Virtual Vocational Education and Training

R2.3: State of the Art Report on Virtual Organizations in Education and Training

WP2: Needs assessment, State of the Art Report on VOs in Education and Training, ECVET strategy

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Executive Summary

According to the project description this deliverable belongs to the preparation WP2, which should define the starting point for the forthcoming WPs and their tasks. The particular aim here is to identify and outline the state of the art in European and international level regarding the provision of vocational and training by virtual organizations. More precisely, the deliverable R2.3 is described like this:

“Investigating the field of virtual organizations, which offer educational and training services, will contribute to emphasizing on VIRTUS’ innovative elements while enhancing its functionality and user-acceptance. The identification and examination of the major breakthroughs in the field, as well as the existing best practices will lay the preparatory ground for the design and development of the virtual VET centre. The outcome of Task 2 will be a State of the Art report, which, will i) outline the state of the art in VOs offering education and training, ii) identify and highlight best practices in the field in national, European and international level.”

This deliverable plays an important role in VIRTUS, as together with R2.2 End-users’ Needs Assessment Analysis Report it will inform the development of R3.1 Specifications of the VIRTUS Virtual VET Centre platform.

We conclude that virtual worlds can be especially valuable in distance learning, providing users a common learning space regardless of their physical location. By controlling an avatar in a virtual world the user interacts with the environment. Such interaction provides a high degree of engagement and supports student-centred learning. 3D virtual worlds support synchronous communication and collaboration more effectively than 2D Web-based environments by extending the user’s ability to employ traditional communication (face-to-face interactions), such as gestures and voice, and having a better sense of presence and place. Second Life seems to be the most functional and suitable virtual world environment for educational use. OpenSimulator is an open source alternative to SecondLife environment and can be used due to the commercial issues, however this platform is not as mature as Second Life. Combining the features of traditional learning management system and 3D virtual worlds may lead to the platform that benefits from the advantages of both sides.
<table>
<thead>
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<tr>
<td>AC</td>
<td>Active Worlds</td>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
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<td>AR</td>
<td>Augmented Reality</td>
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<td>ECQA</td>
<td>European Certification &amp; Qualification Association</td>
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<td>MOOC</td>
<td>Massive Open Online Course</td>
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<tr>
<td>OS</td>
<td>OpenSimulator</td>
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<td>PU</td>
<td>Public</td>
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<td>SL</td>
<td>Second Life</td>
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<td>VLE</td>
<td>Virtual Learning Environment</td>
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<td>VO</td>
<td>Virtual Organization</td>
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<td>VR</td>
<td>Virtual Reality</td>
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<td>VW</td>
<td>Virtual World</td>
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Project Description

The main aim of the “Virtual Vocational Education and Training – VIRTUS” project is the development of an innovative, fully functional virtual vocational education and training centre, which will provide appropriately designed modular certified courses in 1. Tourism and Hospitality Services and 2. Social Entrepreneurship, corresponding to regional growth potential and skills needs and targeting at increasing the participation rate of Adult Learners in continuing VET.

The “main priority” that project VIRTUS addresses is Priority 4 – Opening up (virtual or physical) infrastructures of education and training institutions to adult learning and provision of modular certified learning opportunities, of Strand 1 – Education and Training field.

Each of the two courses will be developed according to ECVET standards and will have duration of five weeks and will be 2-4 hours per week. Courses will consist of video lectures, slide presentations, self-assessment quizzes and a final assessment exam in a simulated VET Centre environment. Learners from Italy, Austria, Greece and Spain will attend the modular courses, in both synchronous and asynchronous e-learning versions, offered by the virtual VET Centre. The video lectures will be delivered in English and will be subtitled in the other four languages of the consortium (ES, IT, GR, DE).

Access to the Virtual VET Centre will be provided through the VIRTUS website. Also, the VIRTUS Virtual Community to be developed will bring together adult learners, VET professionals, tourism professionals and social entrepreneurs, NGOs and communities, policy-makers and the general public. The VIRTUS virtual environment will be available in English, Italian, Greek, Spanish and German and will be easily extendable to more languages.

