Virtual Reality for Augmenting Creativity and Effectiveness of training

EU - ERASMUS+

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Intellectual Output II

Courses 1 - 6

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Contents

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České centrum odborného vzdělávání, z.ú.

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Intellectual Output II – Course 1

ICT in Education Course

Authors

Affiliation

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ICT in Education Course

The digital revolution is in full swing, transforming many aspects of our lives: the ways in which it communicates, we gain knowledge and information, we work ... they have undergone all the fundamental changes. These transformations took place in a remarkably short period of time and today's children and adolescents, the so-called the "Google generation" has little or no recollection of life ahead of broadband, mobile technologies, and ubiquitous search engines.

The big question that makes us think about how they are educated is whether we can engage this generation with "traditional" didactic practices and how they differ from older generations in their attitudes, expectations and behaviors.

The "Google generation" is growing up surrounded by technology and is typical of using information and communication technologies in a variety of life situations, not excluding learning in a natural way.

1 Introduction to Education Technologies

Information technology as we know it today has revolutionised many aspects of society, especially work and communication between individuals and whole communities, not least education. Incorporating information technology into education is intended to create an environment that influences the thinking, decision-making and action of learners, an environment in which they will, to the maximum extent possible, actively acquire the necessary skills and cognitive competencies. It can be assumed that such an environment will promote the solution of meaningful real tasks, develop their creativity, critical thinking, encourage observation, reasoning and, last but not least, an environment where pupils learn to cooperate and evaluate the result of their work[1].

The application of modern technologies also requires the application of teaching strategies to improve the quality of learning. It is necessary to reflect on the possibilities of reconciling rational technical thinking with the educational goal of the school, which is the preparation of a well-rounded educated individual capable of rapid adaptation to the changing conditions of a globalising society[2].

These trends are also reflected in the latest priorities of the European Union, which has included the implementation of information and communication technologies in the education systems of individual EU countries among the top priorities for the development of the information society[3].

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[1] VALENTOVÁ, M., BREČKA, P. and DEPEŠOVÁ, J. 2017. Identification of key didactic strategies for the development of students' critical and creative thinking in the subject of technology. In Strategies of critical and creative thinking in the didactics of educational subjects. ISBN 978-80-558-1227-4, e-resource: 978-80-558-1228-1.

[2] KOZÍK, T. and DEPEŠOVÁ, J. 2007. *Technical education in the Slovak Republic in the context of education in the European Union countries.* Nitra: PF UKF, ISBN 978-80-80-8094-201-4, p. 9.

[3] European Commission. 2007. *Ten years of the European Employment Strategy (EES).* Luxembourg: Office for Official Publications of the European Communities. 43 p. ISBN 978-92-79-06593-4.

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The term "**information and communication technologies**" (ICT) refers to the computer and communication means that enable the collection, recording and processing of information. In particular:

- traditional media (television, radio),
- personal computers with multimedia support,
- means for digitising, sensing, measuring and controlling processes,
- Internet and e-mail,
- integrated education programmes,
- video conferences,
- electronic and programmable toys and kits.

Efforts to rationally guide the pedagogical process using new technologies have been made in the last century when at the beginning of the 20th century linear (Skiner) or branching (Crowder) tutorials were used to increase the efficiency of the educational process. In later years, these efforts were also supported by some philosophical theories (N. Wiener), features of which became the basis for some programming languages (e.g., Prolog, Cobol). In the field of hardware, although the development was transferred from air-conditioned computer rooms to desktops in the form of personal computers, at the turn of the 1970s and 1980s information and communication technologies appeared in the educational process without the existence of a coherent concept. Attention was paid to the study of computer science as a separate subject. Computers, as long as the school had a SMEP or JSEP system, were mainly used as a didactic tool for teaching programming and computer information processing. After 1989, computer labs and training rooms began to be built more widely, especially in colleges and secondary schools, and, thanks to new data transmission technologies, the Internet was made available to a wider public. In the mid-1990s, the first non-interactive tutorials appear.

The advent of multimedia computers has expanded the possibilities of image and sound presentation. The demand for interactivity in educational programmes has come to the fore and the view of the possibilities of applying ICT in education has changed considerably. The beginning of the new millennium is marked by the need for lifelong learning, which has led to the development of distance forms of education that are based on the principles of using ICT in teaching. One of the main programme objectives of the national governments of the European Union countries is the 'internetisation' of schools at all levels, the formulation of various 'information strategies' and the




creation of virtual learning centres linking universities, libraries, research institutes and government offices and commercial companies.

In the context of the introduction of ICT in the pedagogical process, the decline of the classical importance of the school in the acquisition of information has become evident. The Internet and ICT are significantly taking over this once central function of the school. In this context, it is necessary to acquire the means of searching for and, in particular, processing information, which requires ensuring, through compulsory teaching of informatics already at the primary level, the **computer literacy** of pupils.

Computer (information) literacy refers to the ability to use information resources and tools to solve problems and support learning and understanding the social aspects and implications of ICT use. By increasing information literacy, the student is able to use ICT resources more effectively, better assess their suitability and appropriateness for the problem at hand, and become less dependent on information obtained through direct instruction.

There are several reasons why the use of information and communication technologies in the teaching process must be developed[4]:

- **Quality of education** - the emphasis is particularly on the need to improve the quality of education through ICT,
- **Social issues** - statistics show a widening social gap between those who have access to ICT resources and those who do not,
- **Competition in the labour market** - in the 21st century, ICT skills are one of the prerequisites for employment in the global labour market.

However, the introduction of ICT resources into the pedagogical process depends not only on the economic possibilities of the school and its technical equipment but also on the commitment, readiness and willingness of teachers to use ICT resources.

The use of ICT resources in the pedagogical process requires:

- Adequate student knowledge of information literacy and its enhancement through the use of ICT resources,
- the ability of students to use ICT resources independently, productively and effectively in their education,

[4] Palková, Zuzana -- Pap, Miroslav, 2005. Exploitation of e-learning`s methods for courses of programming. In E-learning in Slovak and Czech Republic : computer based learning in science, July 4, 2005, Žilina. Žilina: University of Žilina, 2005, pp. 55--57.




- from the educator to choose appropriate methods and ways of using ICT to achieve the pedagogical goal,
- Effective use of ICT resources by educators for their own preparation and teaching.

1.1 Use of ICT in education

Young people report as the most attractive learning through experimentation and research that they use:

- elements of the game,
- exploring alternative approaches and thinking things differently and unconventionally,
- imaginative thinking that leads to the achievement of the goal,
- linking what has been learned to previous knowledge,
- new learning and critical thinking about ideas, actions and results.

1.2 The role of ICT in the educational process

Most European educational institutions are equipped with traditional ICT tools (PC, smart boards, tablets and internet connection), use LMS, OER platforms, and thanks to COVID-19 lockdown, various web portals with various educational materials, instructions and videos have been created. However, as the crisis of spring 2020 has shown, the main shortcoming of the use of innovative technologies and practices in education is the low ability of teachers to use them. Many of them use ICT only as an extension or replacement of traditional tools (interactive whiteboards as a replacement for whiteboards, PPT presentations as a replacement for printed books). The Internet is mainly used to access new information for teachers during their preparation for teaching.

How can ICT help transform the learning environment into a student-centred environment?

Properly designed, ICT-enabled education can support the acquisition of knowledge and skills that will enable students to have lifelong learning.

With the correct use of ICT - especially computer and Internet technologies - they will make it possible, in particular, to introduce new ways of teaching and learning, instead of improving the practices used by teachers, but also by students. These new ways of teaching and learning are supported by constructivist theories of learning and represent a shift from teacher pedagogy - in its




worst form characterized by a large number of facts and their memorization - to one that is aimed at students is called student-centred approach:

- **Active education**. ICT-enabled education uses tools to explore and analyze information, providing a platform for students' questions, analysis and the creation of new information. Therefore, students learn that whenever appropriate, they thoroughly address real-life issues, reducing the amount of memorization. ICT-supported learning is also just-in-time learning, in which students can choose what to learn and when they need the information.

- **Learning together**. ICT-supported learning encourages interaction and collaboration between students and teachers, no matter where they are. In addition to simulating real-world interactions, ICT-supported education provides students with the opportunity to work with people from different cultures, helping to improve students' team and communication skills as well as their global awareness. It simulates lifelong learning by expanding the educational space to include not only peers but also mentors and professionals from various fields.

Using ICT for a student-centred approach:

- **Creative learning**. ICT-supported education supports the manipulation of existing information and the creation of products in the real world rather than the repeated memorization of information.

- **Integrated learning**. ICT-supported learning supports a thematic inclusive approach to teaching and learning. This approach precludes the artificial separation between the various disciplines and between theory and practice, which characterizes the traditional classroom approach.

- **Assessment learning**. ICT-supported learning is student-centred and diagnostic. Unlike static, text or printed learning technologies, ICT-based learning recognizes that there are many different learning pathways and many different knowledge articulations. ICTs allow students to explore and discover, not just listen and remember.




ICT tools and social networks can influence the learning process as follows:

- To promote different senses through multimedia visualizations and presentations, both through teacher-developed materials and by creating new opportunities for students' creativity.
- To encourage collaboration in creating new online products, commenting on and networking new tools, and improving overall as well as individual performance.
- To promote differentiation and diversity by providing teachers with a wide range of didactic and methodological tools that can be appropriately implemented in meeting the stated learning objectives.
- To encourage students to adapt their own learning process and use a supportive environment of mutual help, reflection, and criticism in interaction with their teachers and peers, combining formal and non-formal learning activities.

The mere replacement of traditional educational tools with ICT tools does not directly lead to creativity and innovation. However, their interconnection can bring significant benefits to both sides of the educational process. Due to changes in technology, such as the development and deployment of Web 2.0 and cloud technologies, the nature of teaching is changing and technology-based learning is becoming more social, collective, and multimodal. The combination of telecommunications and computers has created a number of opportunities to take advantage of the new technological tools on offer for teaching and learning. ICT has opened a new space for accessing, processing, and sharing ideas in different styles and formats. It helps the student to share teaching materials and space, to support student-centred learning, to share collaborative learning and to strengthen critical thinking, creative thinking, and problem-solving skills. Tools such as social networks (Facebook, My Space, Twitter), note sharing, multimedia videos (Flickr, YouTube), online games (Second Life) and blogging offer new opportunities for people to express their creativity, to pass on their creative ideas. to a wide audience and get feedback. Innovation networks can be clusters, business ecosystems and communities of practitioners, strategic alliances or even living labs. Creativity can be enhanced by the following tools:

- **Blogs** develop students' creative thinking and writing because students can write what they want and comment on or share materials with each other, write openly about topics that interest them, and give way to their thoughts without having to worry about grades or grammatical errors. Students who write a blog feel responsible Cartoons and comics for their own learning, and by writing blogs they incorporate their creativity into their own




learning, which they would not otherwise be able to do. Well known and used are Edublogs, Blogger, WordPress.

- **Cartoons and comics** are great tools to support education because students love comics. If we use them in teaching, students will automatically become deeper into the subject of study than ever before. Creating your own comics or cartoons and animations will allow students to demonstrate their creative powers and immerse themselves in the world of creativity without any obstacles. An example of one of these websites with these resources is the 'Cartoons for the Classroom' website.

- **Mind mapping and brainstorming** are other tools that increase students' creativity and help them connect ideas in different ways. Brainstorming on various topics is a great collaborative way that is used in current pedagogical practice. This method encourages students to think outside the usual and creative. Using ICT, students have a set of simple and free tools at their disposal, with which they can create fantastic mind maps and visual graphs to better illustrate or understand the topics covered. Applications such as Online Brainstorming, Mind Mapping Software, Whiteboards for Distributed Collaboration, SpiderScribe, Wise Mapping, ChartTool, Creately, and more help facilitate idea generation and allow a group to attend meetings to generate ideas without being physically present. More sophisticated tools - creativity management platforms and crowdsourcing platforms - help you master the creativity process itself.

- **Infographics** represent data in a colorful and attractive way. Using free infographics tools, students can create amazing charts on their own that make interpretations of information easier and faster to understand. They can use their creativity and imagination by creating an infographic on a specific topic, concept or something else of their choice. They can share these infographics and also embed them in their class blog. Several free tools for creating infographics include Wordle, Tableau, Inkspace and more.

- **Video and audio tools** allow students to create their own video / audio outputs and share them with their class on classroom blogs or the school's website. Video creation tools for students and teachers include e.g. Jing, CamStudio, Screenr, etc. Audio recording tools include e.g. Vocaro, Audio Pal, Record MP3 and more.




- **Digital storytelling tools** are an effective way to communicate with others. They improve young people's creative abilities and help them discover the meaning of their work and gain experience. Students can create their own digital stories using the many free tools available, such as Story Bird, PicLits, Slidestory and more. Nowadays, there are also applications for mobile phones, with which students can create their story anytime and anywhere.

- **Games** are one of the best ways to encourage collaboration and creativity. Educational games draw students into their studies, support interactive and imaginative elements in their thinking and shape students towards creativity. Some educational games that are freely available online are Capital Penguin, Grammar Gorillas, FunBrain.com and more.

*Table 1 Potential Benefits of OERs from Different Perspectives (*Adapted from [5])

Students' activity	Relevant ICT	Teacher's support
Investigation, researching, learning about the topic	Word documents processing Internet and database searching tutorials/webinars	motivating students' questions, training questioning skills
Taking measurements Making results tables, drawing graphs Doing calculation	virtual labs, data-logging, software/application measuring spreadsheets, data processing software	orientation about taking measurements support students in calculation difficulties
Asking „What if...?" questions	simulations, databases, modelling software	orientation in selected simulations software and discussion of questions asked
Comparing results/reviewing a topic	data files, Internet	stimulation of students' questions and explanations the results with other students

[5] Francislê De Souza, 2016. Science Education with and through ICT: Curriculum Design and Questioning to Promote Active Learning, In book: Handbook of Research on Applied E-Learning in Engineering and Architecture Education, Publisher: IGI Global, January 2016, Editors: David Fonseca, Ernest Redondo




Presenting information	word processing, desk-top publishing, spreadsheets, speech	asking and motivating students‘ questions about presentations

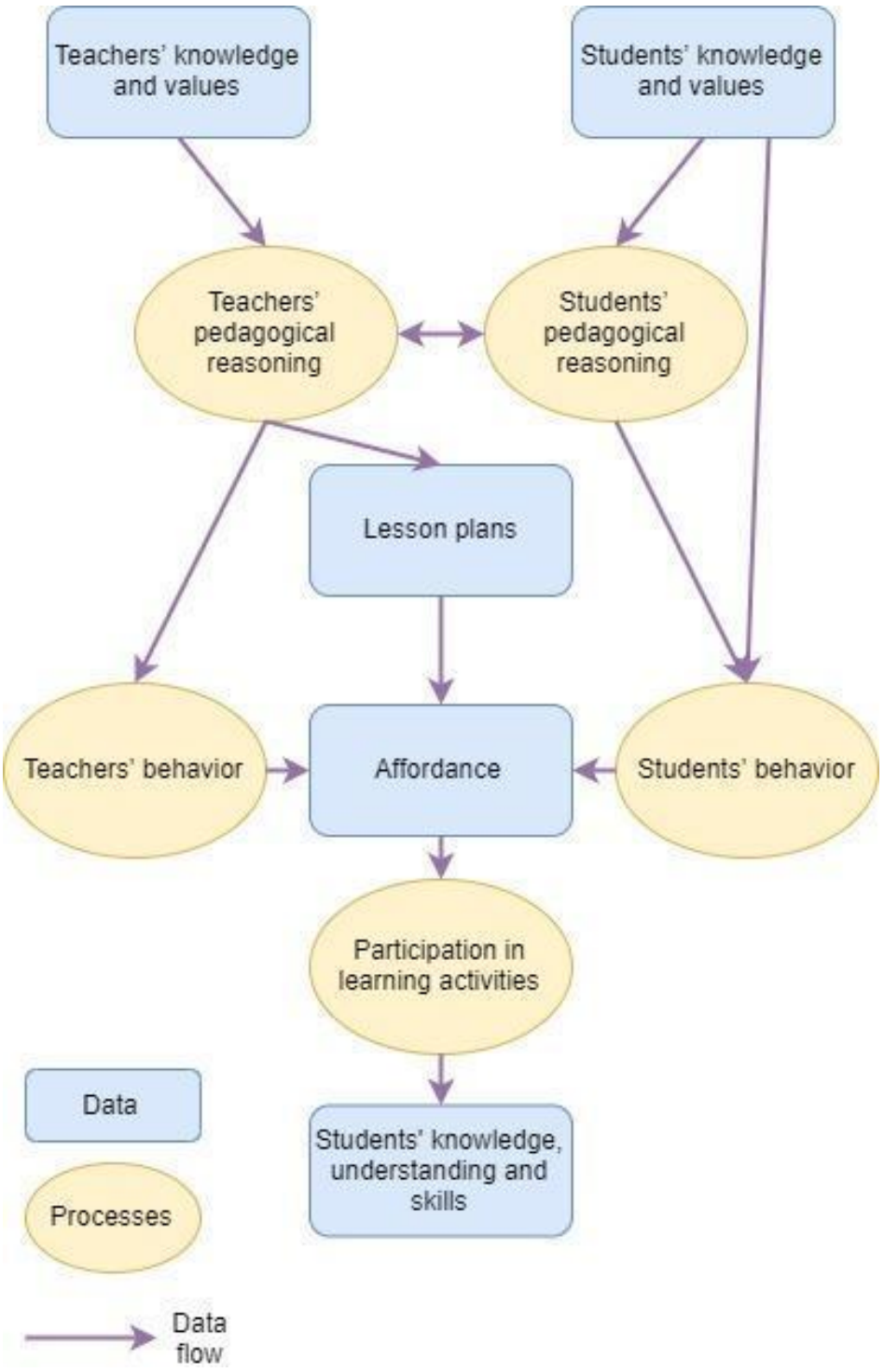

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Figure 1 Questioning framework for pedagogical practices relating to ICT use (Adapted from [6])

