristic of one VW is the *age of the users* (children, teenagers or adults). Virtual worlds have also different technological requirements. They could be accessed by standard web browser by installing a plugin (if they do not have full 3D graphics) or, 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 Virtual Reality 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 modeling and astronomical simulation. In effect the use of simulators in Virtual Reality permits people being trained by cutting down possible risks met in a real training. This is useful, especially, for solders, pilots and surgeons. Another example is in Architecture. Users can get over in real time a 'real' 3D architectural environment. They can examine spaces, light and furniture in order to choose the best project to be realized. Finally, in Art, you can re-build virtually art works or artistic environments damaging by ages in order to favor their conservation.

The systems, which can support these structures, are platforms, namely v-Learning platforms. These are formal virtual learning environments, where learners can fulfil, organize and manage learning courses. V-learning environment is a space inside the Network where users can work together through a variety of tools and informative resources in order to achieve common learning objectives in problem solving activities [8]. Knowledge is considered as a set of meanings, characterized by metacognitive processes through the interaction with an environment including tools and resources[4].

V-learning is a term describing online learning in a virtual world, creating the participants a sense of reality. V-learning promotes learning by encouraging the use of various techniques and increases the level of commitment of students to study the subjects. Full immersion in the virtual environment supports the multisensory transmission among trainees. V-learning provides learners 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 environment and supporting learning based on experience. They set up the potential for learning by doing and problem- or challenge-based learning and offer the learner control through exploratory learning experiences [18]. V-learning promotes better opportunities:

- for learners to personalize and customize their learning process;
- for teachers, trainers and mentors for adaptation and customization of the educational models for learning through virtual interaction and work.

[4] http://www.formazione.unipd.it

There are different types of educational VWs, but two of them are the most important. The first type is characterized by users' access and interaction with the virtual environment through specific tools, such as 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 to go into the virtual world with it. This 'alter ego' is identified in an avatar, which live in the new virtual world interacting still with the other virtual bodies [17].

The use of the virtual worlds ensures a drastic reduction of logistics costs and a better accessibility and interactivity. It is very suitable for simulations and offers a high level of immersion. As learning environment, teachers can develop training path exploiting the potentialities of both 3 and 2 dimensions.

The mainstream class lesson becomes a combination of different tools: voice, chat, text, audio, video and presentations. While the contents management and their updating occur through a web friendly interface, you also can schedule tutorial videos or tests, foresee some monitoring instruments in order to supervise the tasks carried out by learners.

Due to the use of these virtual worlds, Web 3D offers a great opportunity of creating an educational environment [1] where learners, from different places, start jointly and synchronously tactile or kinesthetic activities within the game (such as in TALETE[5] project) or virtual world (such as in AVATAR[6] where the virtual learning environment (VLE) was created in the Second life). Actually the 3D of virtual worlds encourages the creativity development of the learners more than those in 2D [4]. These are defined as communicative environments, which can amplify the cognitive capacities, called "multiple intelligences" by H. Gardner. Therefore the interaction with reality simulated permit learners representing the knowledge's contents as a game to compare and verify with the real situations. In this context learners re-create their educational path according to the different styles of their individual learning, favoring a real comprehension [7].

In the virtual environment the learner activity is structured on the base of comparative analysis on the problems occurred. That means that each learner acts as member of a specific group providing an individual contribution in the dynamic interactions with the others inside the virtual reality. These processes will favor their organizational learning though knowledge sharing [20].

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 [15].

In summary the use of VWs for educational purposes has accelerated exponentially over the last years and the lines among virtual worlds, games and social networks are blurring significantly. However there are some real challenges such as selection of the most appropriate virtual world and how best to design experiences and activities for learners.

Both projects mentioned above (AVATAR and TALETE[7]) were focused on usage of the virtual worlds for education. The starting point form the methodological point of view for these both projects was the broadly accepted Gilly Salmon's Five Stage Model of the e-tivities [10] as well as the Gamification concept.

[5] Teaching mAths through innovative LEarning approach and conTEnts /TALETE/; www.taleteproject.eu
[6] Added Value of Teaching in a Virtual World /AVATAR/; http://www.avatarproject.eu
[7] The authors of the article were involved in the manager teams of both projects.

2. Five Stage e-tivities Model

The Gilly Salmon’s Five Stage e-tivities Model can be used to identify the typical activities tutors may be involved in at different stages of the students’ learning processes (please see Figure 1.).

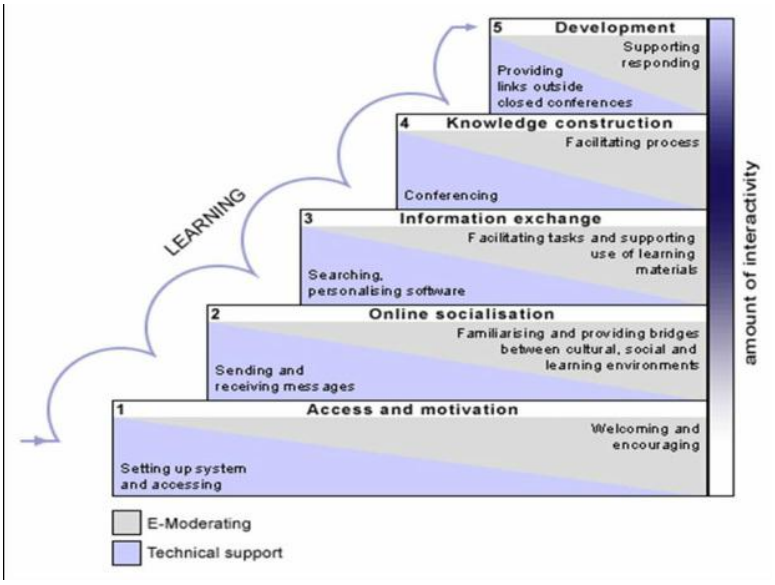


Figure 1 - Gilly Salmon's Five Stage Model of e-tivities

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 in order 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 their learning motivation.
- Students Management - Different learners may be at different stages in this development process. The tutor must manage and support students in the same group who may be at different stages in the Five Step Model.
- The learning philosophy and instructional design integrated into the model are key factors regarding to the students’ progress and achievements.