The strategic aim of the VIRTUS project is to mainstream virtual vocational education and training, providing certified modular learning outcomes to Adult Learners, in Europe and beyond.
1 Distance Learning

Distance learning is an approach of learning, when the student takes classes remotely without meeting a teacher personally in the classroom. The main advantage of the distance learning is its flexibility. It means that learning can take place in a convenient time and place. The learner can decide the pace of progress, focus on the most interesting parts, and get access to a learning community for further discussions.

However, distance learning has also several disadvantages. The personal contact with other learners and teachers is missing. Nowadays, distance learning usually follows the “one size fits all” approach. The materials are seldom personalized to the specific learner needs. Technology barrier is also an issue. For example, learners that are not familiar with online programs need time to get used to work with the required tools.

Distance learning is determined by the following features [1]:

- The geographical distance between trainer-trainee during most of the educational process (this item differs from the ‘face to face’ education in classrooms)
- The responsibility of one institution for the design, production and distribution of educational material and service for trainees through support services
- The use of technological media (print and audiovisual media, computers and the Internet) to bridge the distance between the learner on one side and the teacher and educational materials on the other
- The effort to interact with the aim of exploiting the pedagogical advantages of dialogue and debate
- The organization of the learning process based on the individual study of educational material along with group meetings to serve teaching and social objectives

1.1 Methodology and Distance Environment

The methodology of distance learning primarily characterizes the open education systems and differentiates them from the traditional ones [2]. This methodology enables the trainee to use their residence as the main learning space and to choose the appropriate level and rate of learning. Distance learning refers to an organically structured set of instruments and procedures referred to
in educational material, teaching methods, communication between trainer and learners, support and assessment of learners [1]. According to [3] in a distance environment it is very important to:

- Help learners adapt to self-directed learning
- Pay attention to and strengthen instruction related to learning methods for distance learners
- Specify learning objectives
- Help with improving and promoting the level of the learner’s learning strategy
- Emphasize the self-efficacy

The instructor communication with each student to provide assistance, guidance, support and encouragement are essential elements for the implementation of effective distance education programs. Even with good and tailored learning materials, learners need help and guidance from the instructor.

1.2 Synchronous vs. Asynchronous Learning

The learning process can be distinguished between synchronous and asynchronous. Both of them are important to improve learners’ experience.

1.2.1 Synchronous Learning

Synchronous learning is the process when learners are engaging in learning at the same time. The environment that facilitates synchronous learning is supporting the visual and audio real-time communication between people in different locations. The educational process is carried out at a predetermined time and the trainees live follow their instructor, they may submit questions and receive direct their responses. The modern distance learning services require high-speed networks and specialized equipment from both the trainee and the trainer. A traditional lecture and online conference are examples of synchronous learning, as the teacher and students take part in it at the same time.

Advantages of synchronous learning are that it can strengthen teacher-learner relationships, promotes collaboration and real-time feedback, encourage the feeling of the community and social awareness. Disadvantages of online synchronous learning are mostly related to technology issues, such as a high speed internet connection, online infrastructure, etc. Such process also limits the flexibility of the distance learning. As learners should take a class at the same time, it may cause a communication challenges due to the different time zones.
1.2.2 Asynchronous Learning

Asynchronous learning systems support educational processes without the trainer and trainees having to work in the same space or time. These systems allow the learner to have access through the Internet to an educational material of any nature and to communicate with the instructor and other students through tools like e-mail, discussion forum, blog and bulletin board. The main advantage of asynchronous learning is that it offers learners full control over their learning experience. It allows learners decide when to learn, at what speed and from any convenient place.