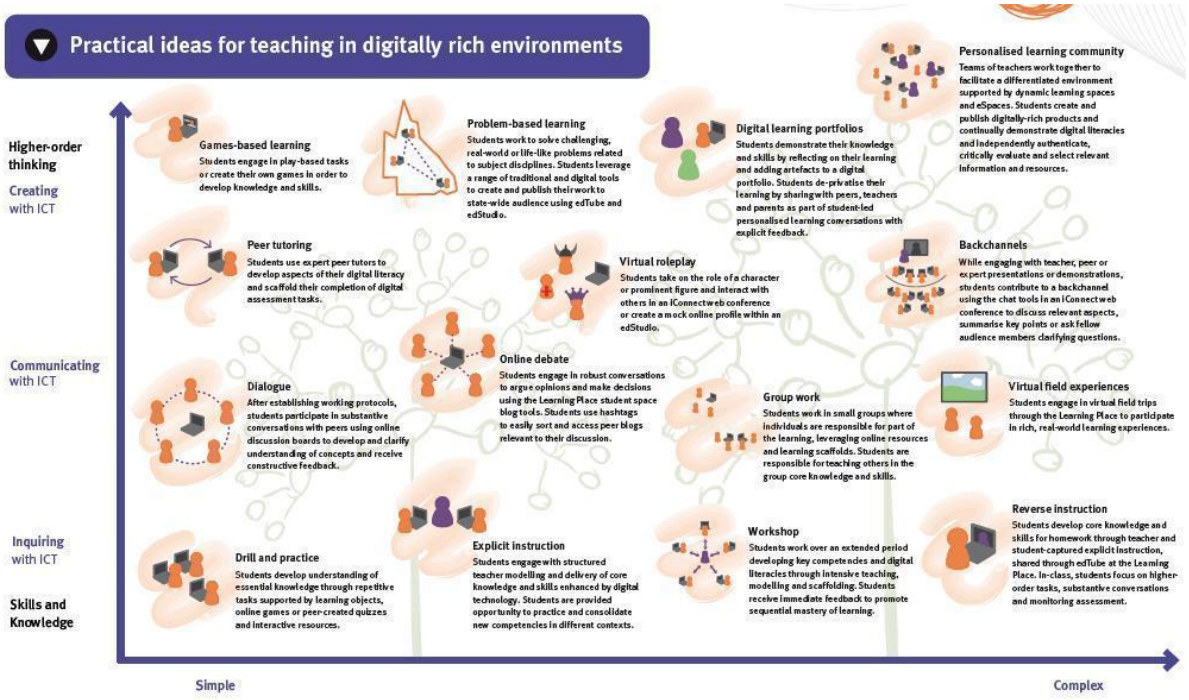

Figure 2 Practical ideas for teaching in digitally rich environments [7]

2 Different Ways of Using ICT in education

Information and communication technologies include not only modern audio visual and digital technologies based on computers and telecommunication services, which allow users to access and work with information to the maximum extent possible (e.g. the Internet, interactive whiteboard, digital camera), but also technologies used for communication (email) and working with information (software and various applications). The benefits of ICT in education and interactive learning materials are illustrated in

Figure 3.

[6] Francislê De Souza, 2016. Science Education with and through ICT: Curriculum Design and Questioning to Promote Active Learning, In book: Handbook of Research on Applied E-Learning in Engineering and Architecture Education, Publisher: IGI Global, January 2016, Editors: David Fonseca, Ernest Redondo

[7] http://sp4ce.eu/en/using-ict-for-teaching-and-learning

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Figure 3The Components of Paradigm Shifts in eLearning [8]

Creating interactive learning materials means creating interactive presentations in software designed for the technical system, taking into account the factors listed in

Figure 3.

2.1 Interactive and passive presentation

- The passive presentation of information through ICT is a set of slides with text, images, animations, sounds and videos, links to the Internet.
- An interactive presentation contains the same but allows the learner to change its course, enter its operation and change the specified conditions[9].

When the passive presentation is used, the learner is not involved in the direct activity or is not expected to be active. The pupil acquires skills only at the level of knowledge, understanding. Interactive teaching brings pupils greater enjoyment of learning, greater self-realisation and, not least, the experience of discovery. It helps to improve the ability to receive and impart information, the ability to communicate with peers and the ability to cooperate. It enables the pupil to better understand the connections between phenomena and thus to master tasks more quickly[10].

[8] Wei-Hsun Lee, https://doi.org/10.2991/ermm-14.2014.74

[9] KOFRITOVÁ, E. and GOGOVÁ, L. 2015. In ORIŇÁKOVÁ, S. and UHEROVÁ, Z. (Ed.) *Interactive whiteboard in the teaching of a professional foreign language.* Prešov: University of Prešov, ISBN 978-80-555-1282-2.

[10] BREČKA, P. 2014a. *Interactive whiteboards in technical education*. Bratislava: IRIS, ISBN 978-80-8153-024-1.




In terms of computer science, the Internet is one of the most motivating elements today that attract people to use ICT resources. The possibility of virtually instant access to millions of pieces of information and the ease and speed of communication between people around the world is appealing. Electronic mail, various communication servers and other ways of communicating via the Internet are what can help educators teaching computer science and computing subjects (but not only them) to make their students more familiar with computers not only as a tool but also as a normal part of life today.

The Internet is an important source of information for the student, and it could even be argued that today only the Internet and its services can provide a sufficient range and availability of current and historical information in any field.

From the previous lines, it is clear that nowadays it is essential for both the teacher and the student to have the possibility to access and work with the Internet. A student without the Internet is at a great disadvantage to those students who have access to the Internet.

The ways of using the Internet in the pedagogical process can be divided into three categories:

1. **Use of existing WWW pages**, which requires basic knowledge of working with a web browser (Chrome, Opera, Mozilla, ...) and Internet connection.
2. **Creation and use of WWW pages prepared by the teacher himself for the needs of a particular subject**, in addition to the Internet connection and the ability to publish on it, requires basic knowledge of creating web applications (HTML language, or some scripting language such as Java or PHP).
3. **The use of web applications and sites prepared by professional companies** requires, in addition to a considerable financial item, the time that must be devoted to familiarizing yourself with the application.

The use of ICT in the pedagogical process can be divided into two groups according to whether the ICT resources are used in teaching as a teaching aid (most of the teaching is carried out in a classical way) or whether the ICT resources are directly the means through which the teaching is carried out:

- technology-assisted learning,
- teaching delivered by technology.

2.2 Technology-assisted learning

- Students have the opportunity to meet frequently with the teacher,
- complements (in fact, is subordinate to) the traditional form of classes ("face to face"),

- can replace student materials previously delivered in the traditional form of textbooks, paper copies, etc., which means publishing syllabi, links to materials and other teaching materials online (materials are accessible via a local computer network or the Internet),
- Teacher-led sessions are live, in traditional classrooms,
- if the meetings are asynchronous, they are conducted via the web or an asynchronous learning management system.

2.3 Teaching delivered by technology

- there is never (or very little) physical contact between the student and the teacher ("face to face"),
- is also known as "distance learning", "distributed learning" or "distance education",
- Educator-led traditional classrooms are minimized, replaced by other forms of engagement, not in real time, or replaced by real-time "virtual classrooms."
- can be administered using a mixture of asynchronous and synchronous technologies,

Within this category we can still distinguish two important **subcategories**:

4. **Course Sharing** - uses technology to share resources (teachers and instructors) between geographically distant students. It is characterized by the presence of an educator simultaneously in multiple groups of students, concentrated using ICT resources. In these groups, the instructor acts as a coordinator, using local adaptations to focus and increase the group's motivation to learn (as the focus of such groups can often be distracting). Course sharing is often the primary solution for universities to get to "online learning" .
5. **Non-standard audiences** - ICT resources are used to deliver a course or learning programme that is not typical of a traditional 'bricks and mortar' university, i.e. for a non-typical audience. The focus of this sub-category is intended to create a new, non-typical and hitherto underserved audience, such as the employed, the homebound, the military, special education, etc.

It is important to distinguish between these two sub-categories as the needs of the students, the modes of teaching and the background of teaching provision may be different for them.

In these two areas of the definition of teaching are also found the subjects of computer science and computing that we are considering. Currently, most teaching in schools and universities is delivered in the form of **technology-assisted instruction** (although there are still gaps in the provision of good quality computing facilities in schools), and very few IT subjects in our country are delivered using **technology-assisted instruction**. Precisely because of the great interest in IT subjects and because of the increase in capacity, a transition from technology-assisted teaching - in computer rooms, using the insufficient capacity of computer technology, to technology-assisted teaching is being considered - students of IT subjects can study with the help of some form of distance learning. This is especially true for universities since at lower levels of schooling the essence of teaching is precisely in the live contact between teacher and pupil. Here, ICT resources will still only be used to support traditional teaching methods.

2.4 Asynchronous teaching

Asynchronous (guided) learning, or **self-study,** relies on some precisely formulated plan that guides the student through the study, without interaction (taking place in real-time) with the teacher. Examples of materials for this form of learning are multimedia courses and textbooks, materials stored on CD-ROM, written correspondence, and "*Click-To-Learn*" - web-based learning systems.

Self-study can be supplemented by asynchronous student-teacher interaction, via email, voicemail, or comments in a topical discussion.

In the traditional assignment of "homework", accredited academic institutions must consider which activities constitute accredited "*contact hours*" and which activities constituting "homework" is not part of contact hours.

Teaching based purely on self-study requires the student to have developed his or her own motivation to study. The number of correspondence course students who do not complete their studies is much higher than that of students in traditional "brick-and-mortar universities".

Asynchronous learning can be used for:

- **creating a foundation for learning** - background necessary for the study of the subject, basic facts, materials related to the study, practice, homework, a means for better memorization (if necessary),
- **Simplification of the learning process** - access to the course syllabus, assignments, course running, assessment made available to the student,
- **Estimation of student success** - through given objectives and measurable methods, tests, analysis and achievement scores

2.5 Synchronous teaching

Synchronous (live, real-time) learning or **teacher-led learning** is important because of the sharing of experiences or events - it usually takes place in real-time, is interactive and has a dynamic flow - it is guided by the teacher.

The teacher-led study has the ability to respond dynamically to the environment and to change the study plan or its course according to the needs of the teacher and the student at a particular time. This helps to maintain student attention and helps to reduce the number of students who do not complete the course.

Teacher-led learning via the web has some of these characteristics:

- the student is aware of the presence of other students "online",
- the ability to use "shared objects" allows teachers and students to work together on learning objects; some "shared objects" can be made available interactively for viewing "live" documents or applications for the whole group,
- allows selective interaction between students and teacher,
- allows (requires) the control and management of the flow of interaction by the educator,

We can distinguish two models of synchronous learning:

- **Broadcast model** - seminar style, lecture style. The lecturer delivers a lecture with little or no feedback and interaction from the audience. This model can easily be extended to larger numbers of learners and is probably the most commonly used (classic university lectures are an example);
- **Dialogue model** - a small group led by a teacher (subject matter expert) often very interactive, dynamically monitored and adapted to the current needs of dialogue and teaching. This model is typical of "brick and mortar universities" and requires smaller numbers of students per group (e.g., computer lab exercises).

The teacher-led study can serve:

- as a catalyst for encouraging future learning and for sustaining progress in learning,

- as a stimulus for the application of the knowledge learned (whether for oneself or in a group) and allows the teacher to assess the cognitive level and the level of progress of the student.

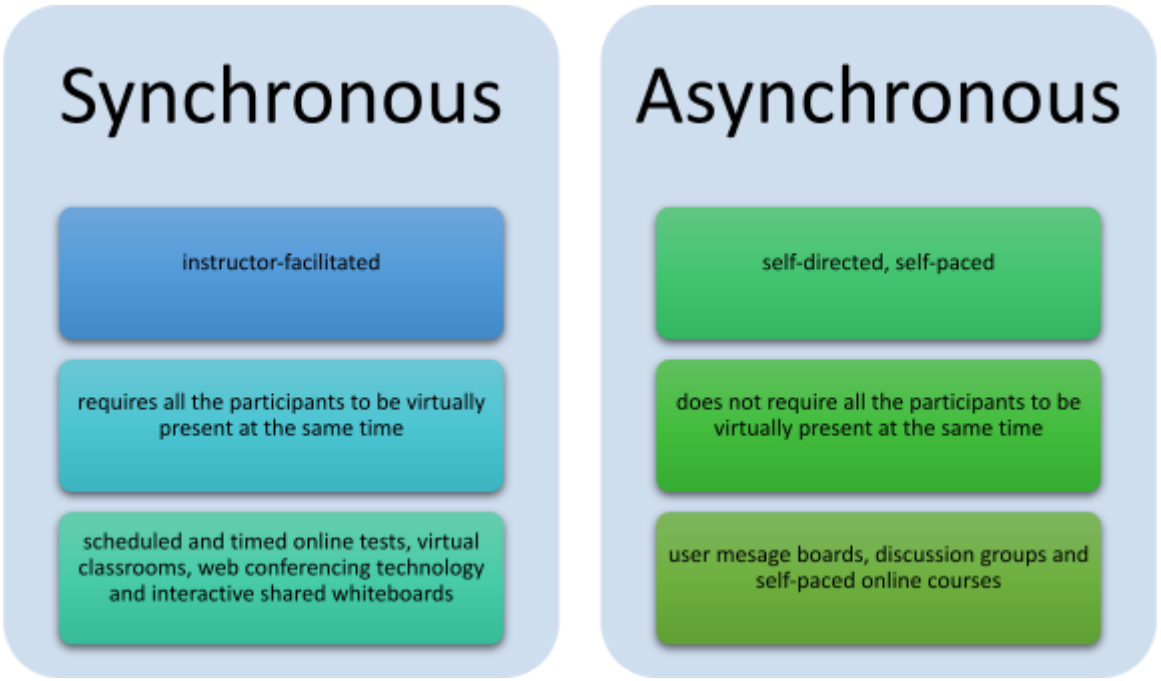

Figure 4 Differences between synchronous and asynchronous learning

2.6 Small group cooperation

Small groups are well suited to the practical application of learned abstract knowledge, according to teaching experience. Small study groups working on team projects not only serve to capitalise on the personal skills of individual students but also aim to teach students to work together as a team.

Small group activities can make use of asynchronous tools from asynchronous learning (email, topical discussion groups or listservers) but can also make use of synchronous tools (such as internet telephony or chat),

Various research has shown that the successful implementation of small collaborative groups increases student engagement in the learning process, increases interest in the learning process (especially compared to direct study), and reduces the amount of time the teacher or instructor has to manage the course.

Small groups collaborating through *the web* require some conditions to support this type of study:

- the student must be aware that he/she is "online" with other learners at the same time,




- the possibility for learners and educators to use "shared objects" at the same time, and these objects must be shared interactively so that the group can modify live documents or use applications together,
- Interactive communication of the "one-to-one" type is a multi-pathway of interaction between individual learners and their teachers, or between a learner and a study group; this option is often used in the form of text communication (chat), with the possibility of using more sophisticated ways of communication, such as voice communication or videoconferencing (e.g. MS Teams, EduPage); it can provide selective interaction between learners and the educator, with control of the conversation being shared equally between all participants.

Small group collaboration is often used to build groups on:

- meeting with the teacher during tutorials, technical assistance or one-to-one meetings,
- Building teams for projects, simulations, etc. or for an instructor-led study group.

3 E-learning

E-learning (e-learning) refers to learning with the help of ICT resources. E-learning should be distinguished on two levels:

- as a **technical system** that includes all the necessary ICT resources,
- as an **education system** that represents a new technology of education with the implementation of a technical system.

The classical way of teaching provided by textbooks, which must be supplemented by the teacher's interpretation of the subject matter, seems to be insufficient at present. With the current demand for university education, universities are trying to make it possible for as many people as possible to study on their programmes of study. This is leading to the increasing introduction of distance learning and the closely related methods of e-learning. The e-learning methods used can be:

1. **CBT** (Computer Based Training), which includes tutorials - multimedia educational courses designed for self-study on the computer.




2. **WBT** (Web Based Training) is learning supported by computer networks such as the Internet or Intranet. It is based on information and database systems and tutorials that combine the possibilities of interpretation by means of texts, animations, sound recordings, video and electronic communication. Information systems enable simulation and modelling of various phenomena, while database systems manage and evaluate the learning process.
3. **Online-learning** is a true virtual learning environment. It requires an online connection of students and teachers to a network server that provides the distribution of the required files. At the same time, it allows for both synchronous and asynchronous teaching.

To introduce e-learning methods into the pedagogical process, the following are needed technical and software resources, operational resources, structural sources.

Technical and software resources:

- a server and a terminal (personal computer, thin client, etc.) equipped with the appropriate application software,
- suitable structured cabling,
- a device that enables multimedia presentations and videoconferencing,
- services (telepresence, e-mail) and software (e.g., NetOp Vision) for interactive communication,
- development environments for the creation and processing of multimedia courses.

Operational resources:

- communications and telecommunications networks,
- server and network administration,
- Licenses and copyrights for application and development software and course content.




Structural sources:

- educator,
- student,
- creators of multimedia courses and presentations,
- education providers and organisers.

4 Blended learning

Hybrid (blended) teaching is one that uses the possibilities of ICT teaching (multimedia files, local computer networks, Internet) and can be combined with the traditional *face-to-face* teaching method. (lectures and exercises).