This model was adapted to two different learning methodologies developed in the framework of the two international projects – AVATAR and TALETE (described in Paragraphs 4 and 5). Both of them are based on different learning philosophies and environments, instructional design, target groups, subject domains, technological solutions, and so on. Some conclusions and generalizations about the effectiveness of the learning process and how it can be improved (on the basis of the provided examples) are briefly described at the end of this article.

3. Gamification Concept

Another important factor in common between these two projects is the use of elements come from games and techniques of game design in different contexts, that, today, is identified with the term “gamification”.

"Gamification techniques strive to leverage people's natural desires for socializing, learning, mastery, competition, achievement, status, self-expression, altruism, or closure.” (Source: Wikipedia)

Taking the definition above into account, it can be concluded that actually the gamification is about more than just playing games. Indeed, 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. In other words, a game based concept is applied to a different content in order to meet specific learning objectives and outcomes and to stimulate desired behaviors[6].

The question whether the applying of the gamification concept in eLearning truly helps learners learn is broadly discussed in scientific, academic and educational societies. Several organizations do not consider the "gamification" in eLearning as a viable approach on account, especially, of longer time for the development and higher costs. However, there are some statistics that clearly establish this new approach cannot be ignored any more.

The gamification seems to progressively appear not only in the schools and universities but also in corporate training environments. For example, some stakeholders are now recognizing the importance of gamification for training purposes in the terms of opportunities for their employees to acquire and cultivate skill sets, making them masters of their own eLearning experience via increased engagement. The market growth of gamification is expected to reach the $1,707 billion in 2015 and the 5,500 billion in 2018. The biggest market is expected to be North America, followed by Europe[8].

TalentLMS[9] conducted a survey regarding learner preferences in correlation with the learning effectiveness and level of motivation. The survey showed (Please, see Figure 2) that 89% of those surveyed stated that a point system would boost their engagement, 82% are in favor of multiple difficulty levels and explorable content, and 62% stated that they would be motivated to learn if leaderboards were involved and they had the opportunity to compete with other colleagues.

Figure 2 - Gamification Survey Results (2014)- http://www.talentlms.com/blog/gamification-survey-results/

The data above show that the relevant application of the game-design thinking concepts in educational environment can significantly improve the motivation of learners to become active participants in the learning process.

There is a 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

[8] Top Gamification Stats and Facts for 2015: http://elearninginfographics.com/top-gamification-stats-facts-2015-infographic/

[9] Gamification Survey Resuls (2014)- http://www.talentlms.com/blog/gamification-survey-results/

components and success factors that have to be considered during the development of a gamified environment:

- Engaging learners in interactions (*competition or cooperation*) – many of modern game-based educational environments let students learn together stimulating peer-to-peer interactions. To consider an appropriate reward for the competition winners and for 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 motivate people to interact with the product.
- Learning aims and objectives have to be clearly communicated. The rules have to be set in order to ensure an effective learning environment.
- *Challenges* and *tasks* for reaching the learning *goals* have to be concluded with *feedback*, which let learners understand the issue and go to the next level of competency. Moreover, according to Flow Theory[10] *challenges* and *tasks* have to be appropriate to learners' skill level.
- The different learning *paths* and *choices* available for learners create uncertainty , but, in the same time, increase their excitement in the activities and tasks to be carried out and be solved. They become autonomous to decide freely which path is more suitable; to construct and re-construct hypotheses on the base of the consequences of their actions.
- The game *story*/scenario, e.g. context, has to be adequate and corresponding to the age level and background of the learners who play the *role* in it. In the same time it has to be appealing, exciting and bringing the motivation and engagement to the highest level.
- Game strategies are connected with *kinesthetic experience* (implementation tasks and practice) which facilitates understanding and comprehending new information by additional sensory channels.
- *Reward* system in the learning process is a very important component. There are many mechanisms which could be used, such as badges or credits (points) but also exposing the development of the learner 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 connected properly taking into account the complexity of the context and the situational use of the artifacts in order to create an enjoyable, engaging and fun solution which stimulates desired behaviors.