1.3 Principles of Adult Learning

Adult learning and teaching principles should be taken into account in distance learning. At the heart of the educational process should be the learner and it has to promote critical thinking. Online distance learners need to manage their learning much more themselves and in this way they are often required to be more self-directed and to monitor their own thinking and action as they work towards the objectives of the course [3]. It is very important to keep in mind the factors that influence adult learners, especially decisions to dropout online learning. According to [4], factors that lead to dropout are:

- Scheduling conflicts
- Family issues
- Financial problems
- Managerial support
- Personal issues
- Social integration
- Instructor follow-up, instructional design, assignment level, activity level
- Technology / technical usability issues
- Lack of motivation

It is very important also to consider learners’ situation while managing or maintaining the course, so that learners can get help if needed. Learners are less likely to dropout when they are satisfied with the courses and when the courses are relevant to their own lives [4]. Moreover, online learners
can easily lose motivation unless the course is designed to stimulate their active participation and interaction and meet their expectations.

1.4 Educational Materials and Evaluation in Distance Learning

The educational material requires careful planning and should be flexible, dynamic, focusing on personalized learning and interaction [5]. Evaluation may take various forms, including self-assessment and continuous assessment [6]. Self-assessment is done through exercises which accompany the teaching material. The exercises are often used because they give the student the opportunity to learn utilizing the theoretical knowledge already taken and also inform him of his progress. Continuous assessment is the assessment of learners in distance education on a regular basis and the main and most commonly used types are essays and reports, questions, short answers, problems, objective tests, practical work and laboratory exercises.

2 Massive Open Online Courses (MOOCs)

One of the successful examples that uses distance learning approach are Massive Open Online Courses (MOOCs). A MOOC is an online course with the option of free and open registration, a publicly shared curriculum, and open-ended outcomes [7]. Such courses have highly influenced online learning and become popular among different institutions. The first MOOC was launched in 2008. It was called “Connectivism and Connective Knowledge”, created by educators Stephen Downes and George Siemens. The next significant breakthrough was the course offered by Stanford University in 2011 “Introduction to Artificial Intelligence”. Huge amount of MOOC start-ups appeared till now. All of them follow the same goal connecting teachers and learners online, by providing learning materials. The MOOC phenomenon is quickly evolving. Many variations in size, openness and delivery mode are emerging [8]. Today major MOOC providers include Coursera (https://www.coursera.org), edX (https://www.edx.org), Udacity (https://udacity.com), Udemy (https://www.udemy.com). The courses are offered to the undergraduate market, but in future there is a possibility there will be graduate-, professional- and doctoral-level MOOCs too [9].

2.1 MOOC Characteristics

MOOCs integrate social network characteristics, online resources, and are facilitated by leading practitioners in the field of study [7]. Moreover, MOOCs build on the engagement of learners who self-organize their participation according to learning goals, prior knowledge and skills, and common interests [7]. Online social networks are used to spread information about upcoming courses and in this way attract more learners to the class.
The MOOC environment is self-guided, a necessity in a course that may have thousands of participants [7]. It is based on active learning, instant feedback, self-pacing and peer learning [9]. MOOCs serve as a rich source of information, offering different media content: text, video, simulations and discussions. Such characteristics provide support for active learning [8].

The learner specific data produced by MOOC participants is usually collected for further data analysis and learner analytics. The results of these analysis can be used to improve learning experience not only in MOOCs, but also in formal and other traditional types of education [8].

One of the major disadvantages in MOOCs is high dropout rate of learners. Technology ownership and bandwidth present additional barriers, especially for participants from developing countries [7]. Time zones can also be concerns in MOOCs, especially if regular live sessions are planned [7]. An overview of pros and cons of MOOCs is presented in Table 1 [9], [8], [10].

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Provide opportunities for lifelong learning</td>
<td>Evaluation is crowd-sourced or computer-graded</td>
</tr>
<tr>
<td>Usually no tuition fee</td>
<td>Student completion rates below 10%</td>
</tr>
<tr>
<td>Unlimited amount of participants</td>
<td>Production of video lectures</td>
</tr>
<tr>
<td>Flexible access time</td>
<td>Lack of student-teacher interaction</td>
</tr>
<tr>
<td>Flexible learning speed</td>
<td>Lack of campus life</td>
</tr>
<tr>
<td>No formal requirements</td>
<td>Issues with intellectual property</td>
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<tr>
<td>Can be used as innovation test bed</td>
<td>Fit-to-all approach and lack of personalized content</td>
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<td></td>
<td>Non reliable accreditation</td>
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<td>High cost of producing courses and delivering them</td>
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2.2 MOOC Model for Distance Learning

MOOCs reduce barriers to information access and to the dialogue that permits individuals and society to grow knowledge [7]. As was mentioned before, as a digital platform, MOOCs provide services for learning, connecting, sharing and interacting across different cultures usually for free or with lower cost.