In general, blended learning refers to the following:

- Some learning happens online in a format where the student has control over the path and pace at which they engage with content
- Some learning happens in an instructor-led classroom
- Online and in-person learning is complementary, creating a truly integrated learning environment

Although there are basic models of blended learning[11]:

- **Face-to-Face**: Traditional instructor-led learning sessions supplemented with technology to allow learners to control their own learning pace. Benefits are role-play, mentoring, hands-on practice, and feedback.
- **Rotation**: Students go from one learning activity to another learning activity, either in a structured learning session directed by a teacher, or online in a self-directed manner.

[11] https://elmlearning.com/blended-learning-everything-need-know/




Examples include learning stations, labs, and the flipped classroom where learners practice the lesson before attending the face-to-face training.

- **Flex**: Flex learning is a term that can be used interchangeably with personalized learning. By accessing means of integration of learning in a Learning Management System (LMS.), the students control their learning path, choosing what they to learn. The instructor is usually present in a mentoring capacity, to answer questions.
- **Gamification**: One of the most effective ways to motivate learners is by letting them play! By using game play elements such as points or levels, learners feel a little competition and are more motivated to experience the material on their own time.
- **Online Lab**: This blended learning model is entirely digital, with little or no instructor interaction, and takes place either before, during or after a training. Learners can access content on mobile phones (mLearning), laptops or tablets. This modality engages and solidifies learning.
- **Self-Blend**: Self-blended learning is supplemental content—either in the form of webinars, white papers, industry blogs, or video tutorials—that help self-motivated learners delve deeper into a subject. A robust LMS can combine diverse content sources under one system to encourage curiosity and growth.
- **Online Driver**: This blended learning model is entirely self-directed and takes place in a digital environment. Learners can engage with an instructor through chat, email or message board. It provides a flexible schedule and personalized learning but lacks the face-to-face interaction of other types of blended learning. An LMS is the best way to encourage users to direct their own learning while still monitoring their process as they enjoy media and eventually, engage in classroom discussion. You can choose from existing learning management systems or opt to have an LMS developed specifically for your purposes.

5 Learning Management System

A learning management system (LMS) is a software application for the administration, documentation, tracking, reporting, automation, and delivery of educational courses, training

programs, or learning and development programs[12]. LMSs are focused on online learning delivery but support a range of uses, acting as a platform for online content, including courses, both asynchronous based and synchronous based. In the higher education space, an LMS may offer classroom management for instructor-led training or a flipped classroom. Modern LMSs include intelligent algorithms to make automated recommendations for courses based on a user's skill profile as well as extract metadata from learning materials to make such recommendations even more accurate[13].

Learning management systems are used to deploy a variety of learning strategies across different formats, including (but not limited to) formal, experiential, and social learning, to manage functions such as compliance training, certification management, and sales enablement[14].

5.1 LMS's Features

There are many types of learning management systems in the market with various features that best meet different content creators and the end user's needs (*Figure 5*).

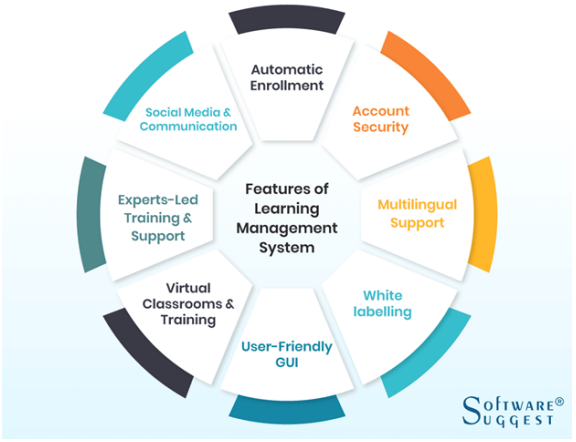

Figure 5 Main features of good LMS[15]

The critical features that every LMS must include e.g., management of courses, online assessment, user feedback, asynchronous learning etc.

Managing courses, users and roles

Learning management systems may be used to create professionally structured course content. The teacher can add, text, images, videos, pdfs, tables, links and text formatting, interactive tests, slideshows etc. Moreover, they can create different types of users, such as teachers, students, parents, visitors and editors (hierarchies). It helps control which content a student can access, track

[12] Ellis, Ryann K. (2009), *Field Guide to Learning Management*, ASTD Learning Circuits, archived from the original on 24 August 2014, retrieved 5 July 2012

[13] https://imsru.edu.in/content/online-learning

[14] https://www.docebo.com/learning-network/blog/what-is-learning-management-system/#subhead1

[15] https://www.softwaresuggest.com/learning-management-system

studying progress and engage student with contact tools. Teachers can manage courses and modules, enrol students or set up self-enrolment[16].

Online assessment

An LMS can enable instructors to create automated assessments and assignments for learners, which are accessible and submitted online. Most platforms allow a variety of different question types such as one/multi-line answer, multiple choice answer, ordering, free text, matching, essay, true or false/yes or no, etc[17].

User feedback

Students' exchange of feedback both with teachers and their peers is possible through LMS. Teachers may create discussion groups to allow students feedback, share their knowledge on topics and increase the interaction in course. Students' feedback is an instrument which help teachers to improve their work, helps identify what to add or remove from a course, and ensures students feel comfortable and included[18].

Asynchronous Learning

One of the best features for improving engagement and knowledge retention is asynchronous learning—the ability for learners to complete course work at their own pace. Combining videos, online readings, messaging, and question/answer forums where students can engage with the material at their own pace and on their own timelines helps promote buy-in and improve return[19]. Students can either learn asynchronously (on demand, self-paced) through course content such as pre-recorded videos, PDF, SCORM (Sharable Content Object Reference Model) or they can undertake synchronous learning through mediums such as Webinars[20].

Learning Analytics

Learning management systems will often incorporate dashboards to track student or user progress. They can then report on key items such as completion rates, attendance data and success likelihood. Utilising these metrics can help facilitators better understand gaps in user knowledge[21].

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[16] Schoonenboom, Judith (February 2014). "Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others". *Computers & Education*. **71**: 247–256. doi:10.1016/j.compedu.2013.09.016. ISSN 0360-1315

[17] Introduction to the E-learning Course Development in LMS Moodle / Zuzana Palková, Martin Drlík. -- Nitra : University of Constantine the Philosopher, 2009. -- 73 s. : obr., tab. -- ISBN : 978-80-8094-487-2

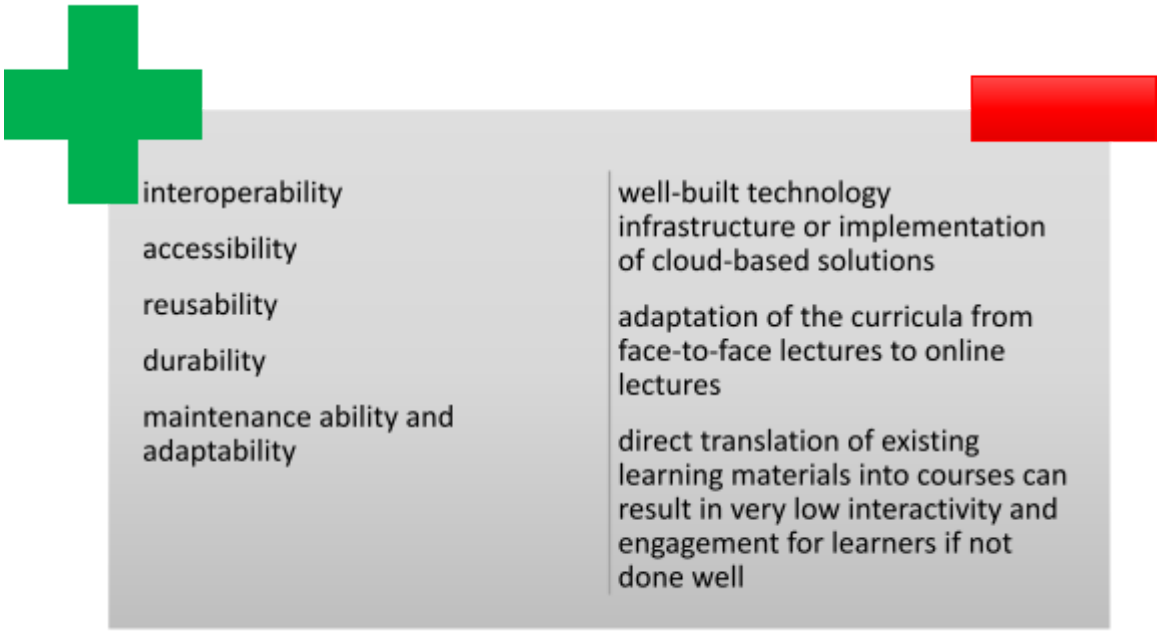
[18] Davis, B., Carmean, C., & Wagner, E. (2009). "The Evolution of the LMS : From Management to Learning". *The ELearning Guild Research*.

[19] https://technologyadvice.com/blog/human-resources/8-important-lms-features/

[20] https://technologyadvice.com/blog/human-resources/8-important-lms-features/

[21] ones, Kyle M. L. (2 July 2019). "Learning analytics and higher education: a proposed model for establishing informed consent mechanisms to promote student privacy and autonomy". *International Journal of Educational Technology in Higher Education*. **16** (1): 24. doi:10.1186/s41239-019-0155-0. hdl:1805/21571. ISSN 2365-9440. S2CID 195766461

5.2 Advantages and disadvantages of LMS



6 Open Education Resources

Open educational resources (**OER**) are freely accessible, openly licensed[22] instructional materials[23] such as text, media, and other digital assets that are useful for teaching, learning, and assessing, as well as for research purposes. A conceptual definition of the OER may be seen as a part of a larger trend towards openness in education including more well-known and established movements such as Open-Source Software (OSS) and Open Access (OA)[24]. To further clarify, OER includes[25]:

- **Learning Content**: Full courses, courseware, content modules, learning objects, collections and journals.

[22] http://opendefinition.org/od/2.1/en/

[23] Lewis, Beth (2018-05-10). "TLM or Teaching Learning Materials Definition". ThoughtCo. Archived from the original on 2018-04-14. Retrieved 2019-01-09.

[24] https://www.oecd.org/education/ceri/37351085.pdf

[25] https://docs.intersearch.com.au/prosentientjspui/bitstream/10137/17756/1/interpublish41675.pdf

- **Tools**: Software to support the development, use, re-use and delivery of learning content including searching and organization of content, content and learning management systems, content development tools, and on-line learning communities.
- **Implementation Resources**: Intellectual property licenses to promote open publishing of materials, design principles of best practice, and localization of content.

6.1 The Concept of "Openness" and the Goals of OERs

The term Open Educational Resources first came to use in 2002 at a conference hosted by UNESCO. Participants at that forum defined OER as: "The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes[26]." The currently most used definition of OER is: "Open Educational Resources are digitised materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research[27]." Nevertheless, the definition of openness is constantly changing and varies according to people, domains and contexts (e.g., sharing software source code, using and reusing content, open access to publications, etc.), but in general the OER should follow the following principles:

- the possibility to keep the source, e.g., on your computer;
- the possibility to reuse the resource;
- the possibility to modify the source, e.g., also by translation;
- the possibility to combine different sources;
- the possibility to further disseminate the resource.

Another important factor related to OERs is the level of openness that materials can have both from a format perspective and license perspective and digital resources need to be published in a format that makes it possible to copy and paste pieces of text, images, graphics, or any published media so that they can be adapted or modified by the user. This means that non-editable formats, for instance Adobe Portable Document Format (.pdf) or Flash (.swf), do not qualify for a high level of openness. Open formats such as Hyper Text Markup Language (HTML), Portable Network Graphics (.png), and

[26] https://en.unesco.org/themes/building-knowledge-societies/oer

[27] https://journals.librarypublishing.arizona.edu/itlt/article/id/1510/

OpenDocument Format (.odf) are more open, although they might be difficult to use and thus they might exclude people lacking technology skills[28].

Table 2 Potential Benefits of OERs from Different Perspectives (adapted from https://journals.librarypublishing.arizona.edu/itlt/article/id/1510/)

Stakeholder	Potential benefit
Government's perspective	– Widening participation in higher education by expanding access to nontraditional learners – Leveraging taxpayers' money by sharing and reuse between institution – Bridging the gap between formal and informal education – Advancing knowledge by unlocking information for the benefit of all
Institution's perspective	– Improving recruitment by helping students find the right programs – Increasing collaboration among students, faculties and other institutions – Attracting alumni as life-long learners – Enhancing the public image of the institution
Educator's perspective	– Preserving a record of teaching innovations allowing others to build upon them – Fostering connections with colleagues around the world – Gaining publicity through increased reputation – Leaving a legacy after leaving academia
Learner's perspective	– Accessing high-quality materials from some of the best universities in the world – Engaging in informal learning, where credentials are not needed – Saving money on expensive required textbooks – Learning through updated materials that are relevant to current issues

7 MOOC

A **massive open online course** (**MOOC**) is an online course aimed at unlimited participation and open access via the Web[29]. In addition to traditional course materials, such as filmed lectures, readings, and problem sets, many MOOCs provide interactive courses with user forums or social media discussions to support community interactions among students and professors, as well as immediate feedback to quick quizzes and assignments. MOOCs are a widely researched development

[28] https://journals.librarypublishing.arizona.edu/itlt/article/id/1510/

[29] Kaplan, Andreas M.; Haenlein, Michael (2016). "Higher education and the digital revolution: About MOOCs, SPOCs, social media, and the Cookie Monster". *Business Horizons*. **59** (4): 441–50. doi:10.1016/j.bushor.2016.03.008.

in distance education, first introduced in 2008[30], that emerged as a popular mode of learning in later years.

7.1 How do MOOCs work?

MOOCs are online courses that a student accesses through the internet. Typically, these courses consist of traditional class materials made accessible online, which may include the following[31]:

- filmed or recorded video lectures;
- readings;
- problem sets;
- online quizzes and examinations;
- interactive learning modules; and;
- interaction with other students via forums.

Typically, each MOOC will include a course provider and a course platform. A course provider is often a university, which supplies the course materials and instructors. The platform, such as EdX, Canvas, Coursera or Udacity, provides the technological infrastructure for course modules, user access and other learning resources.

MOOCs offer a strong starting point for an online education, including[32]:

- **Lack of entry requirements** – a MOOC can be taken by anyone who is interested in the subject matter and able to access the course, regardless of age, background, or location.
- **Repetition** – a MOOC will often run two or three times a year, ensuring that students won't miss their chance.
- **High quality** – MOOCs are led by subject matter experts (SMEs) and supported by teaching assistants so that students have access to first-rate educational resources.

[30] Siemens, G. (2013). Massive open online courses: Innovation in education. In McGreal, R., Kinuthia W., & Marshall S. (Eds), Open educational resources: Innovation, research and practice (pp. 5–16). Vancouver: Commonwealth of Learning and Athabasca University.

[31] https://whatis.techtarget.com/definition/massively-open-online-course-MOOC

[32] https://educationaltechnology.net/massive-open-online-courses-moocs-definitions/




- **Feasibility** – a MOOC usually necessitates around 1-2 hours of study a week for about 5 weeks, making learning doable for students with busy lives.
- **Self-paced but supported learning** – a MOOC enables students to work through the course materials and assessments at their own rates while also interacting with a global learning community.

8 Impact of ICT on Education: Challenges and Perspectives

Information and communication technologies (ICT) and their continuous development are also bringing changes in the field of education, where interactive technologies are significantly innovating the teaching process and becoming increasingly popular. Apart from the necessity to move to online teaching due to COVID-19, schools are adding multimedia classrooms, virtual classrooms, digital libraries, e-books and teaching aids [33].

Education, also influenced by COVID-19, is experiencing major changes in educational practices with a significant share of ICT. A major change has been brought about by the shift from learning through facts, exercises, procedures and rules towards learning through projects, exploring problems, designing solutions or discovery and invention, creativity and diversity, action and reflection[34]. The main feature of this learning transition is a paradigm shift in learning. This evolution of the (e-)learning paradigm is illustrated in Figure 6.

[33] **Z. Palkova (2017) AN INNOVATIVE VIRTUAL REALITY EDUCATIONAL ENVIRONMENT FOR SCHOOL PHYSICS EDUCATION.**

[34] Z. Palkova, P. O'Callaghan (2010) ON-LINE LEARNING MODULES FOR RENEWABLE ENERGY SOURCES FOR LANDSCAPE DEVELOPMENT - PROJECT RESNET OF LIFELONG LEARNING PROGRAMME LEONARDO DA VINCI, INTED2010 Proceedings, pp. 1886-1892.

Z. Palkova (2017) AN INNOVATIVE VIRTUAL REALITY EDUCATIONAL ENVIRONMENT FOR SCHOOL PHYSICS EDUCATION. Z. Palkova, M. Harnicarova, J. Valicek (2019) BIZ4FUN COURSE CURRICULUM & CONTENT - HOW TO DEVELOP A SUCCESSFUL BUSINESS, INTED2019 Proceedings, pp. 4363-4369.