According to the findings of TalentLMS[11] 2014, there are certain gamification techniques that most learners and eLearning professionals can perceive as more effective than others. Among the most preferred ones are progressing to different levels (30%), points/scores (27%), real time feedback on performance (26%), progress bars (25%), and activity feeds (24%). The diagram, shown on Figure 3, presents the techniques used in learning design approaches and their relationship to retention of learning:

[10] Flow Theory http://www.learning-theories.com/flow-csikszentmihalyi.html
[11] Gamification Survey Results (2014)- http://www.talentlms.com/blog/gamification-survey-results/

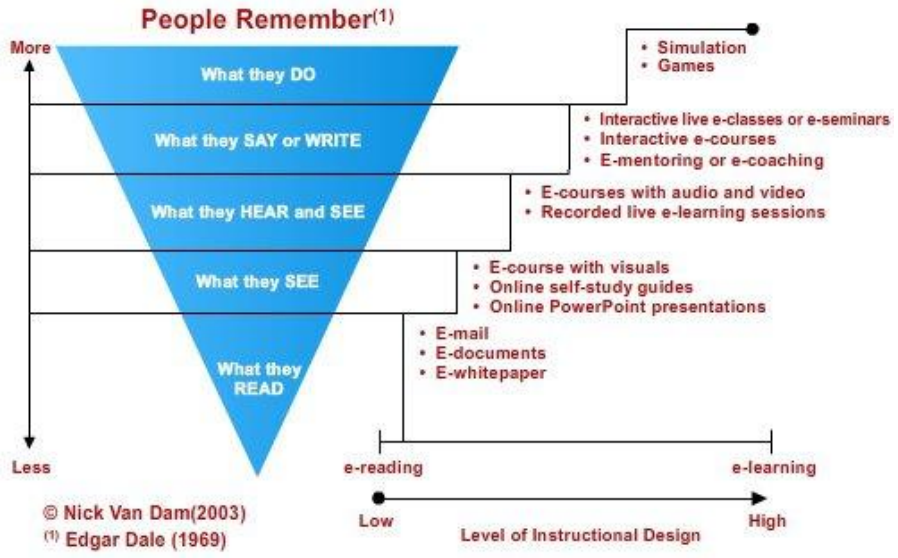


Figure 3 - Learning design approaches and techniques and their relation to retention of learning
(http://elearningindustry.com/top-6-benefits-of-gamification-in-elearning)

Taking into account the relationships presented on the diagram above can be concluded that the integration of the gamification concept into the learning solutions can provide an effective approach to technology enhanced learning. And last but not least, it has to be underlined that the development of gamification concept is cost-effective and less time consuming as compared to production of a game. Therefore, Gamification in eLearning is a highly recommended approach for retention of knowledge.

4. Project AVATAR - Added Value of Teaching in a Virtual World[12]

The main objective of this project was, through the production of innovative AVATAR learning environment (LE), to improve the quality of teaching and learning in secondary schools mainly in Europe. Within the project AVATAR the development of the learning environment, methodology and resources allowed an expansion of the traditional classroom education. The result was to have provided tools and functionality for conducting virtual training in different subject areas with the possibility of applying different educational strategies and techniques and promoting an active students participation and their involvement in the learning process. AVATAR learning environment is an hybrid environment comprising e-learning platform and v-learning environment. The project covered the training of the secondary school teachers (1st stage) and training of the secondary school students at age from 16 to 18 years.

Training was conducted through e-learning platform based on open source platform Claroline, and in a virtual world, built in the Second Life. In the four-month course were provided 100 hours of individual studies and group work. Teachers were trained to work in Second Life in order to build objects and create v-learning products/projects. Then the trained teachers pass on their knowledge and experience of the students and tested with them the developed v-learning products. The survey was conducted among teachers in secondary schools from Italy, Bulgaria, Great Britain, Austria, Denmark and Spain. Respondents were

[12] The duration of this project was from 2009 to 2012.

110 teachers. The obtained study results give the possibility of making some generalizations and conclusions about the state of the use of virtual worlds in secondary education in Europe, and of defining some general guidelines and trends. In terms of e-Learning platforms, as shown by the graph in Figure 4, only 32% of teachers regularly use e-learning platforms in their work. 32% of respondents declare that they benefit from such platforms only in the conduct of certain lessons and 10% of teachers do not use such platforms in their work. In terms of virtual worlds as seen from the graph in Figure 5, only 4% of the respondents regularly use virtual worlds for training in their work. 19% of the respondents 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 [13, 14].

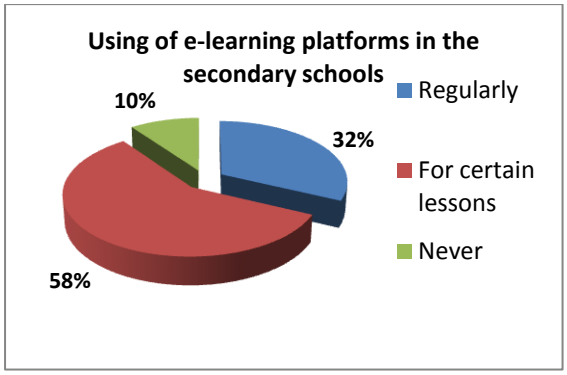


Figure 4

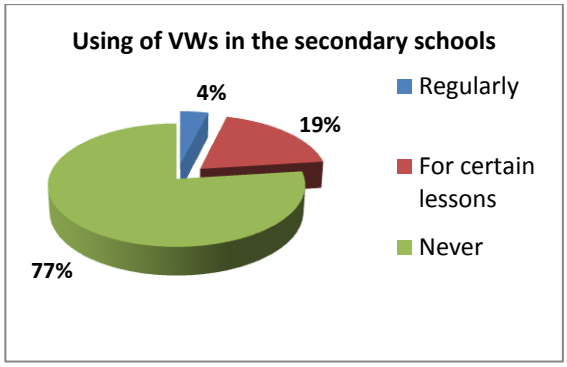


Figure 5

In addition, during the project, a training path was developed. It aimed at improving, in secondary schools, teachers' and students' knowledge, skills and competences regarding the use of virtual worlds for educational purposes in different subject domains.