There are some limitations of distance learning in the online environment, such as the traditional lecture format should be truncated to 12 minutes or less in order to keep learners engaged [8]. Different types of evaluation can be done compared to traditional classes. For example, multiple-choice tests have to be offered instead of essay writing. Peer-reviewed writing is used also at MOOCs, however it is not good for high-stakes evaluation [8].

MOOC users differ from traditional ones, as they may come from different educational, professional, linguistic and cultural backgrounds. The motivation for taking a course is also changed. For example, usually it is not a goal to get a degree, but to use discrete online learning opportunities. Three broad strategies have been recommended for designing a MOOC course [11]:

- Provide clear, explicit communication about exactly what students need to do to succeed in the course
- Deliver information consistently each week
- Help students build a supportive learning community – make sure the online forum is used well to offer a place for students to connect, construct, and make meaning

To maintain and build the MOOC platform the investment and funding have to be made. The financial sustainability of MOOCs is still an open question. Nevertheless, MOOC courses are full of possibilities and hold promising future [9].

3 Gamification in Learning

To deal with the high dropout rate in online courses several techniques can be used to attract more participants and keep them engaged during the online course. Gamification is application of game mechanics and game design elements within non-game environments.
Figure 1: Based on Kevin Werbach’s Gamification Course (2014)

Figure 1 shows a game elements pyramid for gamification [12], which comes from Kevin Werbach’s gamification design framework in his online MOOC (https://class.coursera.org/gamification-003/wiki/GamificationDesignFramework). For designing educational course, specific questions have to be answered:

- Define business objectives - Why are you gamifying?
- Delineate target behaviors - What do you want your learners to do?
- Describe the players - Who are the learners who will be participating in your gamified activity?
- Devise activity loops - Explore in greater detail how you will motivate your learners using engagement and progression loops
• Don’t forget the fun - How your game would function without any extrinsic rewards

• Deploy the appropriate tools

Various tools use gamification techniques in educational frameworks. Unity (https://unity3d.com) is a game development platform that can be used to build high-quality 3D and 2D games, deploy them across mobile, desktop, and VR/AR. The eAdventure platform (http://e-adventure.e-ucm.es) is a research project aiming to facilitate the integration of educational games and game-like simulations in educational processes in general and Virtual Learning Environments (VLE) in particular.

4 Virtual Organizations

The distance learning concept is applied also in virtual organizations. VIRTUS defines Virtual Organization (VO) as “an organization involving detached and disseminated entities (from employees to entire enterprises, students to entire universities etc.) and requiring information technology to support their work and communication”.

Although, the concept of VOs has received the greatest attention already in the 90th [13], [14] there is still no general definition of it. Kreber [15] defines it as “an organization or a productive entity that does not have a central geographical location and exists solely through information technology tools”.

Another definition [16] considers VO as ”a geographically distributed enterprise whose members are bound by a common interest, pursue a long-term goal, communicate and coordinate their work through specific tools of information technology”. Authors specify several conditions for the existence of VOs:

• Infrastructure that allows interaction in informatics plan

• Powerful database describing resources

• Very good virtual management

The key element that characterizes the participants of a VO is the common purpose or business goal [17].
There are several domains where VO can be employed: organizing meetings and events, marketing, e-commerce, social science experiments, etc. In education and training VO supplement traditional approaches. An example of various forms of virtual learning centres is provided in Fig. 2 [15]. In Table 2 we compare advantages of traditional learning course and virtual one (adapted from [16]).