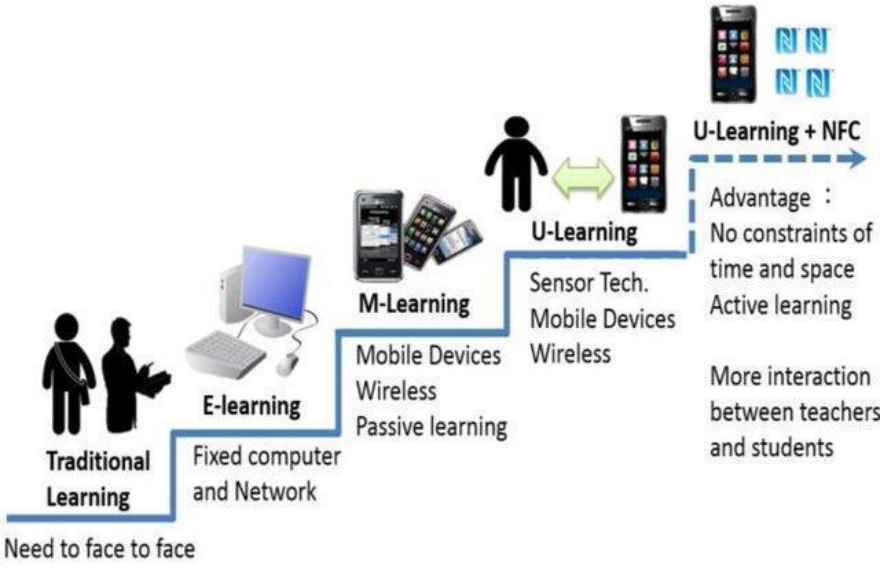


Figure 6 The Components of Paradigm Shifts in Elearning [35]

The current way of education seems to be insufficient for the current society. Creating a new, suitable model requires making some changes:

1. **Changing the way, we teach**. The established "classical" model of education is based on the reproduction of the educator's knowledge by the student. The student acquires a huge amount of encyclopaedic knowledge, which he is unable to use effectively in practice. Moreover, the current pace of developing the knowledge base means that the knowledge thus acquired does not reflect the real situation. The role of schools should therefore be to teach students to obtain the information they need when they really need it.
2. **Changing the way knowledge is presented**. Existing ICT facilities allow the creation of multimedia courses that both enable students to better absorb the subject matter and allow teachers to more easily update the information presented, which is a significant advantage, especially in IT-related subjects where developments are particularly rapid.
3. **Availability of multimedia courses**. Connecting universities to the Internet will allow students to access individual e-courses and obtain the information they need from a variety of sources from any location and at any time.

The degree of accessibility and sophistication of e-courses will allow for a partial, or in some cases, complete, change in the nature of the forms of learning provided. At the same time, e-learning will have a significant impact on the composition of the learning population by increasing the proportion of those studying alongside employment.

[35] Wei-Hsun Lee, https://doi.org/10.2991/ermm-14.2014.74




The introduction of e-learning into the pedagogical process will also change the position of the educator. While currently, the educator is the creator of the information content of the course, the lecturer and the creator of didactic aids, the creation of multimedia courses for new forms of education will require close cooperation of several experts - educator, graphic designer, programmer, analyst...

Last but not least, accountability for student learning will change. Currently, it is primarily the educator who is "held accountable" for student knowledge. In the new forms of learning, it will be only the student who will take responsibility for his or her learning.

Table 3 Overview of Pedagogy in the Industrial versus the Information Society[36]

Aspect	*Less* ('traditional pedagogy')	*More* ('emerging pedagogy' for the information society)
Active	– Activities prescribed by teacher – Whole class instruction – Little variation in activities – Pace determined by the programme	– Activities determined by learners – Small groups – Many different activities – Pace determined by learners
Collaborative	– Individual – Homogenous groups – Everyone for him/herself	– Working in teams – Heterogeneous groups – Supporting each other
Creative	– Reproductive learning – Apply known solutions to problems	– Productive learning – Find new solutions to problems
Integrative	– No link between theory and practice – Separate subjects – Discipline-based – Individual teachers	– Integrating theory and practice – Relations between subjects – Thematic – Teams of teachers
Evaluative	– Teacher-directed – Summative	– Student-directed – Diagnostic

[36] Source: Thijs, A., et al. Learning Through the Web Available Online http://www.decidenet.nl/Publications/Web_Based_Learning.pdf Accessed 31 May 2002.




9 Planned the lesson with ICT

Innovative means "introducing or using new ideas or methods [37].

Innovations:

- everything you do, and it is no longer a habit, is innovation,
- new ideas and solutions require creativity.

Creativity:

- belongs to strategic skills,
- is one of a set of complete functional and behavioral properties,
- the main aim is to think outside the usual procedures and to arouse curiosity, to break away from rational, conventional ideas and formalized procedures, to rely on imagination and to consider several solutions and alternatives.

According to Bryan W. Mattimore[38] there are seven creative states of mind:

1. **Curiosity** - without curiosity, the creative process never has the basic stimulus it needs.
2. **Openness** - active and creative openness to others and their ideas.
3. **Ability to understand ambiguity** - the ability to combine conflicting, ambiguous and/or incomplete information.
4. **Searching for and transmitting principles** - this state consists of two parts: the mental habit of constantly identifying the creative principles that lie in the idea, and the second part: adapting the identified principle or idea to another context and creating a new idea.
5. **The search for integrity** - the desire to discover and the belief that there is a connection that unites seemingly disparate elements into one element.
6. **Cognition**.
7. **Creating a new world** - the ability to imagine completely new worlds, places, people and things.

[37] http://www.merriam-webster.com/dictionary/innovative

[38] https://assets.thalia.media/doc/4a/d9/4ad9d4c7-de4c-4b1c-8eca-cf3cbbca7b3d.pdf

Figure 7 Seven creative states of mind

Table 4 Levels of a creativity[39]

Level 1: basic	Level 2: medium	Level 3: advance	Level 4: expert
He/she creates new ideas in connection with work	He/she create many new and unique ideas	He/she develops innovative ideas and methods for doing things	He/she constantly generates and implements original ideas for himself and others, for simple and complex problems
He/she tries old solutions to problems, but also tries new methods if it needs to	He/she is looking for new and more effective methods, combining them with previous seemingly unrelated ideas	He/she creates new methods and solutions, thinks outside the usual procedures, combines seemingly unrelated ideas, is not afraid to use unusual methods	He/she uses analysis and transfers the interrelationships between information from one situation to another to solve problems
He/she seems creative and contributes to the creation of ideas during brainstorming	He/she seems original and valuable for the brainstorming process	He/she seems to be a motivator and guides others in creating new ideas in brainstorming	He/she brings the most to the brainstorming process and leads others to discover new connections, new solutions and new ways of working

[39] http://sp4ce.eu

9.1 Didactics

- is understood as the art of teaching,
- includes a wide range of factors that characterize teaching,
- goes beyond the usual boundaries of classroom learning, especially in adult education, where too many factors are involved, with a focus on non-formal and informal learning.

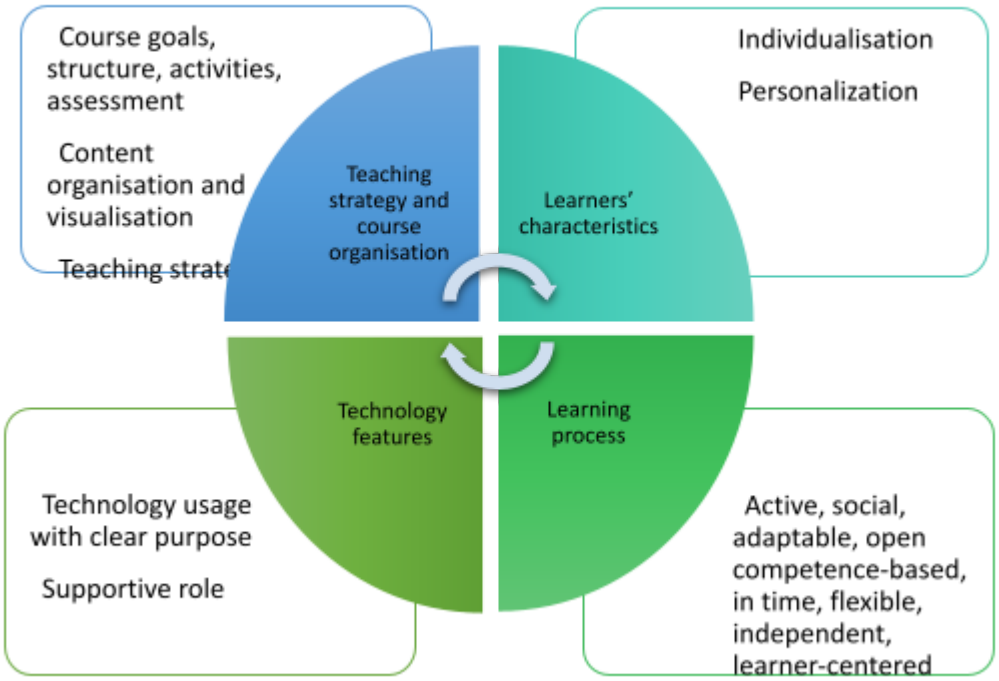


Figure 7 The principles of eDidactic (adapted from [40])

9.2 Basic framework of didactics

Categorizations of learning theories:

[40] Minkovska, D., Ivanova, M., & Yordanova, M. (2016). Didactic principles of eLearning — Design and implementation of an interactive adaptive learning system. *2016 15th International Conference on Information Technology Based Higher Education and Training (ITHET)*, 1-6.

- **Behaviorism** is interested in behavior and observable changes. Therefore, behaviorism in teaching focuses on creating new patterns of behavior.
- **Cognitivism** is interested in the thought processes behind behavior. Therefore, cognitivist learning theory emphasizes the importance of the acquisition (including reorganization) of cognitive structures.
- **Constructivism** states that knowledge is constructed by the interplay of existing knowledge and individual (or social) experiences.
- **Connectivism** is a completely new approach, claiming that learning "is aimed at linking specialized information sets and connections that allow us to learn more and are much more important than our current state of knowledge." (16)

9.3 Connectivism

Connectivism[41] "Theory of Learning in the Digital Age" developed by George Siemens and Stephen Dowens based on their analysis of the shortcomings of existing theories of learning based on behaviorism, cognitivism and constructivism.

Principles of connectivism

- the knowledge and skills acquired are based on differences of opinion,
- learning is the process of connecting specialized nodes or sources of information,
- the source of learning does not have to be people, but also technology,
- knowledge may be latently contained in a particular community, network or database,
- the ability to learn is more important than the current volume of charged knowledge,
- the ability to find information is more important than knowing it,
- maintaining and developing connectivity facilitates the growth of education,

[41] https://spomocnik.rvp.cz/clanek/10357/




- the ability to find connections and parallels between different areas, ideas and concepts is a basic skill,
- the goal of all connectivism learning is accurate and current knowledge,
- decision-making itself is part of the learning process - we choose what we learn and look at the significance of the information we receive through the lens of changing reality (just because we have the right answer today does not mean we will have it tomorrow, because everything around is changing).

The current challenge for educators is to harness the potential of new learning approaches, including those that incorporate dominant elements of information and communication technologies. The Georg Siemens *Table 5* shows the different learning models, and which facilitates the orientation of teachers and trainers in choosing the right approach.

Table 5 Different learning models

Property	Behaviorism	Cognitivism	Constructivism	Connectivism
How learning arises	Black box — focusing mainly on observed learning	Structured, calculated	Social, every learner creates meaning (personal)	Distributed online, socially supported by technology, there are models for recognition of learning outcomes and interpretation
Factors that affect	Nature of appreciation, punishment, incentives	Existing scheme, previous experience	Engagement, participation, social, cultural	Network diversity, strong ties, context emerging
Memory role	Memory recalls recurring experiences — as long as reward or punishment is most important	Coding, storage, reprocessing	Previous knowledge mixed with current context	Adaptive models representing the current state exist networked
How the transfer arises knows"	Incentives, answers	Duplicate knowledge is "who"	Socialization	Connection to information nodes (addition) and growth of networks (social / conceptual / biological)




Property	Behaviorism	Cognitivism	Constructivism	Connectivism
The types of learning that are best explained	Task-based learning	Reason, clear goals, problem solving	Social, unclear ("poorly defined")	Comprehensive education, rapidly changing core of learning, diversified learning resources

10 Good practices

1. NET project - https://net-project.eu
2. Biz4fun project - www.biz4fun.eu
3. VR WAMA project - https://www.vr-wama.eu
4. TESLA project - https://www.facebook.com/teslavrproject

Co-funded by the Erasmus+ Programme of the European Union




11 Additional reading

https://pedagoo.com/uses-of-ict-in-education/?lang=en

https://www.richtmann.org/journal/index.php/mjss/article/view/5279

https://www.stthomascollegebhilai.in/wp-content/uploads/2016/10/emergingtrendsinictforeducationandtraining.pdfhttps://en.unesco.org/icted/sites/default/files/2019-04/88_ict_in_education_around_the_world.pdf

https://pdfs.semanticscholar.org/866e/63c955907ae7ffd24a9cda391d7f8f29d7b6.pdf

https://www.stthomascollegebhilai.in/wp-content/uploads/2016/10/emergingtrendsinictforeducationandtraining.pdf

https://www.mooc.org

https://en.wikipedia.org/wiki/Open_educational_resources

https://www.idosr.org/wp-content/uploads/2020/02/IDOSR-JAM-51-51-57-2020.-1.pdf

https://en.unesco.org/icted/sites/default/files/2019-04/88_ict_in_education_around_the_world.pdf
https://www.stthomascollegebhilai.in/wp-content/uploads/2016/10/emergingtrendsinictforeducationandtraining.pdf

Co-funded by the Erasmus+ Programme of the European Union

Virtual Reality for Augmenting Creativity and Effectiveness of training

EU - ERASMUS+

2020-1-UK01-KA201-079177

Intellectual Output II – Course 2

Web 2.0: **Tools for School Education**

Serious Game developing group

Institute for educational Technology - National Research Counc

Co-funded by the Erasmus+ Programme of the European Union

Course 2 – Web 2.0: Tools for School Education

1. Overview on Web 2.0 tools

The term "Web 2.0" originated in 2004 as a result of conferences organized annually since that date by Tim O'Reilly. There is no “official” definition of WEB 2.0; it does not represent something new but rather a more complete realization of the true potential of the WEB created by Tim Berners-Lee. The main difference with WEB 1.0 (original WEB) is not the technological aspects, rather it is the role of users. In Web 1.0 the users had a role of simple readers of the information contained in the web pages that could be considered as catalogs or simple books to browse. Web 2.0 adds the potential for users to write. Each user thus becomes a producer of knowledge, adding value to websites by promoting the so-called "architecture of participation" allowing the emergence of new technologies like blog, wiki, chat and social networks.

Howe (2006) proposed a categorization of the uses and services that can be implemented and made available to WEB 2.0 users:

- sharing user-contributed content (“You make it”)
- large sets of user-contributed content (“You name it”)
- the development of content collections by the user community (“You work on it”)
- finding not only objects but trends and overviews of contributions (“You find it”).

The user today is not only a consumer of information but has become an active producer. This represents a change of vision of the Web defining its new social dimension and amplifying its potential and possibilities. The computer knowledge, that in the beginning was necessary to publish any web page, today is practically zero, and anyone, even if lacking knowledge of the basic HTML tools with which still comes the navigation can publish its content. It all started with the publication of the first blogs (Web Log) network diaries in which people began to publish their experiences, their passions, and their ideas. This gave rise to the first virtual communities that brought together users who shared the same interests and paved the way for the modern phenomenon of social networks.

This transformation has also led to profound changes in the knowledge society, modifying the concept of acquisition and dissemination of knowledge. An emblematic example is the diffusion of wikis, the most famous of which is certainly Wikipedia, which represents an example of information and knowledge shared on the net. Wikipedia is an online encyclopedia compiled thanks to the contribution of the community in which the entries are written directly by users who play the dual role of users, producers, and verifiers of the quality of the material produced. This new way of using the web brings together the skills and competencies of each individual, promoting collective intelligence and active participation by individuals in "virtual communities" that today we know by the term social network. A predominant feature of the new Web in recent years is that it is not limited to computers. Especially young people use most of the

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services offered by Web 2.0 through portable devices such as smartphones and tablets, so much so that applications are now specifically designed to be used by these devices.

From what has just been described, we can understand how the potential of WEB 2.0 can bring benefits in the educational context, deeply modifying what was the traditional pedagogical scenario and providing effective educational tools.

2. Benefits and Barriers to use Web 2.0 Tools in school education

One of the main features of WEB 2.0 is the possibility of developing learning environments in which students can both interact and become "knowledge creators, producers, editors and evaluators" (Richardson, 2009). Continuous discussion with peers and teachers can improve critical skills and a sense of belonging to a group that works cooperatively can become a source of motivation to learn.

Web 2.0 can "support active and social learning, provide opportunities and venues for student publication, provide opportunities to provide effective and efficient feedback to students, and provide opportunities to support learning in the student's zone of proximal development" (Hartshorne & Ajjan, 2009; Vygotsky, 1978).

To use these applications it is important to follow some guidelines

- Do not introduce too many new technologies to students at once as using too many Web 2.0 technologies could lead to shallow learning. It would be preferable for teachers to use a small number of tools, adding more only after expertise is developed.
- Important is not to use multiple technologies that do the same thing, often managing multiple email accounts and forums and a new technology can create confusing management issues.
- Teachers should provide appropriate instruction, tutorials, examples, and frequent feedback to support learning activities.
- Facilitate collaborative learning using Web 2.0 technologies, e.g., use wikis for collaborative writing projects, blogs as spaces for collaborative reflection, requiring participants to respond and provide feedback to one another, social bookmarking sites for sharing resources, peer review systems.
- Create an engaging and supportive environment, provide clear goals for using Web 2.0 technologies, reward students for good work and contributions, and show YouTube videos to begin or end the lesson.

The main benefits of using Web 2.0 technologies in teaching can be summarized as follows:

- interaction, communication and collaboration, the use of Web 2.0 in teaching helps to build a community, facilitates interactions and communication, encourages collaboration and sharing of resources.