The training was implemented in a hybrid environment combining e-platform, based on the open source platform Claroline, and v-learning solution developed in the VW of Second life. The e-learning platform (Figure 7) provides all the necessary arsenal of tools and functionality to support the process of e-learning: calendar of courses; resource center with study materials that can be reused and shared in changing pedagogical context; educational content structured in modules, each covering a distinct logical sequence of lessons and tasks to be performed; chat; forums - national (where it communicates in the language of the country) and international (where communicating in English - the official language of the project), Wiki, tracking system; notice board; frequently asked questions section and so on. Via the platform to trainees were delivered self-assessment forms containing a list of competences that the participant can acquire by completing the module tasks as well as questions that give feedback from the participants concerning their experienced outcome of the module including an assessment of their own learning process.

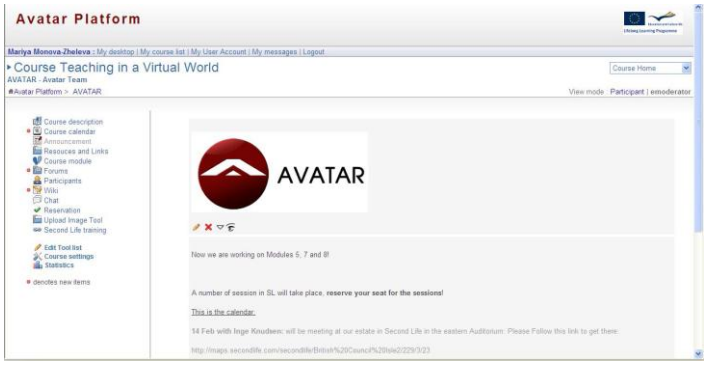


Figure 6 - AVATAR e-learning platform

AVATAR v-learning environment was established in the VW of the Second Life including the following spaces:

- Conference hall for virtual meetings and seminars – here were assured: support of the high-quality audio, voice communications; the ability for import and shared use of multimedia documents; opportunity for video recording of events. (Figure 7)

Figure 7 - Virtual conference hall of the AVATAR Project

- Learning playground – the trainees improved their knowledge and practical skills to construct and edit 3D objects.
- Auditorium where the v-learning sessions in charge of the proven experts in v-learning were held. (Figure 8)

Figure 8 - AVATAR Project Auditorium

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

The training path structure addressed to the teachers covered the following training modules:

- Introduction Module – the teachers' access to the e-learning platform and course overview, browse the start guide to become familiar with the contents, post a contribution in the Welcome forum, browse the guides on the e-learning platform and create a blog profile of yourself following the guidelines provided.
- E-Learning Platform Introduction Module – main aims here are socialization and getting to know the functions of the e-learning platform. Teachers introduce themselves

to the other participants by posting contributions in the Café forum, read the course curriculum and the course chart; study the team building and team work resources; post entries on your blog stating your view on the benefits and challenges of working and learning in teams; participate in a chat session with fellow participants and with your moderator as well as participate in a virtual classroom session to get to know your fellow participants and your moderator; learn about Second Life requirements on your computer.

- V-Learning Platform Introduction Module – Accessing Second Life, acquiring basic skills, accessing Second Life support resources. Teachers watch the video presentation: Introduction to virtual world platforms and write a blog entry in your blog on your expectations towards becoming a Second Life inhabitant; they sign up for an account with Linden Lab and create an avatar; download, install and set up the Second Life Viewer and experience different movements, tasks and communication skills: take a tour of one of the Second Life Welcome Island learn how to search, communicate and participate in groups in the world.
- V-Learning Intermediate Module – moderator teach and guide the participants as they practice the use of the community tools with a set of practical tasks; in groups participants choose a Second Life location and explore it - take screenshots, create landmarks and share these via the class wiki, describe and reflect on your experiences in the class wiki.
- V-learning Advanced Module – Basic Object Creation - The participants access this module through the V-Learning platform. In Second Life a moderator introduces the Build menu and give a short demonstration of the object creation tools, where upon the participants is given a set of object creation tasks to complete under the guidance and support of the moderator. The participants are provided with a texture library for this activity.
- V-Learning Advanced Module – Advanced Object Creation - The participants access this module through the V-Learning platform. In Second Life a moderator introduces the advanced features of Second Life building and provides a set of object creation tasks for the participants to complete under the guidance and support of the moderator. The participants are provided with various scripts for use in these building tasks.
- V-Learning Educational Design Module – Teachers participate in an ongoing discussion on education and virtual worlds. They write a post in their personal blogs on their choice of discussion; read and comment on the reviews of your fellow participants.
- Ongoing V-Learning Seminar – The participants access this module through the V-Learning platform. The presentations takes the form of traditional classroom teaching, discussions and Q&A.
- V-Learning Project – in the framework of this module the teachers consider what you have learnt in modules 1 to 8. They write a description of their idea for a virtual world course using the template provided and post the description in the forum, write a blog entry in their blog on the e-learning platform and share their idea with the other participants. All teachers read the blog posts of each other and find out whether some of them have similar ideas to yours. The technical moderators assist this process. Afterwards the teachers design a virtual world course for one of your classes using Second Life as virtual world platform; carry out the course with their students; evaluate the course with the students and write a blog post on their own and on their students’ experience.