![Diagram of virtual learning centres]

**Figure 2: Example of various forms of virtual learning centres**

**Table 2: Comparison of traditional course and virtual one**

<table>
<thead>
<tr>
<th>Traditional Course</th>
<th>Virtual Course</th>
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<tr>
<td>Personal contact between teacher and student</td>
<td>Flexibility of study program</td>
</tr>
<tr>
<td>Real-time communication</td>
<td>Access to learners around the world</td>
</tr>
<tr>
<td>Existence of reading rooms and laboratories</td>
<td>Flexibility of learning time</td>
</tr>
<tr>
<td>Social interaction</td>
<td>Networking</td>
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According to [16] efficiency of virtual organizations is much higher than that of traditional ones, because the structure of expenditures is allocated efficiently for virtual organizations. In the following sections we review virtual worlds platforms and frameworks as a possible infrastructure for designing and implementing VO.

5 Virtual Worlds

During last years three-dimensional Virtual Worlds (3D VW) are increasingly being explored as a support for education [18] and their use has been growing rapidly in the first decade of the 21st century. 3D VW have been touted as being capable of facilitating highly interactive, engaging, multimodal learning experiences [19]. These immersive environments offer the ability to create complex, highly interactive simulations using in-world modeling and scripting tools [20]. 3D VW are suitable for collaborative learning with various types of content [21] and expand traditional e-learning platforms.

Till today the use of 3D VWs as learning environments is a promising direction that is under research [22], [23]. Regarding the potential of virtual 3D environments for higher education, researchers have focused on the identification of requirements and potential benefits of project based instructions and collaboration [24]. The education community has identified virtual worlds as a novel medium for collaborative learning [21].

Formal definitions of VW are still generally rare [21]. This is one of them [25]: “A virtual world is a simulated persistent space based on the interaction by computer, inhabited by several users, who are represented by iconic images called avatars, who can communicate with each other and with the world in a synchronized way”.

5.1 Users as Avatars

Users are represented in the form of avatars (Fig. 3) in VW [26]. The concept of avatar-mediated communication is essential for an understanding of the novel potential of VW [18]. Avatars can interact using chat, voice or gestures with other 3D objects and media, such as text, graphics, sound and video, all these features are essential for creating a collaborative learning environment. Avatars can be considered as a part of the learning community [27].
VW can provide a better learning experience when students self-regulate and the activities are learner centric. One of the most significant means of promoting student behaviour with self-regulation is to link their avatar names to their real identities [28].

5.2 Key Elements of Virtual Worlds

The design of environments or learning spaces within 3D VW is important, however, there are no strong guidelines how to do it [29]. In the following, we investigate characteristics that can help us create three-dimensional virtual organization (3D VO) to support educational activities. Pivec et al. [30] define several steps that have to be taken to design a 3D learning environment:

- Determine the pedagogical approach
- Situate the task in a model world
- Elaborate the details
- Incorporate underlying pedagogical support
- Map learning activities to interface actions
- Map learning concepts to interface objects
In recent years, the usage of VW for educational purposes has increased [31]. The design of such educational environments is often based on the social constructivism approach [32] that allows learners to participate in the creation of learning environments. Recent research has also suggested that crucial for a success of VW is the trust factor [33]. Moreover, besides technical special skills, language and intercultural competences are particularly important in transnational VW. Cultural differences can lead to problems in interpreting information. Schmeil et al. [21] provides characteristic for creating VW:

- It must be interactive and the participant interacts with the virtual world through an embodied avatar
- It must enable computer-controlled character agents to interact with the virtual world through embodied avatars
- It must support API that enables the Automated Story Director to monitor the participant and the state of the world
- It can support an API through which the Automated Story Director alerts the world state

A framework for the description and creation of collaboration patterns in VW, based on semiotics theory, is presented in [34]. This approach was also used later in [21]. Key elements of VW include [25]:

- Shared space: the world allows many users to participate at once
- Immersion and Interactivity: virtual worlds allow users to interact with the environment, to change, develop, build and submit content
- Persistence: the world’s existence continues regardless of whether individual users are logged in or not
- Immediacy: an immediate virtual world allows real-time interaction between the user and the world
- Socialization: interaction with others, working as teams to create communities
6 Virtual Worlds in Education Domain