- knowledge creation, Web 2.0 technologies allow students to "become knowledge creators", they can create content on their own taking responsibility for their learning. The teacher becomes a facilitator of learning and is no longer just a distributor of knowledge.
- ease of use and flexibility, Web 2.0 tools are easy to use and flexible, they eliminate time constraints by providing a more flexible learning environment not closed off by classroom walls
- Writing skills and technology. The use of Web 2.0 technologies helps students become more proficient in writing and applying technology.

The main barriers to the use of Web 2.0 in education fall into two main areas: Technological and Methodological.

From the technological point of view, one of the issues to be addressed is the digital divide, defined as a "division between people who have access to and use digital media and those who do not". Even today, many families at home are not equipped with broadband internet connection systems that enable them to access to web 2.0 resources.

The European Broadband Portal (https://www.broadband-mapping.eu/) shows that the efforts of recent years to bring broadband to European citizens' homes have paid off, but still in many countries there are large areas where less than 10% of homes are served by an internet connection or have a bandwidth fewer than 30 Mbps. The availability of a stable 30 Mbps connection is essential to take advantage of real-time services such as video conferencing, screen sharing, and video recording that are so useful for distance education. Another problem to be taken into account is the age and obsolescence of the computers present in many computer rooms in our schools, which do not allow the use of certain services because they are now too old. Lastly, there is the aspect of computer literacy among teachers, who often do not have the basic skills to use these services.

From a methodological point of view, it must be understood that the simple use of a tool such as Web 2.0, if not supported by correct planning from an educational and methodological point of view, does not bring any kind of benefit. It is therefore important that the teacher, starting from the pedagogical objective, selects the correct tool to integrate, the teaching strategy, and the most suitable materials for the purpose.

3. Web 2.0 Tools to support parent-school communication and family engagement

Educational-didactic family-school continuity is a valuable ally in guaranteeing students access to quality education and instruction. The collaboration of the entire educational ecosystem is fundamental to educate young students. In this context, the school and family play a leading role. School-family cooperation does not mean confusing the roles, which on the contrary always remain distinct in carrying out their specific educational function. School-family cooperation means, on the one hand, offering parents the opportunity to participate in the growth of their child as a person and as a student and, on the other hand, offering the school a valid aid that collaborates in the informal formation of the young student and promptly communicates any discomfort.

It is well known that a good relationship between school and family means that students can:

- Achieve better learning outcomes
- Promote greater self-regulation and general well-being
- Reduce absenteeism
- Maintain a more satisfactory relationship with teachers and classmates
- Have a more positive attitude toward school and cultivate greater ambitions for their education

In recent decades, educational research has developed several proposals to describe the educational continuum between the process of acquiring skills at school and the activities that take place at home. The traditional parent-teacher meetings that were often done a few times a year and in which only specific needs of the student were communicated, today have been supplanted thanks to new ICT tools to a continuous confrontation in which the school and the parent are in close contact and can work in synergy and promptly when a problem arises in the student.

The interaction and communication between teachers, their students, and their parents are therefore fundamental and needs intuitive students to cope with simple, functional, and affordable communication.

The following paragraphs propose some WEB 2.0 tools designed to facilitate school-family communication.

3.1 TalkingPoints

TalkingPoints (https://talkingpts.org/) is a text-based communication tool available for both desktop and smart device environments. TalkingPoint was created to enable communication between schools and foreign parents who speak only their home language. TalkingPoint integrates an automatic translation system that supports more than 100 languages. This tool breaks down language barriers and is of particular interest in stimulating the engagement of foreign parents who have not yet mastered the language of the country in which they live.

TalkingPoints Communication Flow - Image From:https://talkingpts.org/

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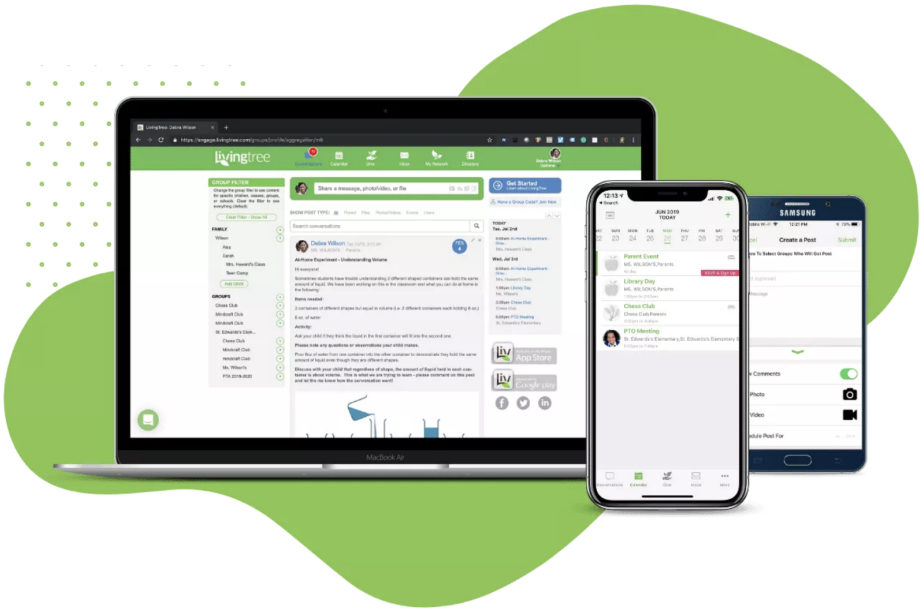
Figure above shows the communication flow of TalkingPoint. All messages written by the teacher are sent to the parents who can read them in their home language. The parent can reply in their language; the message will be sent to the teacher and translated into the starting language.

3.2 LivingTree

LivingTree is a Web 2.0 tool developed as a free platform for smart devices and Web devices. LivingTree was created to allow teachers and students to share, in real-time, moments from their day with their parents and family.

The environment allows parents to view activities and educational moments experienced by their children while providing access to academic records, papers, sporting events, children's artistic creations, etc.

The platform provides parents with shared calendars in which dates of interest can be inserted from teachers or school personnel. The appointments in the calendar will be notified through updates and reminders; so that nothing of their children's educational and emotional growth is missed. The platform was designed by a parent for a parent and offers all the tools to be able to manage and organize the daily activities of a child together in an efficient and safe environment. The system provides features for teachers that make it the ideal environment to organize their work as well. Teachers will be able to elaborate and plan their lessons and interventions in the classroom and these can be shared with parents who will thus be made to participate in the details of the educational planning.



LivingTree Platform - Image from: https://learn.livingtree.com/

3.3 Class Dojo

ClassDojo (https://www.classdojo.com/) is an online platform for classroom management that transforms the classroom into a large community where gamification mechanisms are integrated. Within this environment, dynamics are developed that allow for the allocation of rewards and penalties that can incentivize positive student behavior.

Teachers can monitor student behavior, curate student portfolios, facilitate classroom activities, and engage parents. Parents can see their child's behavioral and academic progress and communicate with the teacher through an instant messaging system and exchange opinions and educational experiences with teachers and other parents. Teachers can also share their classroom events and photos so that parents feel more connected to the classroom and involved in the daily lesson plan.

Image from: https://www.classdojo.com

4. Web 2.0 Tools for teachers

The daily work of the teacher is not only limited to the frontal lesson with the students, but all teachers are engaged in ongoing activities of preparing lessons, planning and organizing teaching work, preparing and evaluating tests, refresher courses, relationships with parents, relationships with colleagues and with the administrative staff of the school.

Every day in the life of a teacher can be truly chaotic, and often chaotic days become weeks and even months. If you fail to organize, often the work piles up or even worse can be forgotten to accomplish. One day in a teacher's life can be chaotic. Then, that day becomes a week and that week becomes a month. If you don't get organized, things pile up or even worse, get forgotten.

For teachers, as in many other professions, Web 2.0 technologies such as the ones we outline below can come to the rescue.

4.1 Evernote

Evernote is a web application dedicated to productivity and work organization used every day by thousands of professionals and very useful for teachers as well. The basic idea is that of a digital notebook in which to write down all the information of interest using multimedia channels such as text, images, audio, and video clips. In the educational field, its uses are unlimited and range from lesson planning, presentation of learning content, noting down feedback from students in the classroom and so on. Like all notebooks, Evernote allows you to take notes, create to-do lists, and make appointments, but with its multimedia features, it also allows you to record voice memos, capture photos, capture video making these notes searchable for quick and easy access wherever you are, whether at school, at home or on the go.

Teachers can easily exchange and share materials with Evernote and can use it to create student portfolios, lesson plans, class management, and meeting minutes.

Evernote is an indispensable tool for collecting and organizing information that might be of interest during Internet surfing. The collected notes can be selected at a later time giving the possibility not to lose any information without having to add all the pages, potentially of interest, in the favorites of your browser.

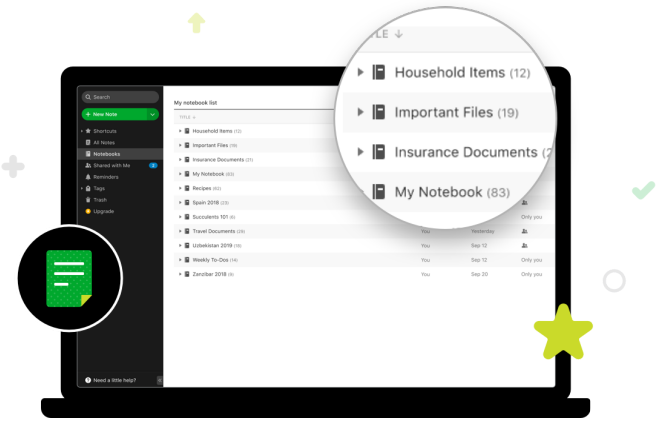


Image from: https://evernote.com

4.2 Trello

Trello is a Web application for the management and organization of work in a single or collaborative mode. From an operational point of view, Trello can be imagined as a clean whiteboard, where you can create lists of tasks and organize them most appropriately.

The key elements are only 3:

- Board: the whiteboard that represents the project
- List: depending on the nature of the board, they represent the macro-steps of a project (e.g. "To do", "In process", "Done"); ideas (e.g. "Ideas for a task", "Ideas for a classroom activity" and so on), or they can be related to the various students who are part of group work (e.g. in a board created to do collaborative research on a particular topic, the lists will be used to collect the tasks of the various people involved).
- Card: is the basic unit of the board and represents a single task or an idea.

Image from: http://trello.com

These elements can be used by a teacher to organize their training programs, involving students by assigning tasks to carry out a common program together.

4.3 Basecamp

Basecamp is a project management application available on the Internet and on mobile. It is used by millions of professionals around the world and is appreciated for its ease of use. Basecamp can be used on 6 boards:

- Campfire: an informal discussion space for brainstorming and extracting the best ideas. This vision works like a social network where employees can vote and comment on the best ideas. This space allows you to share documents, links and requests
- Message Board is a space for official announcements such as a product launch, the start of a new project and the proposal of a great new idea.
- To-dos: To-do list is a manager of shared tasks that are related to people and a milestone (date).
- Schedule is an agenda presented in a "planning" format from the most immediate to the most distant events (meetings, interviews, deliverables, etc.).

- Check-ins is a smart tool that lists all the good ideas appreciated by the team. It is then a matter of making a selection to materialize them into a project.
- Finally, the last space is dedicated to sharing documents within the project team: images, spreadsheets, text documents, etc.

Image from: https://basecamp.com/

5. Web 2.0 Tools to create educational resources

Web 2.0 has led to the emergence of so-called web applications in contrast to traditional desktop applications. A web application is a software that works according to the client-server paradigm. The application program is stored on a remote server, which may be accessed by a client on the other side of the world.

Compared to desktop applications, web applications provide many advantages. Web applications do not need to be installed on the computer, but can be accessed from any location through the use of a browser and an Internet connection. You can share files with multiple users and work collaboratively on the same project without the need to exchange documents and maintain versions. There is no need to install and update a web application, and it generally requires fewer hardware resources.

For these reasons web applications for content creation are excellent tools available to teachers and students who often have to work with old and outdated computers at school.

Thanks to these tools, students and teachers can create educational content and learning material of different types through use of images, movies, text, links and sounds.

Some systems for the creation of digital content for teaching are analyzed below.

5.1 Genial.ly

Genial.ly (http://www.genial.ly) is a free online platform that allows, after a quick registration, the creation of interactive presentations and infographics with personalized content that can be used in learning and teaching processes. Genial.ly is a tool that allows the creation of different types of resources from scratch or starting from existing resources (infographics, postcards, posters, presentations) searchable through a search engine within the Genial.ly site and navigable through different filters (Media - Corporate - Education - Others).

This platform is ideal for all levels of education (primary, secondary and higher) and e-learning. The characteristic of genial.ly is the possibility to insert links, texts, and images to every single slide that transform a presentation into an interactive experience. In this way, those who read and study through the presentation will be able to enjoy the content in an autonomous and in-depth way.

The program is based on drag and drops functionality. To create the presentation you have to choose the elements and with the cursor drag them to the page you are working on. As you proceed with the creation of the slides, Genial.ly automatically saves the progress. It is also possible to share the presentation on social networks or via email: a useful function both for distance learning and for integrated digital teaching.

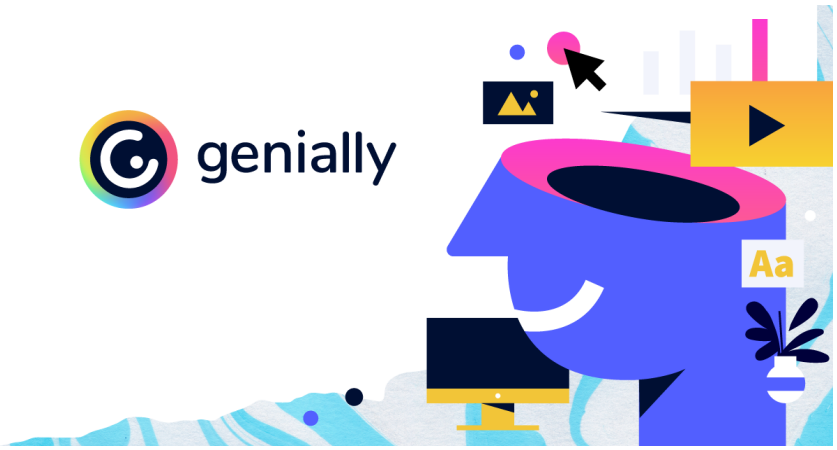


Image from: https://flipnet.it/vuoi-sperimentare-genially-ti-conviene-diventare-socio-flipnet/

5.2 Prezi

Prezi (www.prezi.com) is a free online platform (users who use the product for free must publish their work on Prezi.com) based on the use of the cloud. It is an innovative tool that allows users to create dynamic, effective, and highly engaging online presentations. Thanks to its original virtual canvas (user interface) it allows users to edit, rotate or insert objects. It is also possible to share the development of a presentation with collaborators who can edit and make changes. With this software, you can capture images and text, link them together, and quickly and thoroughly explain how these ideas were connected. In addition, you can implement a number of ideas with a strong scenic impact that will strike a chord with prospective learners and keep their attention. A series of appropriate photos can make the

concluding presentation even more complete and up-to-date. Besides, its cloud functionality lets you keep Prezi under control from your PC browser and from the various latest generation mobile devices, including smartphones and tablets. The work can be carried out and modified constantly in any type of context.

Image from: https://prezi.com

5.3 Mentimeter

Mentimerter (http://www.mentimeter.com) is a freemium interactive presentation tool that allows the presenter to capture the attention and participation of the audience in real-time. It allows the users of the presentation to ask their opinion in real-time through the use of their mobile devices. With Mentimeter it is possible to create questions and surveys, submit them to an audience, and view the answers in real-time. It can be used to gauge the opinions of the audience while giving a presentation, to carry out quick polls in a classroom to make decisions, to check in real-time the level of understanding achieved after a lesson, or, again, to gauge the students' opinions on a topic while it is being discussed. The presenter can choose whether to show respondents' answers in real-time and/or anonymously. Users can create surveys and question batteries based on the different options provided by Mentimeter (open-ended, multiple-choice, word clouds).

The access data to the survey can be provided through a code that is automatically generated and that students can enter by connecting to the web site.

Image from: https://www.g2.com

5.4 H5P

Daily, students play with their media devices, consoles, and smart devices that offer a wide range of highly interactive activities with engaging graphics. Students are comfortable with apps that allow them to tap, drag, and respond to stimuli displayed on the screen. Therefore, teaching resources need to follow this trend and be developed interactively and engagingly that keeps students' attention.

Although it is easy for a computer developer to create this kind of content, usually a teacher does not have the right skills for this kind of activity. Interactive content creation tools are developed to allow everyone, even those without computer skills, to create quality and engaging interactive content. One of the most widely used tools for interactive content production is H5P (www.h5p.org).

H5P is a web tool that allows everyone to create rich, interactive web experiences more efficiently. H5P enables existing CMSs and LMSs to create richer content and tools for teaching and assessment. H5P takes advantage of all those resources on the web that can potentially be used as educational material (clips, audio, images, web pages...). The advantage of this tool is to organize all these resources making them interactive.

With this plugin you will be able to produce "talking" presentations, exercises within a video. It currently supports sites or learning platforms based on Drupal, Moodle and WordPress.

Once you produce the interactive content you can publish it in your WordPress, Moodle or Drupal site, or you can create content directly on H5P and embed it in your website.

Image from: https://alessandroiannella.com/progettazione-didattica/moodle-e-h5p/

6. Web 2.0 Tools for school staff communication

In the school community, communication can be defined as a process of sharing information through the use of a set of commonly accepted rules. These rules may vary depending on circumstances: for example, the flow of information may be interrupted by situational pressures, differences in the perspectives of different teachers may interfere with the nature of shared meanings, and the rules themselves may be changed by inappropriate responses. Establishing good communication among the various figures involved in the school setting can:

- increase awareness about problems and instructional solutions;

- Enhance individual or group supportive behaviors;
- Highlight the skills of each individual;
- Implement cooperation;
- reinforce positive behaviors and attitudes.