According the official project figures, 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 summarized in the following groups: lack of time, lack of interest, technical problems and insufficient support. Questionnaires were distributed in different countries to secondary school teachers who had participated in the Avatar course and had gained experience of using virtual worlds and their students. The majority of the participants answered the post course online questionnaire [16]. The responses can be summarized as follows:

- In general the teachers' attitudes are positive. Teachers share the opinion that Second Life (SL) is an appropriate training environment for students with age over 16.
- Useful environment if the students live far away and cannot come school every day.
- Valuable teaching activities that supplement real life teaching can also take place in SL.
- SL is good for simulations and virtual tours.
- The VW offers a new interactive way of teaching, which is in line with how students interact in the modern world.
- Students are stimulated to be active part in the learning process. They are engaged in a new way of learning and this increases their motivation and interest to participate in emotionally-driven activities.
- SL gives the opportunity for "better visualization of the subject for better understanding of the matter". The students are able better to realize the real value for the training course and to understand that what they are learning adds value to their lives.
- Excellent environment for communication, exchange of information and knowledge, cooperation among students and all participants on international base.
- 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.

The next diagram on Figure 9 shows what teaching activities have been carried out using virtual worlds and how often these activities have been implemented.

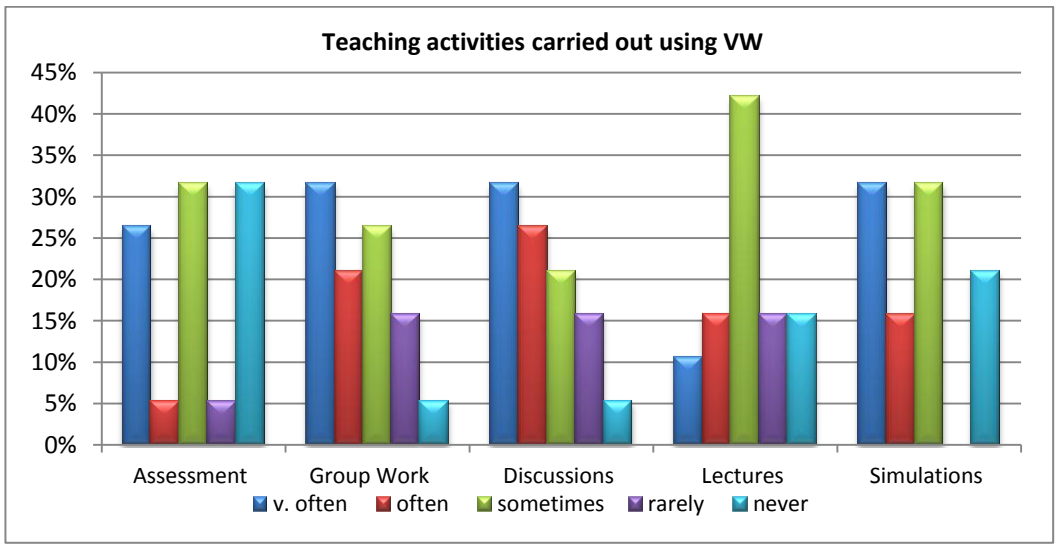


Figure 9 Teaching activities carried out using virtual worlds

Apart from these positive aspects some disadvantages also were documented:

- Such kind of virtual environment is useful in some subjects but not in general.

- The establishment of the environment is consuming too much time and other resources.
- Residents of the VW can hide their persons.
- Technical requirements of the VW environment are high for the majority of the secondary schools.

5. Project TALETE Teaching maths through innovative learning approach and contents[13]

Main aim of the project TALETE was to improve the training and learning of Math (especially Geometry) by the development of modern pedagogical instruments and methodologies based on the advanced ICT achievements and Serious Games Theory.

TALETE outcomes and products, addressed to the teachers and their students, aimed to test an innovative pedagogical tool making the study of Mathematics more interesting and creative, transforming a possibly difficult situation into a simpler, more dynamic, flexible, surprising, engaging, intriguing one to foster the student's curiosity. Through the TALETE training path the 14-16 years-old students can improve their deep mathematical understanding with a focus on the geometry, especially their performances on the base of OCSE PISA[14], IEA TIMSS[15] and national evaluation schedules.

Main target groups of the project are:

- Teachers – involved in the development and testing of innovative didactic tools that can help raise the interest level and motivate students to acquire mathematical skills
- Students – considered to test directly with their teachers the attractiveness and efficiency of new didactic tools and also to improve their transversal skills (e.g. communicative, learning to learn, social and digital skills) useful for future professional life.

The educational model of TALETE project starts from the concept of the mathematization: it describes real-world context expressed mathematically. The mathematization uses everyday contexts expressed in mathematical language and concepts for solving real problems and the mathematics becomes the vehicle for this purpose [3].

The mathematization is viewed as a constructive, interactive and reflective activity. The point of departure for education is not learning rules and formulas, but rather working with context. A context is a situation which appeals to children and which they can recognize in theory. The mathematization of the nature has to be enriched with the dense spectrum of various mathematical practices. It means that math can be taught and learned in active and creative process. On the basis of the concepts and principles described above and in accordance with the standards set by TIMSS, PISA and National Curriculums of Math, the project Research Educational Team (RET) selected relevant assessment schedules on national and international level in the domain of teaching and learning Math (especially Geometry) for 14-16 years old students in the partner countries. These schedules were developed as 3D serious games scenarios implemented in a virtual environment. Under the project framework was developed a training course for teachers of Math in order to make them familiar with the v-learning principles and to improve their theoretical and practical preparation for using virtual worlds

[13] The duration of the project was from 2011 till 2013
[14] OECD PISA (Program for International Student Assessment) http://www.oecd.org/pisa/
[15] IEA TIMSS (Trends in International Mathematics and Science Study) https://nces.ed.gov/TIMSS/

in the classroom activities. After finishing the course, the involved teachers tested the innovative methodology and pedagogical instruments with their students who were separated in experimental and control groups.