Educational virtual environment can be considered as a part of a bigger set of educational VW [31]. Then initial requirements for representing a real institution as a 3D virtual campus can include the following ones: learners should be represented by customizable avatars, the learner should have possibility to communicate in different modes, presence of social networking. In our research, we have collected several advantages of using 3D VW in education domain:

- VW help to overcome time constraints and travel requirements [18]
- VW support social interaction, collaborative learning, partially liquefied social boundaries and lowered social anxiety [24]
- Avatar representation of learners provides low costs and high safety, by increasing a sense of presence [35]
- Virtual campuses are also important due to their support for informal learning and as providers of open, distributed and lifelong education in a globalized world [31]

From another side, the use of VW can be difficult at the beginning, as also game-based 3D environment can be distracting from the main focus - learning. As also, VWs were not purposely designed for learning, and therefore they may have features that become irritating and obstructive in the learning process [31].

Currently there are various virtual platforms that support 3D VO development: Opencroquet (http://www.opencobalt.net), There (http://www.there.com), Edusim3d (http://www.edusim3d.com), 3D Learn (http://www.wilostar3d.com), Quest Atlantis (http://atlantisremixed.org), The Sims (http://thesimsvirtualworld.wikidot.com), Open Wonderland (http://openwonderland.org), etc. In this section we describe the most used 3D VW for the educational initiatives: Second Life – SL (http://secondlife.com), Active Worlds – AW (http://www.activeworlds.com) and OpenSimulator – OpenSim (http://opensimulator.org). These platforms allow end-users with enough expertise to program behaviors for virtual objects and avatars and make them interact with external computer systems [36]. The reasons why some of these systems are used in the education domain are the following [25] – they:
• Support the concept of avatars
• Allow integrating different technologies
• Allow to present learning materials
• Provide tools to share learning documents
• Hold meetings and events
• Have collaborative space for sharing research findings and meetings

6.1 Active Worlds

Active Worlds (AW) is a sandbox platform for creating real-time interactive 3D content over the Web, developed by ActiveWorlds Inc. and launched on June 28, 1995. It consists of a predefined library of building blocks that can be extended by objects designed with third party tools. The platform has a list of standard avatars and a list of gestures. End-users can communicate via chat and instant messages. AW (Fig. 4) is divided into educational (Eduverse) and commercial universes.

Figure 4: Example of the meeting room in AW
A successful example of using this platform in educational domain is AW3DU – Universe of Immersive Educational Experiences) (http://www.aw3du.com). Using 3D cloud based tools and networks, this platform allows users to participate in classes from any place connected to the Internet. The platform offers simulated experiences with socialization and a shared building to explore educational concepts. One of the absolute strengths of AW is its unmatched capability for users to create their own creative 3D objects with almost no limitations. The main disadvantage of AW is that the graphics are outmoded and the buildings are complex. Thus, it takes more time to build objects than in the Second Life environment [37].

6.2 Second Life

Second Life (SL) is a three-dimensional environment where people interact by means of avatars [18]. The platform was launched in 2003 by Linden Lab and it requires to download a free software program to access it. It is inhabited by millions of ‘residents’ across the world. Physical requirements for SL are a computer with Internet access, a loudspeaker and (a headset with) a microphone.

The platform enables participation in learning activities (Fig. 5) and an effective use of educational resources. It is used as a platform for education by many institutions, such as colleges, universities, libraries and government departments worldwide [38]. For example, the online learning program at Monroe College, Bronx, New York, takes advantage of the unique opportunities that exist on Second Life to provide students virtual internship [39]. Communication channels include: visual image, voice chat, text chat, instant messaging.

SL allows educational activities to be designed that involve a number of health centers in different geographical locations, consequently eliminating the need to travel and making more effective use of educational resources [18]. It can be used to create simulations and environments for learning and interaction, with following features: streaming video and audio, the ability to link to resources outside the SL, instant messaging, multi-party chat, voice chat, social space. Gestures are another form of interactions in SL. There is a tool that let’s users create their own gestures. [38] provides a practical guide to using SL in higher education.