Web 2.0 tools and social networking technologies can be used to support teaching and learning in the classroom. Currently, there is a lot of excitement about Web 2.0 in education, but we still know very little about how these tools can be used by teachers to create a community of practice among teachers both from the same school and from different schools that belong to a common network. Collaboration is therefore an essential element and teachers need to communicate with colleagues and administrators.

In general, all video conferencing systems can be used, as they are useful tools to continue teaching even from home, allowing the possibility to talk and see each other through the screen. The apps for video conferencing that can be used at school must have certain characteristics

- ensure high standards of security
- Ensure lesson moderation
- Allow for the exchange of information
- Allow for scheduling of meetings
- respect the privacy of participants

Some of the most used videoconferencing platforms are 4 detailed below.

6.1 Hangouts Meet

A great first platform for distance learning is the one offered by Google, namely G-Suite For Education. The Hangouts Meet and Classroom components allow video conference participation for up to 250 people. The Classroom application, in particular, allows you to create virtual classes, distribute assignments and tests, and give and receive feedback on a single platform.

Like all of Google's platform tools, Classroom meets high security standards. In fact, all of G-Suite for Education's core services are COPPA (Child's Online Privacy Protection Act) and FERPA (Family Educational Rights and Privacy Acts) compliant.

Many users have, however, complained about some problems such as, at times, the difficulty of access. However, Google is working hard to offer quick support and immediate troubleshooting.

The limitations of the Hangouts Meet video conferencing app lies in the lack of tools for class participation and moderation.

6.2 WeSchool

Another of the most popular platforms used by students these days is WeSchool, which can be used from both apps and computers. It is a digital classroom platform that allows teachers and students to use a virtual classroom for live video conferencing lessons and a chat facility.Once the teacher creates his or her Class Group, he or she and his or her students will be able to take advantage of various tools, such as .A bulletin board for notices and communications and a folder (Board) where the teacher can upload content.

Also available is a test area dedicated to verifications and an electronic register.

Regarding the security of this platform, WeSchool only uses secure data and protects underage students, thanks to an authorization from the parent or legal guardian before its use.

However, the Online Lesson mode has some issues, such as the fact that there is no real control of the video call entrusted only to the professor, or other problems with access to the platform itself.

6.3 Zoom

Zoom is a remote conferencing service in which you can create a virtual classroom in which the teacher shares his screen. Very useful is the "Raise your hand" feature, to ask questions just like in the classroom.

The free version allows the participation of up to 100 users, while some paid variants go up to 300-500 participants.

This platform has encountered some security issues. For example, it is possible that some users from outside the video conference may interfere and disturb the other participants, often sharing various types of content or hate speech.

Also, many video calls recorded on Zoom have been published on the web without the consent of the users involved.

The software house has tried to solve the various security and privacy issues with some updates, such as hiding the meeting ID from the title bar. But it is still involved in serious account theft incidents.

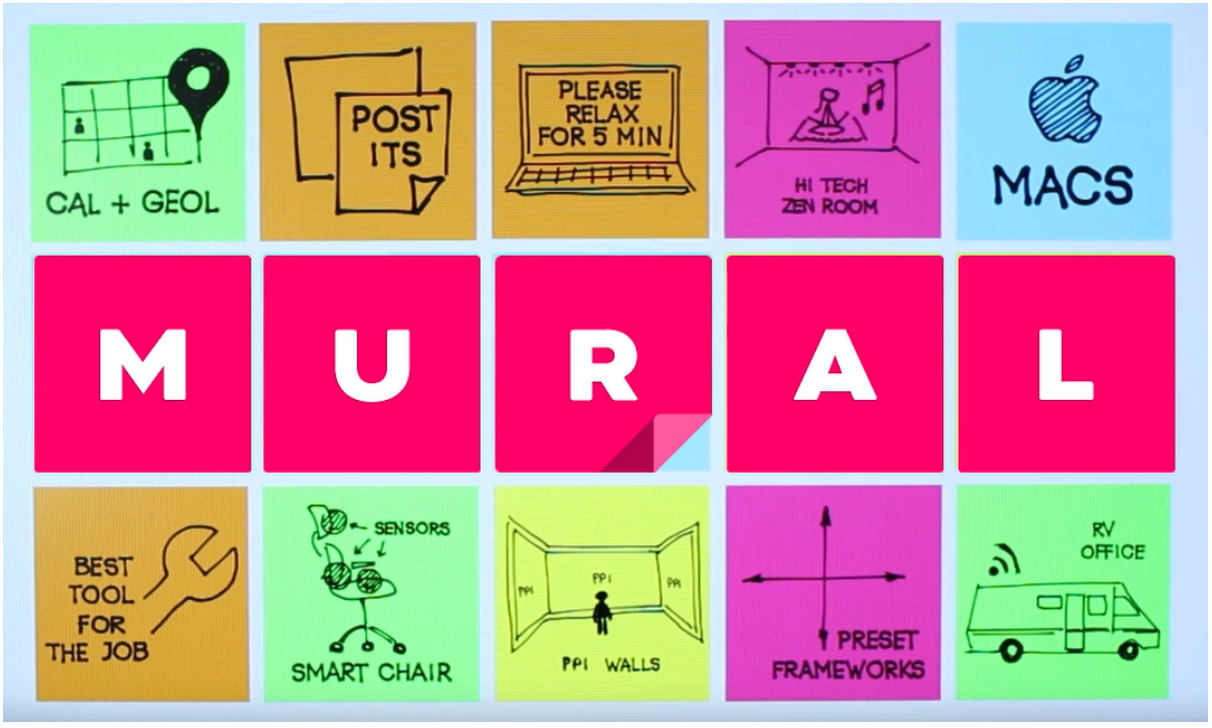
7. Web 2.0 Tools to support student collaborative activities

The ability to collaborate has now become an indispensable skill in the digital world where both work and study are becoming increasingly interdisciplinary. It is therefore essential to prepare students to perform tasks collaboratively both while in school and while at home. Several Web 2.0 tools can be used to support collaborative learning. Today there is a very large literature that includes research articles that highlight how Web 2.0 tools, such as wikis and blogs, can contribute to online social interaction and collaborative learning teachers increasingly understand how the use of such tools and can facilitate the processes of knowledge and as well as communication, which are essential elements in an educational context.

Web 2.0 tools can be used in the context of education because they can help both engage students in their learning and provide social interaction with their peers during the learning process. Sharing a goal by building a community of practice allows you to work on understanding complex problems, discover relationships, and develop a deep understanding of content. Web 2.0 tools include Weblogs, Wikis, Google Docs, Moodle, and social networks. These tools offer countless possibilities for collaborative learning and can support teachers and students in their learning processes. We present 3 Web 2.0 Tools to support collaborative activities: MURAL, Breakout EDU and Drawp for School.

7.1 MURAL

MURAL is a tool for amplifying the possibilities of collaborative activities through a variety of ready-to-use templates, useful for many meeting types and goals to pursue. MURAL design is aesthetically pleasing and the templates are utterly simple and intuitive (e.g. sticky notes and diagrams). MURAL is a very successful resource since users are typically more willing to collaborate when the tools they have to use are user-friendly and effective. There are other instruments that may be used for a collaboration, such as voting for a certain idea or celebrating a success: MURAL features all of them and more. Finally, the site provides on-demand learning courses to improve teamwork.



Mural Image from: https://www.smartworkers.cloud/mural-a-digital-workspace-for-visual-collaboration/

7.2 Breakout EDU

Breakout EDU is a Web 2.0 tool consisting of a series of immersive learning games, specifically a combination of physical and digital puzzles that have to be solved in a limited time. The tool offers a platform in which teachers may organise a

collaborative game with their students, who will have to solve the said puzzles. Through collaborative effort, students will be able to apply what they understand, use critical thinking and problem-solving. Breakout EDU has over 350 free games for educators and offers School-Wide Subscription options so that all educators may maximize the possibilities offered by the application.

Breakout EDU Image from: https://resources.breakoutedu.com/

7.3 Drawp for School

Drawp for School is a Web 2.0 tool that allows educators to easily reach students and to support them at any moment regardless of their knowledge level. The aim of the platform is to provide a tool for exploiting creativity and developing collaboration skills. Students can attach to their homeworks voice recordings, pictures and drawing, giving a well-rounded feedback for the teacher to analyse and having fun while doing so. The platform offers the possibility to set up the educator/student's account and to create assignments to share. Other than students, teachers may share many types of media (images, drawings etc.) so that the communication is effective in both ways.

Drawp for School EDU Image from: https://blog.drawpforschool.com/

8. Web 2.0 Tools for student evaluation

Tools for assessing learning levels are essential elements in obtaining quick and accurate feedback from students or participants in a training course. With these systems, teachers or presenters can have an immediate report on "learner" progress. Web 2.0 applications add new interactive elements to traditional assessment tools. For example, during a presentation, a presenter can ask a question that each participant can answer in a few seconds, either simultaneously or individually. It is possible to do "yes/no questions" or open-ended questions where you can put together participant's

comments and suggestions in 2-3 words. In this way it is possible to do short "brainstorming" sessions and show them to each participant or ask for the opinion of the "audience" who can express their agreement or disagreement.

It is very beneficial to use these tools when you are speaking in front of a large audience, such as a group of 2-3 classes of students, and you want the students to continue to interact. This is possible because these "tools" guarantee anonymity and encourage interaction even among those who, due to shyness, are not normally willing to interact and share their point of view.

In schools, it is possible to conduct surveys quickly without having to come up with a result through extensive discussions. Brainstorming, for example, the collection of ideas from students or previous activities to prepare new topics, is also easier when stimulated with these tools.

Each LMS platform has its tools for assessing students and the progress they make in their learning path. Some of the platforms to consider are:

- Moodle
- Edmodo
- Weschool
- Docebo

9. Web 2.0 Serious Game

Game-based learning (GBL) is an approach through which different scenarios of specific problems can be organized in a game context. It specifically refers to the use of computer games with educational value or software applications that leverage games to enhance learning in various domains. Through this approach, students can enhance knowledge and improve thinking skills because they face immersive and realistic problem-solving scenarios in an engaging and not frustrating environment. Within this framework, web-based Serious Games (SG) are promoted as an excellent tool to support formal and non-formal learning because they are often simulations that are closer to real-life experiences. SGs are used to enhance learning at different ages and in different branches of knowledge (ranging from entrepreneurship to computer coding, for example), to engage players in activities and tasks aimed at improving knowledge and thinking skills, and to repeatedly recall learning experiences in an engaging way. There are three main factors that may have contributed to the rapid growth of serious games in educational settings. The first factor is the emergence of a new paradigm in the field of teaching and learning. This new paradigm consists of three changes: 1) the formerly listening-based model of education is now based on interaction; 2) the pivotal point is no longer the teacher but the student; 3) learning is no longer based on memory but on being able to find and use useful information. The second factor is the development of new technologies that offer the opportunity to actively involve students in problem solving. The third factor is the tremendous ability of serious video games to capture students' attention and engage them in curricular content.

Several research and review studies have been conducted to investigate the effectiveness and positive effects of GBL on improving players' knowledge. However, no agreement has been reached on either the existence of such benefits or, if so, what it would affect (cognitive skills, content knowledge, or player behavior). By the way the pedagogy of the last century has extensively debated the role of play within the learning process of the child, because the game is the natural way to learn from birth, starting from social rules in a controlled situation, and if properly guided by an adult, can serenely stretch to the zone of proximal development (ZPD) to discover new horizons.

9.1 Kidseconomics

Kidseconomics is a Web 2.0 Serious Game developed by the National Council of Research (CNR) with the aim of spreading the basic concepts of economics for primary and secondary school. Among the many activities that are offered, the project also provides a web tool for playing a series of games, for example economics-related crossword puzzles.

Kidseconomics can be used both remotely or in presence, through a digital animator (the teacher) that will organise the room and a number of challenges regarding economics. The students will be divided into teams and will play four different games (Crossword puzzle, Taboo, Quiz and What, Where, Why?). Their aim is to compete and climb the leaderboard (which is accessible from the home page of the virtual room) and to become Economy Master. The students are motivated to take on the challenge since the games are very simple but entertaining and the graphics are captivating.

Kidseconomics Presentation Image

9.2 Scratch

Scratch is a Web 2.0 visual programming language Serious Game that allows students to create interactive stories, animations, and games. In the process, they learn to think creatively, reason systematically, and work collaboratively - essential skills for anyone in today's society. Several educators are integrating Scratch into the study of many subjects and with students of different ages. Its intuitive user interface is designed specifically for the 8 - 16 age group, but is used by people of all ages.

Children have always been fascinated by games with Lego bricks, with which, using their creativity, they were able to build 3D physical objects, even of great complexity. Scratch can be considered the evolution of this activity. Scratch is a graphical block programming language, designed for learning and teaching coding in primary school but usable at any age.

The operating principle of scratch is very simple. Scratch provides colored bricks, each of which contains a very simple script that allows you to perform an elementary action: move forward, backward, rotate to the right, play a sound, etc. These colored bricks can be dragged onto the main screen (stage) and fitted together in a logical order to create a flow of instructions.

These colorful bricks can be dragged onto the main screen (stage) and interlocked in a logical order to create a flow of instructions. The instructions thus assembled will be used to guide characters and objects (sprites), to make them move and act, thus making it possible to create interactive stories, videogames, musical stories, and much more!

Scratch is completely free and was created by the developers of Lifelong Kindergarten at the MIT Media Lab.

Image from: https://www.digitaleducationlab.it/blog/scratch-dal-gioco-al-coding/

9.3 AdaptedMind

AdaptedMind (https://www.adaptedmind.com/) is a serious game for teaching Maths, Science, and Reading designed for primary and secondary school students. The game is designed to keep students' engagement high and in fact

integrates a number of social mechanics such as the use of badges, leaderboards, and the possibility to customize one's characters with graphic add-ons. The main characteristic of the game is the light and attractive graphic interface that offers engaging gameplay. The game can be used in its free version for one month and provides maths lessons using carefully designed video explanations for the student. The continuous positive and negative feedback from the game is a valuable reinforcement for learning the subject. The maths course includes more than 300,000 maths problems in different levels with video explanations and, in case of errors, videos detailing how to solve the problem. Teachers are provided with a dashboard where they can follow the progress of individual students, analyze their learning results, and, thanks to the possibility of creating and managing groups/classes, analyze the results of the whole group.

Image From: https://ana-aqra.org

10.Web 2.0 Tools for gamification

The game-based learning focuses on learning through the use of games or video games with the purpose of achieving an educational objective. Gamification is the application of gaming mechanics in outer contexts with the objective of involving students into learning by leveraging on the engagement. This purpose is often achieved by adopting game mechanics such as challenges, rewards and high scores. Gamification tools are a very useful resource for an interactive and fun way of learning. Since they are games, it is understandable that the students tend to be more responsive towards them with respect to traditional classes. Learning through playing does not feel like studying, but the information is shared and received as well, also thanks to the positive attitude and will of playing. The tools that we will list here as an example are Quizlet (www.quizlet.com), Kahoot (www.kahoot.com) and Quizizz (www.quizizz.com).

10.1 Quizlet

Quizlet is a useful tool for creating simple learning gizmos, especially for the enrichment of vocabulary. Students may for example solve exercises and repeat the terms they need to learn. This is a stimulating approach for kids and young

adults, since its high game-based approach and the diversity of possible techniques for learning. Keeping this in mind, the level of concentration is kept high and the learning process is developed. They work using an online interactive tool that is accessible from everywhere and at any time. There is no time limit, so that the totality of the words that the student needs to learn is analysed. Students may share their vocabulary set with their classmates, so that a cooperative study may be conducted. Quizlet is available both as a mobile phone application and a web application.

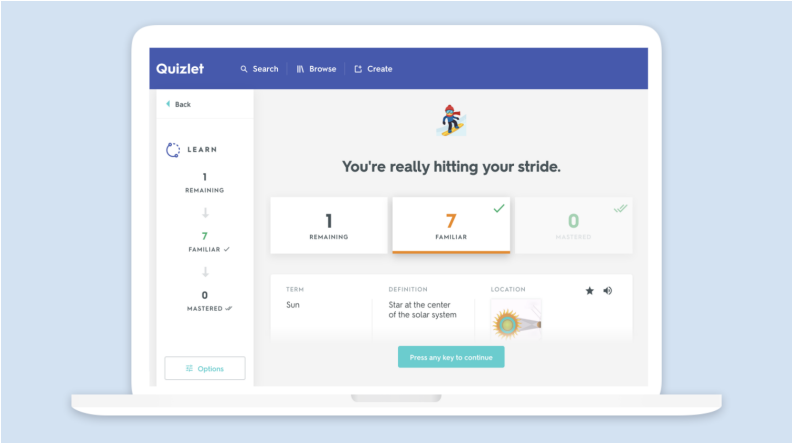


Image From: https://techcrunch.com:/quizlet-valued-at-1-billion-as-it-raises-millions-during-a-global-pandemic

10.2 Kahoot

Kahoot is a game-based learning platform, widely used as an educational tool in schools and other educational institutions. With Kahoot you can create a quiz game in which the set of questions and the topic may vary in a custom fashion. It is a very powerful tool for teachers, since it is possible to test the students in a fun way. Teachers may perform small learning quizzes so that the new content is best settled. During the game it is possible to share a video and to test the students about the comprehension of what they saw.

Kahoot is available both as a mobile phone application and a web application.