The TALETE training path design is divided into two sections related to the learning and training environment and according to the target group considered: e-learning platform for the teachers and 3D environment for teachers and students. It included 23 hours of theoretical knowledge, web seminar and testing of the pedagogical tools, 15 hours of experimentation with the students involved.

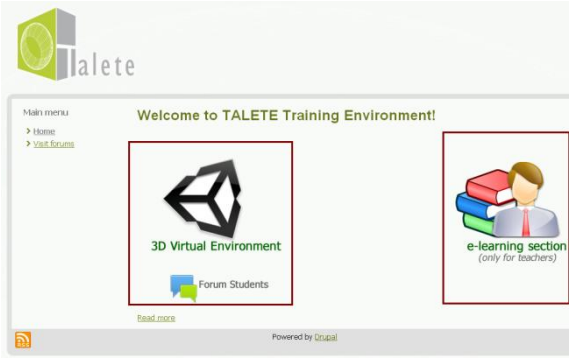


Figure 10 – TALETE training Environment

TALETE e-Learning Platform contains educational pills (translated into English, Italian, Greek, Bulgarian and Turkish) and a forum addressed only to the teachers, and the 3D virtual environment contains the scenarios produced on the base of the assessment schedules previously selected by Research and Education Team. The e-learning platform is realized in order to deliver the e-course, in terms of educational pills and web seminars, and the social area for the teachers. This tool allows target group to access their training contents according to the defined the TALETE training path. Afterwards the 3D virtual environment was used by the teachers in order to test the effectiveness of new pedagogical tools with their students.

Figure 11– 3D scenarios for TALETE games

In detail, here below, we can describe the two learning environments.

The TALETE e-learning platform was developed on the basis of open source platform Claroline (please see Figure 12). The learning content was produced in form of the SCORM

learning objects. The “Learning objects” are defined as small, independent chunks of knowledge or interactions stored in a database, which can be presented as units of instruction or information. They are typically self-contained, interactive, and reusable.

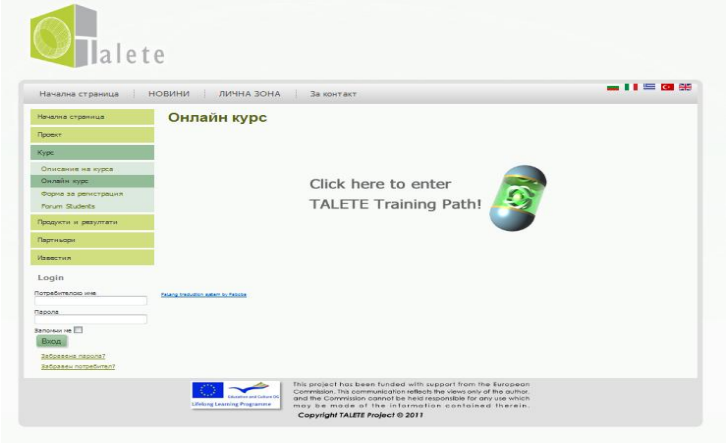


Figure 12 TALETE e-learning platform

The following learning objects are available in the TALETE e-platform: the multimedia lesson; slides and lecture notes.

The multimedia lesson is a learning object delivered through the e-learning platform built up by an audio explanation synchronized with a slide presentation using the Adobe Presenter plug in. The interface of each multimedia lesson is provided with a hypertextual index allowing the user to navigate the lesson, to interrupt and start again the listening without returning at the beginning of the explanation.

The slides realized by the didactic experts for their audio lessons have been converted into .pdf. Slides are printable documents allowing the users to take note while listening to the explanation. Thanks to the slides the user will write didactic expert’s comments or memo and reminders. They are useful to brush up the lesson in off-line modality.

The lecture notes represent in depth studies to better detail one of the contents dealt with during the audio lesson or to provide students with a different perspective of the contents already explained.

The educational pills, delivered to the teachers, cover the following main topics:

- Results of last international surveys (PISA, TIMSS),
- International and national selected schedules to be used in 3D world,
- Concept of “mathematisation”
- Contents and methodologies focusing on the potential use of new technologies
- Role of the teachers involved as trainers of the students during the second phase of the experimentation.

Afterwards, in order to access the 3D virtual environment the students involved had to follow the instructions described in a video demo published on the TALETE website. An animated, 3D scenario plays at the opening of the game to introduce the overall storyline. The students then arrive in a virtual kitchen (everyday context where math ideas have been embedded) to unlock the challenges set forth by the TALETE partners.

The virtual world was developed on the basis of the software platform Unity 3D for creating of serious games and virtual worlds and is addressed to the teachers and students from secondary schools in Europe. The challenges are specific mathematical problems covered by

the topics of the National Curriculums of the partner countries. The problems were implemented as separate, but linked in a common scenario, mini-games. Clicking on selected objects throughout the kitchen interactive exercises and hidden surprises, also known as “Easter eggs”, are unlocked. All eight mini-games (challenges) can be accessed by student username and password. Please, see the Figure below.

Figure 13 - TALETE 3D Virtual Environment – Access

The kitchen is a fully explorable 3D space, viewed by the user in FPS (first person shooter) camera mode. Students can watch videos, explore a 3D environment and play interactive games directly in their web-browser. In addition, they may explore the kitchen independently or with the guidance of a teacher as part of a lesson plan. Each student’s scores are recorded to a database that can be accessed by the teachers to evaluate performance.