The SL capacity for customization is extensive. Similar to AW, in SL the user can create his world using the predefined tools for the design and implementation. The objects and avatars’ behavior can be controlled using Linden scripting Language (LSL) [25]. Residents can even build houses and other buildings. Some users use programs like AutoCAD to design their structures before importing them into SL. They can hear and view streaming audio and video inside virtual rooms, avatars can choose to display video on specific surfaces in the land they own.
Avatars can get around SL by walking, flying or teleporting to their destination. Flying lets avatars navigate over water or avoid other obstacles they might encounter on the ground. For the developers, SL has a sandbox to practice building objects and special object creation tools. SL and OpenSimulator could be integrated into a traditional virtual learning environment (Moodle) [40]. There are two main obstacle aspects of SL – to access full functionality the user have to pay and there is an age limitation for entering SL: the user should be over 18 years old.

Figure 5: Example of the virtual lecture in SL
6.3 OpenSimulator

OpenSimulator is an open source multi-platform, multi-user 3D application server. Created in 2007, it can be used to create a virtual environment (or world) which can be accessed through a variety of clients, on multiple protocols. It is written in C# and can be used on Windows, .NET framework and on Unix over the Mono framework. However, OpenSimulator is still a high complex software system that can suffer of various bugs and quirks. This environment can be managed through the following functional areas: land, content, avatar activities, groups and user access control [28].

It has two modes, standalone and grid. The first one hosts virtual history on the server and has a limited number of users. Grid distributes simulations among different nodes. Since 2009 there exists an extension of OpenSimulator, hypergrid, which enables avatars to teleport between virtual worlds. In general, OpenSimulator is open source alternative to Second Life.

OpenSimulator environments (Fig. 6) look and feel like Second Life because they share the same code, which was developed on an open source early version of the Second Life platform [41]. OpenSimulator allows for interaction between simulations and games, social networking by which knowledge is shared and created, collaborative work environments, and various media to meet different learning needs.

Figure 6: Example of the virtual world in OpenSimulator
6.4 Comparison of Existing Frameworks

Virtual platforms share the same basic attributes as they represent a virtual copy of the real world or a part of it and it is often difficult to identify particular similarities or differences. In Table 3 we compare characteristics of Second Life (SL), Active Worlds (AW) and OpenSimulator (OS) that can be useful to design and deliver an innovative, fully functional virtual learning environment.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>SL</th>
<th>AW</th>
<th>OS</th>
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</thead>
<tbody>
<tr>
<td>OSS</td>
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<tr>
<td><strong>Build</strong></td>
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<tr>
<td>Pathfinding</td>
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<td>Sound</td>
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<tr>
<td>Texture</td>
<td>+</td>
<td>+</td>
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<tr>
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7 Sloodle and Virtual Worlds Best Practices

In this section a learning and research practices in 3D virtual environments Second Life or OpenSimulator with integration to Sloodle platform will be discussed. We focus on the identification of best practices in education created with 3D virtual technology. Simulation Linked Object Oriented Dynamic Learning Environment – Sloodle (https://www.sloodle.org) is a free and open source project which can be used to integrate 3D virtual environments of Second Life or OpenSimulator and traditional learning management system, such as Moodle. Modular Object-Oriented Dynamic Learning System (Moodle) is an open source e-Learning platform which offers the user the functionality to create and manage teaching material [42]. Sloodle provides a range of tools for supporting learning and teaching in the immersive virtual world platforms, which are fully integrated with traditional learning environments and currently do not exist in most virtual worlds. It also brings social networking features in a fun and interactive way to Moodle. It offers the functionality to link for example Second Life and Moodle and to exchange and synchronize data flow between these two environments [20]. During registration the user (profile) links Second Life avatar to their Moodle accounts. The architecture for interaction with external applications is facilitated by the Linden Scripting Language and presented in Fig. 7 [20].

Figure 7: Architecture Sloodle
The idea to integrate traditional learning environments and virtual worlds was successfully evaluated during previous years. In [40] the authors have used Sloodle to integrate OpenSimulator into Moodle. In such way the student performed the activities in OpenSimulator and the teacher had Moodle interactions in a transparent way.