Image From: http://kahoot.com

10.3 Quizizz

Quizizz is a free Web 2.0 tool designed for creating quizzes multiplayer in real-time modes.

The multiplayer feature of the environment activates the competitive dynamics of students who will have to answer questions faster and more correctly than their peers in order to excel.

Through this environment, it is possible to activate different educational methodologies such as peer education by proposing to the students themselves to create quizzes to be administered to their classmates in order to rework the knowledge of the students and fix the concepts studied in a creative way.

The questions can be composed with multimedia resources such as images and text that can be uploaded from your own PC or from the Internet. Once the questions have been entered and the quiz completed, the timings can be defined by setting response times. Finally, it is possible to activate the quiz by obtaining a unique code for it, which can be sent to all those who take part in the game. The teacher can use a computer connected to a projector to view the players' live rankings, creating a positive climate of challenge in the classroom. Finally, thanks to a dashboard, the results of the class can be analyzed and the percentages of correct and incorrect answers can be displayed, both by student and by question.

Image From: http://quizizz.com

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Virtual Reality for Augmenting Creativity and Effectiveness of training

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Intellectual Output 2 – Course 3

Using Social Networks for School Education

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Course 3 – Using Social Networks for School Education

Overview on using social networks in education

There's no denying that, ever since social networks and social media made way into our lives, everything is different. Beginning with the way we socialize, interact, plan for parties or even how often we go out. We won't go into a debate regarding the ethical aspects of the way social media is influencing our lives. Instead, we propose to focus on the numerous ways in which social media is changing the way the education system works. So, stay tuned to find out what effects does social networking have on the way our children are educated both at school and outside of it.

Starting from elementary school up until university graduation, social media has the role to empower parents, students and teachers to use new ways of sharing information and build a community. Statistics show that 96% of the students that have internet access are using at least one social network. What's even more extraordinary is that, even though some of the students use the social networks for entertaining and other purposes, there are a lot of them that actually use it to promote a lot of positive and useful activities. From finding a summer internship, promoting a success story about how to win the student-loan battle or collaborate on international projects, everything is made possible.

When it comes to social media, schools tend to adopt different positions. It is a general consensus that they're useful when it comes to sharing information or organizing the school tasks. And at the same time, the social networking is blamed for the lack of attention in students during classes.

But an increasing trend of adopting social media in school is starting to show. And since students already devote a lot of time for social media and connecting with others outside school hours, why not do it during school time as well?

Challenges and opportunities of social networks in education

It's a matter of practicability, really, because it makes perfect sense to use the online universe to communicate with your students since they're already there most of the time. There is no need for another case study about the usage of social media in schools. You simply need to walk through the

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hallways of any school or colleague to see kids of all ages totally immersed in their smartphones. Browsing their news feed, sharing photos on Instagram or sending Snapchat messages has become a part of their daily routine.

Of course, the examples of teachers already implementing social media in classes are far more numerous that we can know of, however, there are a few that did such a great job that their students almost made them viral. For example, a biology teacher from Bergen County proposed a challenge to his students. They had to debate over the subject of meiosis on Twitter by using a specific hashtag. This is a great opportunity for students to have fun and learn at the same time. As you need to know your meiosis in order to compress it into 140 characters. No matter how strong the resistance, technological progress and new trends will eventually become a standard. Of course, this applies to developed countries that already have a well-structured traditional educational system. It is a totally different situation when it comes to developing countries that are still struggling to find their way.

The benefits of social media in the education process does not have to stop at the teacher-student relationship. There are a lot of other benefits that can be extracted from the use of social networking at higher levels as well. For example, principals or administrators can find a new way to integrate social media. Like sharing school news via social networks, holding online meeting with the parents or even starting fundraising for different projects.

And social media can quickly become the only channel of communication, since we are living fast-paced lives, and parents are usually busy with work and cannot attend school meetings. But this does not mean they should not be in touch with events or be able to check on their kids every once in a while. Just like in every other field, communication is vital and if it can be done easily with the help of social media, why not go for it?

“The best teachers I’ve ever had have used technology to enhance the learning process, including Facebook pages and events for upcoming projects” – Katie Benmar, Freshman. As the above statement emphasizes, students also react very positively when a teacher is willing to use their methods and adapt them as part of the educational process. And it makes perfect sense since a homework has a certain strictness about it, but an online chat discussing a certain book gives students the ability to open up and share their opinions.

Facebook in education

Facebook is seen as a vital tool for teaching and learning in the 21st century and for making education more social. It is an essential 'toolbox for educators' in schools, colleges, universities and other learning settings to open up, inspire and catalyse young people's learning. From transforming the teaching of subjects across the curriculum within the classroom, to the huge potential for using Facebook for non-formal and out of school hours learning in breakfast clubs, lunchtime, after school, weekend and holiday activities; from young people 'liking' each other's work on a Facebook Page or Group, to young people making, creating and curating their own content and learning; to the ways in which social networks can be harnessed to engage young people in informal learning in youth and community settings. Facebook can be used in three types of learning applications.

Formal learning

- Creating a Timeline or Facebook Group to support the teaching of any curriculum subject.
- Creating a space and platform for homework and revision resources.
- Running debates on topical issues and hot issues in the media.
- Peer tutoring and support.
- A research tool to post, share ideas, videos and resources.
- Creating Groups in schools to make life easier for teachers and staff.

Informal learning

- Organizing a sports team or after school club.
- Pastoral care - making new pupils feel at home at school or college.
- Creating and designing digital making activities including App creation.
- Organizing TeachMeets
- Informal support from friends (likes) for projects and other activities
- Uploading social and video podcasts to students/peers
- Creating private Groups for teachers across a faculty or federation of schools/ colleges /universities.

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Wider applications

- A communication tool and ‘broadcast account’ with parents, carers and the community.
- Enabling language students to converse with exchange partners overseas.
- Engaging hard to reach learners in school/college and through online learning.
- Providing inspiration in life skills and enrichment subjects.
- Teaching digital skills for young people and adults.
- Engaging young people in youth and community settings.
- Enabling students to socialize and make friends.

Youtube in education

While YouTube is better known for Taylor Swift and video game commentary than higher education, the video hosting platform has gone from a potential classroom distraction to a multifaceted learning tool.

To date, YouTube has more than one billion users in 91 countries—that is almost one-third of the population with Internet access. Of all the videos watched in a single day around the world, one billion of those are learning-related videos. That includes edutainment (often hosted by subject-matter experts), how-to or curriculum-based videos (often hosted by educators or experts) and skills-based learning videos for teachers.

But is YouTube truly useful as an educational tool, or is it better suited for watching teens play Fortnite? Antonio and David Tuffley write: “As the 21st century unfolds, we are seeing a shift from the campus-based model of education that has endured for a thousand years to an open, anywhere, anytime model. On-demand video is a disruptive technology that is providing a flexible new way of delivering education that will require some adaptive thinking from higher education providers if they are to survive this period of change.”

Here are a few ways YouTube can be incorporated into your classroom.

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Free lecture content

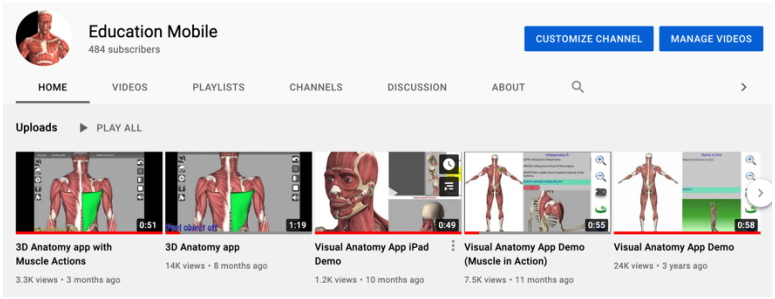
There are literally thousands of educational videos that can supplement course material—and, best of all, they are free. For example, TED Talks offers more than 3,000 lectures from experts in their field, while non-profits, educational organizations and large broadcasters, such as the BBC's Open University offer their own YouTube channels with quality content. Tip: Do not use video to replace a lecture, but rather to complement it.

If you create an account, you can curate playlists, bringing together diverse voices on a particular subject. You can show videos in class (as an intro to a new topic, for active learning or for a research project) or assign videos to be viewed outside of class. You can also recommend students subscribe to relevant subject-related playlists for supplemental learning.

Start your own channel

Setting up a channel for your school on Youtube is insanely easy. Simply go to the www.youtube.com/create channel and a series of prompts will walk you through the process.

An example of YouTube channel is shown below.



Create your own videos

Once you have your channel set up, you are ready to start making videos, which may sound easier said than done. After all, you are not a film maker. Maybe you struggle with a selfie, let alone filming a decent-looking video. Don't worry. It is not as hard as you think. In fact, many teachers, administrators, and students find that making the video is actually a lot of fun.

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You want to establish some standards for production quality, but at the same time, you do not want to discourage contributions. Here are a few tips to get you started on YouTube video production. Most smartphones are capable of producing good videos. You do not need an expensive camera system to shoot your own videos. Smartphones have advanced to the point that they are fully capable of capturing high-quality videos. It is more important that you shoot a wide frame in landscape mode and that you get plenty of lighting. If you do those two things, you will be off to a good start. While cell phones may capture quality video, the same cannot always be said for sound. You may be surprised, when you start shooting, to see that the sound just did not come through the way you would have hoped. Always make sure you are close enough to the action to get good sound. You may find that you need an additional microphone. A quick search online should yield plenty of quality microphones that you can simply plug in to your smartphone.

YouTube wants people watching videos, which means they want your videos to be high quality. To help you with that, they have created YouTube editor, a powerful tool for giving your videos the kind of presentation that you used to only be able to get from a professional. You can add cuts, transitions, music, captions, and much, much more. Best of all….it is free! The editor is available to access when you upload your video.

Instagram in education

When Instagram was launched nearly ten years ago, it was simply a social media network for sharing pictures with friends (with some fun filters to make you feel like a professional photographer). Since then, the popular social media platform has evolved into a major player in schools' social media strategies for reaching both Millennial parents and Gen Z students alike. Since 2012, major changes have transformed Instagram from a simple, photo-sharing platform into a marketing and advertising powerhouse, the network still operating on the importance of sharing high-quality images and videos to engage followers — a strategy that is essential for schools today.

The Instagram Explore page is a great marketing and communication tool and it contains a collection of public photos, videos, Reels and Stories tailored to help each individual Instagram user discover posts, accounts, hashtags or products they might like. **Stories**: These ephemeral posts allow you to share real-time posts that stay live for 24 hours. Stories can be found in the Explore

page, which can help you engage with audiences who do not already follow you. **Highlights**: If you captured some great moments in your Stories and wish they could live on your school's Instagram profile for a longer period of time, you will want to try Highlights. This feature allows you to group stories together under a category, and they are featured just above your Instagram grid. **Reels**: As Instagram's newest addition, Reels are making a splash as an effective way to engage with your audience. These less than 15-second videos, often set to music or following a theme, are given a lot of precedence by Instagram as it attempts to compete with TikTok. Reels can be organically found on the Explore page, or through its dedicated space in the Instagram app. If your school has created Reels, the Reels button will automatically be added to the top of your school's Instagram feed.

Hashtags are used to categorize and organize content. Many schools have incorporated branded hashtags into their marketing and event strategies to encourage conversation and expand reach. Hashtags on Instagram play a significant role in reaching new audiences, growing your following, and engaging with your school community.

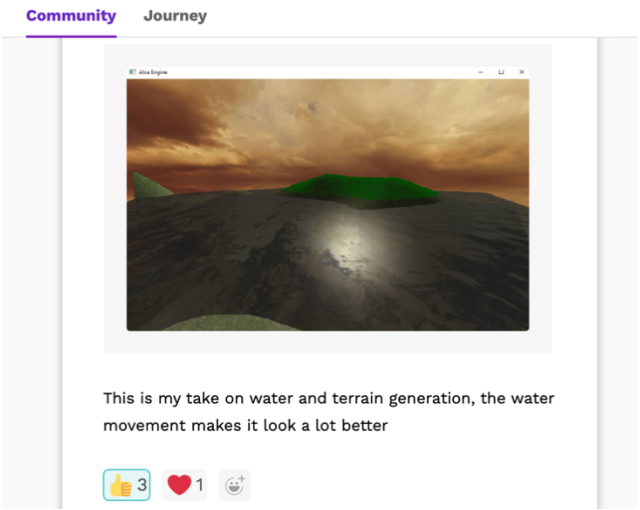
Social platforms of learning management systems: Moodle and Aula

Moodle is an example of learning management system that involves online learning for more than 10 years now. Slowly but steady, such systems will lead to the actual implementation of social media within classrooms. And the best tool available for teachers is social media itself. Only by being open-minded and using the technology themselves will they be able to really reach out to students. Recently, the Moodle Socialwall has been developed, and it has transformed the Moodle course into a social learning platform. This includes a familiar post interface, timeline of posts, filtering of the timeline, and integration with Moodle's activities and resources. A social learning format allows teachers to pick up the tool and begin using it right away.

On the other hand, Aula is a recently-developed online learning system. It was used as a core tool in teaching and learning ecosystem and a key part of digitally-enhanced teaching in a university. As a "Learning Experience Platform", Aula offers educators and learners the opportunity to approach their modules in the more social and conversational way. Using the Feed, students can communicate with one another, answer questions, share their work and get help from their educators and their peers.

In the Materials section, educators can structure all the learning materials required for their module in an accessible way.

For example, in the community section, students can share their works with other students and educators can leave comments.



MS Teams as a teaching tool and social platform

Microsoft Teams for Education offers specific team types that can be created for use in a school scenario. This Class team type offers classroom tools such as Assignments, a OneNote classroom notebook, a class materials folder for read-only content, and the ability to mute students.

Teachers can set up their own classes manually and add students, with invite codes, at any time. Once created, it is possible for the team owner (the teacher in most cases) to customize the setup. This includes the ability to add a team picture, create a channel for class subjects or group collaboration areas, and add apps such as Kahoot!, Flipgrid, and Quizlet. The team can then be mentioned as the first post so everyone is notified, allowing the conversation to start.

To start a virtual class you need to begin a "meeting," which allows you and your students to see and hear one another, similar to being in the classroom together. The background blur function is a useful feature that enables you to hide your surroundings and maintain your privacy easily.

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When it comes to compatible devices, there are a whole host that work with Microsoft Teams. Of course, the most obvious and most widely compatible are going to be Microsoft devices. So, things such as the Microsoft Surface tablet or two-in-one laptop device is a great option, as it uses touchscreen and runs the Windows OS. Any relatively up-to-date Windows machine can run Teams well and most desktop school machines and laptops will do the job. Since Teams is an online-based platform, with app access, it can also be used on iOS and Android phones and tablets. It will even work on Linux machines.

Other social networks for education

Twitter

Twitter, a popular microblogging social networking site, allows individuals to communicate by sending short messages of up to 140 characters. Twitter has been deemed a supportive tool within the classroom and has a strong potential as a technology-enabled learning instrument. The majority of the reviewed studies point out that implementing Twitter improved not only students learning, motivation, engagement, and communication but teaching as well, all of which leads towards creating a more resourceful classroom environment.

Twitter has been used for homework and assignments. Both teachers and students can easily and quickly tweet details of homework and assignments using Twitter in education. You can also include links to important online sources/pages, and don't forget to mention the due dates in your tweet. Students also use Twitter as a collaborative tool. HashTags are used for regular news updates and for an interesting topic to debate in class.

TikTok

TikTok lesson plans are popular now as a way to help students engage in and beyond the classroom. For a history class, as an example, students can create 15-second video clips that succinctly summarize key points learned on a topic. This helps students to condense and simplify their thoughts, making the lesson easy to remember. But since these can be shared, it also means other students can learn from their videos. When going over a subject, before setting the task of

creating these videos, it can be helpful to play some other examples already created by students using TikTok.

Twitch

Twitch is a live streaming platform that was originally designed for gamers to share their gaming experiences. Although, several educators have already tried to put their online lesions through Twitch, there are several drawbacks on current version of Twitch. In contrast to tools such as Zoom or MS Teams, students cannot participate in the discussion through a voice channel on Twitch. The nature of Twitch is less "serious" compared to traditional lecturing platforms. Also, distractions such as raids, commercials, and bots add to this problem.

Pinterest

Teachers can also use Pinterest as a place to post additional resources for their classes. They can create several boards and invite specific students or classes to the group. They can have focus groups for specific lectures. Teachers can use Pinterest to find new books to recommend to their students. Pinterest has dedicated hub – Pinterest for Teachers– designed specifically for educators to find and swap creative ideas.

Planning lessons with social media. Good practices

Students can learn how to use social media responsibly through teacher modeling and shared responsibility for posting. Class social media account is one solution that provides students with opportunities to practice digital citizenship in context, with a teacher's mentorship. There are several things to take into account to ensure that a class social media account is a positive learning space. First you have to decide on a platform. It might help to poll parents and guardians to see which platform(s) most of them already use, since they will be part of your audience. Next you need to decide on the purpose of the account with your class. What will you post, and how often? How will you manage the posting? Teacher can release responsibility to individual students or student committees. It is important to make parents a part of the conversation and respect their right to keep their children offline. When this happens, it is a wonderful learning opportunity for kids. You can have students participate without sharing their names or photos. You can also explore the many editing tools that blur or disguise photos, and help kids develop a culture of permission and respect for online privacy.

Case studies

MathInTheNews (Twitter)

Many students think about social media only as a place for entertainment, yet it can be a great tool for learning. @MathInTheNews, for example, posts math questions on Twitter that are based on current events. And using your class account to ask an author or a scientist a question shows students a way to use social media to satisfy their curiosity about things they are learning.