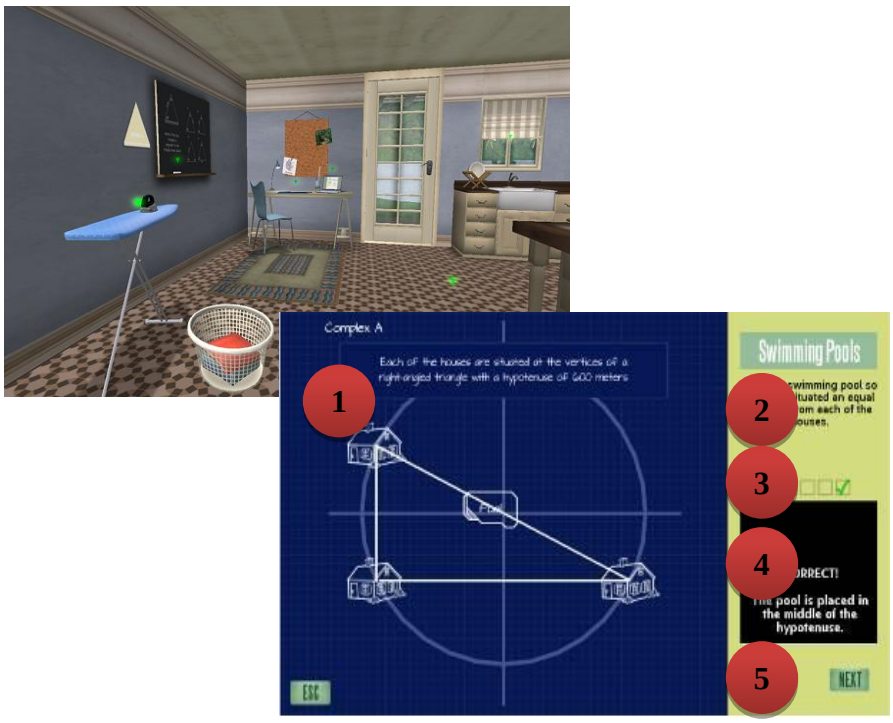


Figure 14 - TALETE start screen + screenshot of a scenario with the following areas: 1 - Area for visualization of the context and visual feedback, enabling learning by doing and exploring techniques; 2 - Area for textual representation of the context, problem, tasks and questions; 3 – Area for answering; 4 – Feedback area and 5 – Navigation area.

TALETE 3D environment is addressed to teachers in order to:

- test the effectiveness of new pedagogical tools with their students;
- evaluate the student performance for the achievement of the final pedagogical goal.

The main objective of the TALETE educational game is to improve learning skills and overall understanding of the course material. An appropriately developed game can introduce an amount of wit and levity to balance the intensity of the experience and to make a big improvement. 3D environment helps teachers to [12, 19]:

- Get Attention – aids students in shifting from one task to another and increases focus.
- Maintain interest – students are moved into content that stimulates them and continues to intrigue them.
- Achievement – collecting some points and earning some badges adds a sense of purpose and supports focus on key elements. Students are also very goal oriented and want to make sure their time is taking them somewhere.
- Increase Openness to New Ideas – when people are enjoying something, they can be a lot more receptive to new concepts.

In order to obtain valid data to be compared and discussed, two kinds of student groups were formed for the testing phase: a control group and an experimentation group. These were set up in order to check and compare better the results obtained at the beginning and at the end of the experimentation phase.

In each partner country one experimental group, including 30 students, and another control group, including at least 30 students, were selected for the experimentation.

The project partners or the teachers trained established two student groups on the base of a random criterion. The two groups were independent, that is none of them knew the existence of the other group. Finally, the participants into the experimentation were no. 471 teachers, 39 classes and 311 students.

Teachers submitted to both experimentation and control groups the maths schedules before and at the end of the practical activities in order to collect relevant and evident data on the efficiency of new educational tools. These maths schedules are those selected for the production of the scenarios for the 3D virtual environment [19].