[42] presents a framework development to create teaching materials for the training of survey-based 3D virtual environment by using Sloodle. As for future work, authors plan to extend it with gamification elements in order to increase the learner motivation to use it.

[20] provided an example of the use of virtual worlds and virtual learning environments for teaching. During the case study, an ‘Engineering Education Island’ was introduced and a range of practical examples were presented, that confirms the flexibility of the Second Life virtual world as a viable tool for educators. Moreover, an integration of virtual learning environment and virtual world is presented.

In [43] the author reviewed educational function modules of Sloodle and created a Sloodle-based English collaborative learning model. He describes an integration of the Moodle Web-based virtual learning environment and the 3D virtual platform Second Life, resulted in 3D/Web virtual learning environment. Fig. 8 shows the main educational function modules of Sloodle [43]. It extends the functions of Moodle, such as blog, wikis, forum, content management system, etc. with features provided, for example by Second Life: Web-intercome, quizzes, distributor, choice tool, etc. The author specifically describes the model based on collaborative learning.

The summary of research that seeks to integrate virtual learning environment and virtual world using Sloodle is presented in [44], where a case study involving the teaching of algorithms and programming is demonstrated. The authors have used Open Simulator, Moodle 2.5 (https://download.moodle.org), IDEOne (http://ideone.com) for teaching algorithms and Sloodle. The authors claimed: “The use of virtual world added to Moodle through Sloodle tool, is a valid alternative to the process of teaching and learning”. However, some difficulties and technological limitations have to be overcome. For example, “if the education environment is hosted on a server or the user does not have access to the file system, neither holds administrator privileges, the installation cannot occur or becomes too complex.” [44] As authors mentioned, the solution will be to give the user administrator rights on the Moodle account. That may cause a problem for the users without required technical knowledge. In addition, a big amount of elements available in the virtual classroom caused learner distractions.
8 Discussion and Conclusion

Research shows, that virtual worlds can be especially valuable in distance learning, providing users a common learning space regardless of their physical location. Users can organize private groups, create presentations, and video. By controlling an avatar in virtual world the user interacts with the environment, moreover the user can create their own content to extend their learning resources [36]. Such interaction provides a high degree of engagement and supports student-centred learning. Self-regulation is one of the main assumption behind the success of student-centred learning and virtual worlds [28]. 3D virtual worlds support synchronous communication and collaboration more effectively than 2D Web-based environments by extending the user’s ability to employ traditional communication (face-to-face interactions), such as gestures and voice, and having a better sense of presence and place [45].
After reviewing several virtual worlds for creation of virtual organizations, we conclude that Second Life seems to be the most functional and worthy virtual world environment for educational use. The wide array of available examples, related resources, and potential uses for Second Life is simply unmatched by any other tool set. For example, in Second Life discussions can be done isolated and transcripts of the discussion can be reviewed later by the instructor [39]. Although virtual worlds are often used in education domain, as was mentioned before, steep learning curve of 3D environments as also game-based features can easily distract the user from the actual learning process [25]. The teaching activities in Second Life can be categorized into four categories [43]:

- Role-plays and simulations
- Group work and team-building
- Events and presentation
- Constructive activities

In [38] the author provides four main reasons why Second Life can be used in the education domain:

- It provides a visual learning environment as a creative learning space
- It offers experiential learning opportunities not always available in real life
- Its openness enables power and control in learning
- It serves as a mirror to higher education practice across different levels

Another possible solution is to use OpenSimulator. It is open source alternative to SecondLife environment and can be used due to the commercial issues, however this platform is not as mature as Second Life. The main advantage of using virtual worlds in education domain is that it offers an opportunity to develop learning communities online, create trust and increase sense of presence compared to traditional learning environments. Combining the features of traditional learning management system and 3D virtual worlds may lead to the platform that benefits from the advantages of both sides. The blended solution of virtual world and virtual learning environment may serve to frame the activity in pre and post reflective activities and during the activities by prompting the student with guiding questions or instructions that help him stay on task and heighten his attention [43].
# References