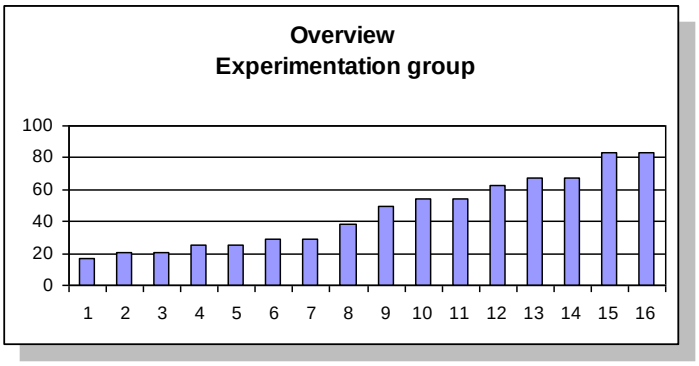
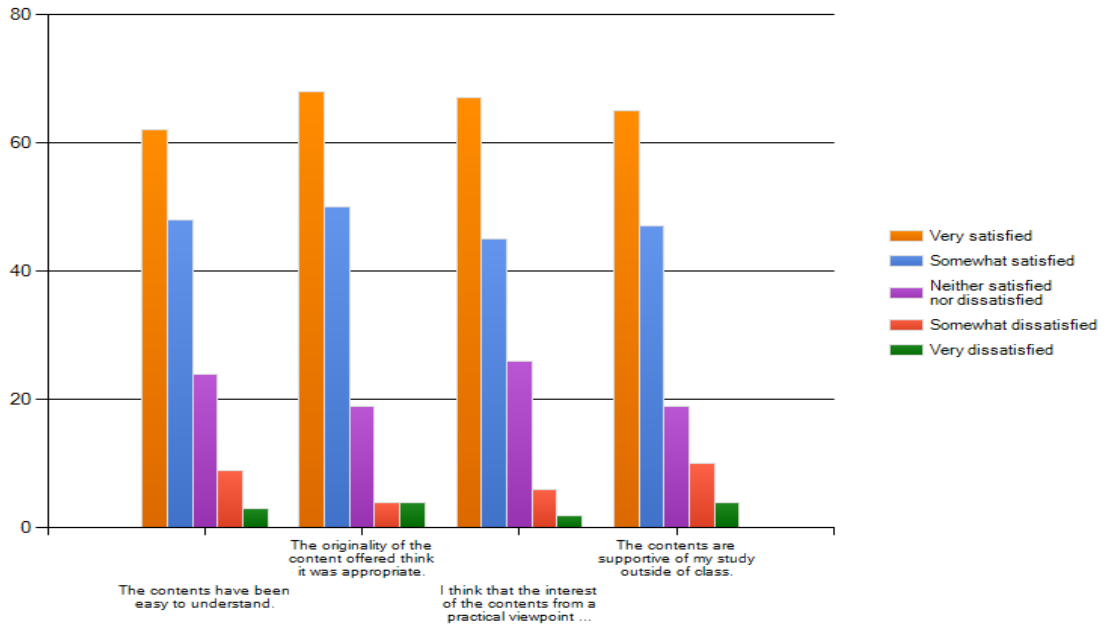


Figure 13 - An example of the results achieved by one experimentation group

Moreover the evaluation of the TALETE pedagogical approach and tools was, also, carried out by teachers and students through “e-survey” during the testing phase. The survey was developed using a Web-based program such as Survey Monkey. This facilitated the collecting and processing work, because the system was connected directly to a database where all completed survey's data were categorized and stored for later specific analysis.

Each questionnaire was developed following the criteria concerning the project phases and divided in two main arguments: Expectation and Satisfaction for both teachers and students.



The data collected show on average a good rate of appreciation for student satisfaction level.

Considering that the attribution of compliance / non-compliance provided:

1. an assignment of “*Full compliance*”, when the overall ratings (average) for a given item had reached at least 75% in the two best categories of assessment;
2. an assignment of “*Partial compliance*”, when the overall ratings (average) for a given item had reached at least 75% in the three intermediate categories of assessment;
3. an assignment of “*Non-compliance*”, when the overall ratings (average) for a given item had reached at least 75% in the worst two categories of assessment;

Monitoring and evaluation team assigned the "full compliance" for the results reported for this item, because:

- 75,50% of the sample involved assigned ratings between category 1 and category 2 (the best evaluation categories proposals), for “The contents have been easy to understand”.
- 82,30% of the sample involved assigned ratings between category 1 and category 2 (the best evaluation categories proposals), for “The originality of the content offered think it was appropriate”.
- 76,70% of the sample involved assigned ratings between category 1 and category 2 (the best evaluation categories proposals), for “I think that the interest of the contents from a practical viewpoint was adequate”.
- 77,20% of the sample involved assigned ratings between category 1 and category 2 (the best evaluation categories proposals), for “The contents are supportive of my study outside of class”.

In summary, the teachers consider innovative and interesting the ICT use as well as the link with mathematics contents and reality that the created 3D exercises represented. They are even motivated, in some case, to apply this approach to their teaching everyday activity.

However, most of students were very engaged by experimentation: one big success of TALETE project was to have given chance to get into the subject to those students usually facing problems or not interested in mathematics. Even if the involvement and the collaboration of students depends on also from the interests of their teachers and their ability to get in a game with their students themselves.

An obstacle for most of the schools was the use of old ICT tools that did not allow implementing and testing new technologies with more advanced systems. On the other hand there are still gaps in the ICT areas and English language that don't allow a more competition among schools at European level. Even if it is preferable that the students learn and get more familiar with foreign languages also favoring their participation in more different European projects.

Despite of these difficulties, the experimentation of TALETE training path showed good results from the point of methodological view in terms of innovation and attractiveness. Actually, considering all the feedbacks and comments from teachers and students, we made some corrections in the TALETE scenarios and the TALETE application is now also available with a lower-solution of the scenarios in order to allow all the schools to use it.

Conclusions

Integration of the Gamification concept and strategies into the virtual learning environment helps create an effective learning system that enables learners to rehearse real-life scenarios and challenges in a safe environment. The usage of virtual worlds and Gamification educational strategies contribute to the realization of emotionally-driven learning and the formation of positive attitude which ensure an enjoyable experience for learners and motivate them to develop their skills, talents, and interests.

Learners are able to practise in real-life situations and challenges in a safe environment which leads to a more engaged learning experience that facilitates better knowledge retention. During the training sessions participants receive instant feedback. This also facilitates better learner engagement and thereby better recall and retention. Gamification approach can lead towards strong behavioural change especially when combined with the scientific principles of repeated retrieval and spaced repetition.

Taking all the aspects described above, we can conclude that the careful selection of the virtual environment, gamification strategies and the pedagogical model in line with the concrete specifics of the educational context, is crucial for the building of learners' self-confidence and their empowerment during the learning; for encouragement of learners’ positive attitude and catalysing behavioural changes and, last but not least, for support of enriched learning experiences.

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