The Forest School (Facebook)

The Forest School, Knaresborough, used Facebook for a way of communicating quickly with existing parents and carers but also to engage with prospective parents and the local community. Of particular importance to the school was to restrict some of the information to a tailored audience. It was possible to set up a "closed group" on Facebook, which meant that followers had to be invited to join the group or make a request to the school for approval to be admitted. This gave the schools peace of mind that any targeted message they posted would only go to the intended recipients. It also enabled them to put photos of the children online without them being visible to a wider audience than the one they wanted.

Pinterest for Teachers https://www.pinterest.co.uk/teachers/

@MathInTheNews https://twitter.com/MathintheNews

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Intellectual Output II – Course 4

3D Virtual Worlds

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Co-funded by the Erasmus+ Programme of the European Union

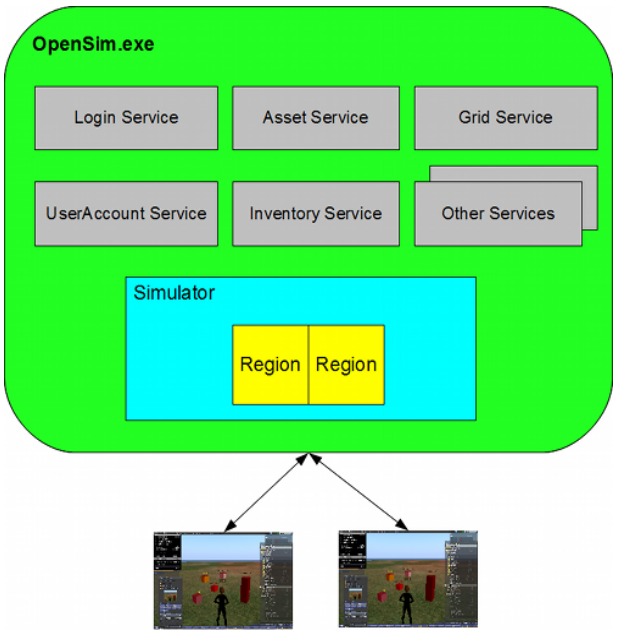
Course 4: 3D Virtual Worlds

1. Introduction

OpenSimulator is an open-source server platform for hosting virtual worlds. It allows anyone to create their own virtual worlds, hosted on their own machines. OpenSimulator can be used to simulate virtual environments similar to Second Life, which along with OpenSimulator have been widely used in Education. As a multi user 3D environment, it facilitates communication between users, allows easily building areas and content, allows using scripts in objects to achieve specific behavior and allows interactions with other users.

OpenSimulator Architecture

OpenSimulator is written in C# and is designed to be easily expanded through the use of plugin modules. OpenSimulator uses a Server-Client Architecture where users of the virtual world use viewers (clients) to access the virtual world regions (server). OpenSimulator can operate in one of two modes: stand alone or grid mode. In standalone mode, a single process handles the entire simulation. In grid mode, various aspects of the simulation are separated among multiple processes, which can exist on different machines.



The Image above shows OpenSimulator running in standalone mode. Both simulator and services run in the same process (OpenSim.exe).

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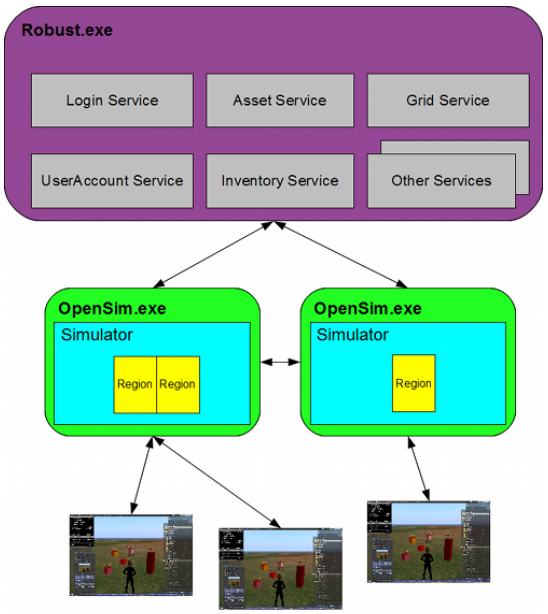

The image above shows OpenSimulator running in grid mode. In this case, all the services are being run within a Robust.exe process. Multiple copies of OpenSim.exe (usually running on different machines) all use the same set of common services.

Alternative Options to hosting a 3D World in your own machines

Unlike OpenSimulator, Second Life runs on private servers owned by the company Linden Lab. In order to own an area, there and create content you need to pay some subscription. Second Life has a big community of users so you may be able to attract others to visit your area. Alternatively, there are companies that run their own versions of OpenSimulator on their servers and allow users to create accounts and own some area with varied subscription options (e.g., Kitely).

Advantages: You don't need a server and particular networking / ICT knowledge. You don't spend time to configure the World. You can focus on creating content in your World. You become easily accessible from other users (If you want) and you may have access to a marketplace of available content to buy and use.

Disadvantages: You don't have the freedom to configure the World in great detail. You usually have to pay some monthly subscription to keep the area you have created. You rely on remote servers and good internet connection is required.

Advantages and disadvantages of running OpenSimulator in your own machine

OpenSimulator on the other hand is an open-source version of Second Life that anyone can download and run on their own computer / server. You are free to configure the platform as you prefer and have as many areas as you like. You can also connect your local world to grids of other Worlds to become easily accessible from them.

Advantages: You can configure in detail the parameters of the 3D World without restrictions. You can have as many areas as you like for free. You can use it in your local network so Internet Connection would not be required.

Disadvantages: You have to invest some time to install, configure and maintain the 3D World and some networking / IT skills are required. Your World will not be as easy to be discovered and visited by other users.

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2. OpenSimulator Installation

To use OpenSimulator you just Download OpenSim and extract it in a folder (no installation is required). You can find the latest version here: http://opensimulator.org/wiki/Main_Page

We present the steps for configuring and running OpenSim for the simpler 'Standalone' mode:

For Windows operating systems, run 'OpenSim.exe' in the 'bin' folder. For Linux you have to use 'mono' to run it.

```
sudo mono bin/OpenSim.exe
```

The first time you run it, it will guide you to configure some parameters (create a first region and a user and configure the system IP and port that clients will connect to).

```
We are now going to ask a couple of questions about your region.

You can press 'enter' without typing anything to use the default

the default is displayed between [ ] brackets.

=====================================

New region name []:
```

Initial Region of the World (you can create more later)

- **Region Name**: A name to identify the region / area
- **Region UUID**: A unique ID for the Region (just can just press enter and it will generate an ID for you).
- **Location Coordinates [X,Y]:** This set of values can adjust the location of the region in relation to other areas. For example, if region A is located at coordinates 1000, 1000 and you create a new region B at 1000, 1001, then region B will be located directly north of region A.
- **Internal IP address:** In most cases you can just press enter and use the default value.
- **Internal Port (default 9000):** The internal port used for communications. If you want others to be able to access your 3D World, you should configure your Firewall or Router to allow TCP and UDP traffic through this port. Each region of the 3D World needs to use a different Port.
- **External Host Name:**
  - If you want to only allow connections from machines on your local LAN network then you can use SYSTEMIP (default) or your machines LAN IP address (e.g., 192.168.0.1)
  - If you want anyone to be able to connect to your 3D World, you should use the machine's external IP Address or hostname (e.g., myworld.org)

You also create an 'Estate' in which the region will belong to and an owner:

- Name of Estate
- Owner (firstname, lastname, password) This will be an admin user/avatar with advanced permissions inside the 3D World!

The simulation should now be running and waiting for connections! You should have access to a console that displays the status of the simulation. You can now test the simulation by trying to connect to it using a 3D Viewer (e.g., Firestorm).

The following times you just run it whenever you want to start the 3D World simulation (in the production server you should probably set the application to run automatically when the system starts up).

As mentioned above, running the application gives you access to a console window that displays information about the status of the simulation and the communication between services. You can also use this console to run specific commands for various actions like creating and managing users and regions. You can learn more about these commands here:

http://opensimulator.org/wiki/Server_Commands.

You can configure various aspects of the simulation by editing some configuration files (you need to restart the simulation for these modifications to apply).

By default, OpenSim is configured to use SQLite for the database. Data are simply stored in files so no configuration is necessary. This is appropriate for a simple local installation. For better performance in the production server, it is advised to use MYSQL instead. You just need to create a database and change a configuration file to instruct OpenSim to use that database.

Finally, you can also check the Diva Distribution, a preconfigured hypergrided standalone version of OpenSimulator that has many modules already configured, including a web interface that allows users to create their own avatar accounts.

3. 3D Viewers, Inventory, File Types

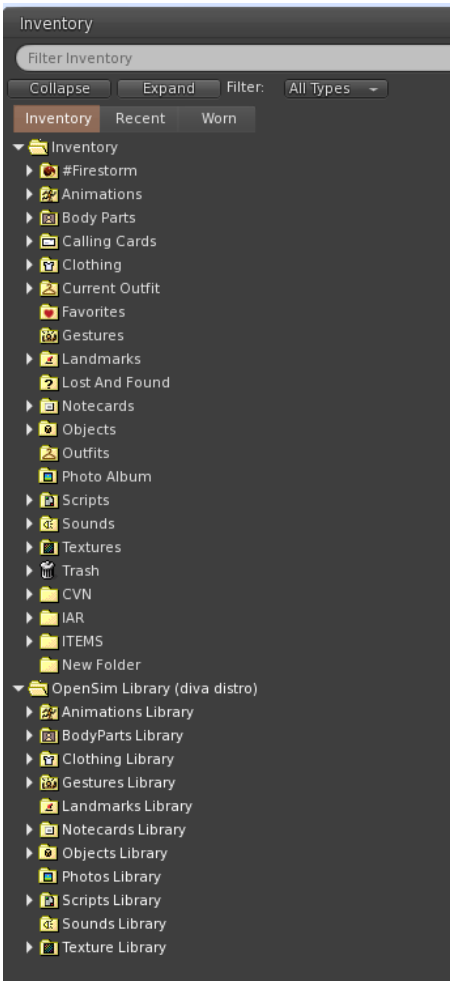
There are many types of software clients (called viewers) currently used worldwide to connect to 3D VR Environments (Second Life and OpenSimulator grids). The most commonly used option is Firestorm, on which we are going to focus for this course. Firestorm is available at: http://www.firestormviewer.org/downloads

Singularity viewer is a client for Second Life and OpenSimulator, developed as open-source and can also be used as an alternative to Firestorm Viewer software. The Singularity Viewer is available at: http://www.singularityviewer.org

For more compatible viewers check the article here: http://opensimulator.org/wiki/Compatible_Viewers

Each avatar has an inventory of files organized by file type. You can access it by selecting from the menu “Avatar -> Inventory” (Ctrl + I). You can also create your own folders to organize your files as you wish.

Some of the most important file types are the following:



- **Animations**: Animations files ‘.bvh format’ that can be performed by avatars (e.g., running, sitting, wave)
- **Body Parts**: Items that can be used to adjust the appearance of an avatar. There are four types: Hair, Skin, Shape and Eyes.
- **Clothing**: Clothing items that can be equipped by an avatar to adjust their outfit.
- **Gestures:** Animations that can be performed by the avatar to support the communication with others.
- **Landmarks**: Location files that you can use to save favorite destinations, teleport between them and share with others.
- **Notecards**: Text files with some capabilities to add links to other files.
- **Objects**: These are simpler or complex 3D objects that you can put inside the world (this action is commonly referred to as ‘rez’)
- **Scripts**: Text files containing code that can be put inside of objects to change their behaviour.
- **Sounds**: Sound Files (.wav format) that can be put inside of objects and be triggered through scripts.
- **Textures**: Image files that can be applied on the surfaces of 3D Objects.

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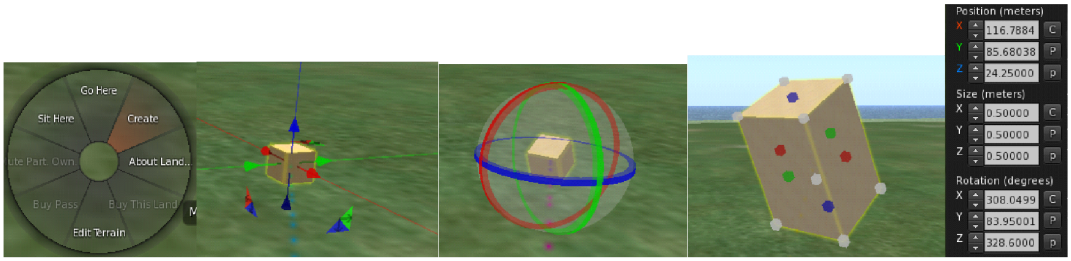
4. Generating 3D Content

One way to create 3D objects, is by using the built-in capabilities of the 3D Viewer Environments. They allow to create several basic 3D objects, known as primitives-prims (boxes, cones, cylinders, spheres, pyramids) and manipulate them. Additionally, they give the option to combine (link) multiple primitive prims, to create more complex objects.

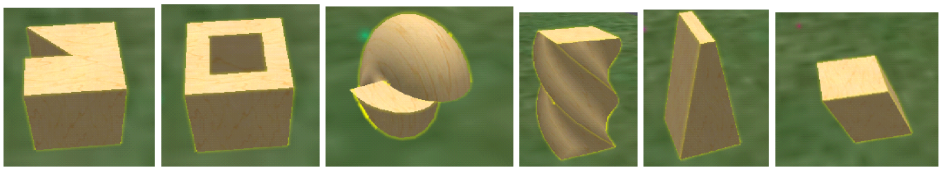
Creating prim objects is as simple as right clicking on any location in the screen and selecting “create”. A menu will appear and the user can select one of the basic shapes.

To Edit an object, users can right click on it and select “Edit”. The menu that appears has multiple tabs that can be used to manipulate various aspects. In the first tab, you have the option to give the object a name and description.

While the object is selected, you can use the mouse to move it around (towards one of the 3 axis), rotate it (press and hold Ctrl to show the rotation axis), or resize it (press and hold Ctrl+Shift to show the resize buttons on edges). You can also go to the second tab of the edit menu and adjust the Position, Rotation and Size values.



You can further Change the shape of a basic prim - Object - by modifying the values for: Path Cut, Hollow, Skew, Twist, Tapper, Top Shear:



You can select multiple prim objects (while keeping the Shift key pressed, click each one) and then click the “Link” option in the edit menu to combine them together to a complex object (a linked set of prims). The linked set is going to behave as a single object (e.g., when you try to move it around). The last prim you had selected when you created the linked set is called the “root” prim of the set. If you have a linked set and want to manipulate one of its “prim” parts, check the “edit linked” checkbox before selecting it. Notice when selecting a prim of the set, that its linked id is displayed.

After creating a simple or complex object you can take it in your inventory by right clicking it and selecting “Take” or “Take Copy”. Giving it a relevant name will make it easier for you to find it later. You can also export the object as a 3d file (with the collada .dae format), by right clicking and selecting “Export”. You can open the exported file with other 3D Modeling Software such as Blender and manipulate it further. 3d files in the collada format can be inserted in your inventory by selecting the import option.

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Other useful options in the Edit Menu:

- The ‘Locked’ property , will protect objects from any modification in terms of properties or dimensions and position.
- The ‘Physical’ property will make an object to follow physics rules like Gravity , Friction and Collisions.
- The ‘Phantom’ property will cancel its Collision properties so an avatar can go through it.
- The ‘Temporary’ property will make life duration of an Object according to time , thus it will disappear after some time - can be useful to create some temp object like a cannonball dropped from a cannon.
- The ‘Flexible Path’ options can adjust the effects of Softness, Gravity, Drag, Wind, Tension, Forces on X/Y/Z (useful to make objects that is affected by wind such as flag)

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5. Terrains, Textures, Media on a Prim

Terrains

You can edit the terrain of each region by changing the height of the ground in each place. One way to change the height is to enter the 3D World as an avatar and use the tools provided by the 3D Viewer (you must be the owner of the region or the region to be configured to allow changing the terrain). To do this, right click somewhere on the ground and select 'Edit Terrain' and the terrain editing toolbox will open.

A quick way to quickly set the heightmap to specific values is using the "terrain fill" command in the OpenSimulator console.

There is also 3rd party software that can be used to generate a terrain file (heightmap) for use in OpenSimulator. An OpenSim terrain is basically an image file composed of gray-scale dots. A black dot is an elevation of zero, or twenty meters (60 feet) below default sea level. L3DT is a Windows application for generating terrain maps and textures that can be used to generate high quality terrain files.

Textures

For any 3D Object you create in Opensimulator, you can assign and adjust specific images/textures in each plane. From the edit menu of a prim object or a linked set, you can go to the "Texture" tab to change the texture image. If you want to select specific surfaces of the object, make sure you select the "Select Face" checkbox. Keep the 'select' key pressed, if you want to select multiple surfaces.

Select one of the texture (image) files in your inventory (you can easily upload images there) to apply it on the surfaces. The values below (Horizontal Scale, Vertical Scale, Repeats pert meter, Rotation degrees, Horizontal offset, Vertical offset), can help you adjust how the image texture is applied. You can change the color as well, adjust the transparency and the Glow effect. You can use images with transparency (like .png) to achieve some complicated 2D objects.

Media on a Prim

Media on a Prim can help make your world more interactive by providing a way you can embed web pages, videos, and other web-based content in your world. Pretty much anything with a URL can be embedded. You can use the Media on a Prim feature to display some document from Google Drive on a panel. Find the document and share it as 'Public on the Web' in order for the document to be accessible without logging in to Google Drive. You can also use the Media on a Prim feature to display videos in panels inside the world. The approach is similar to the previous section. You need to use the URL of the page where the video is hosted.

6. Animations, Sounds, Attachments

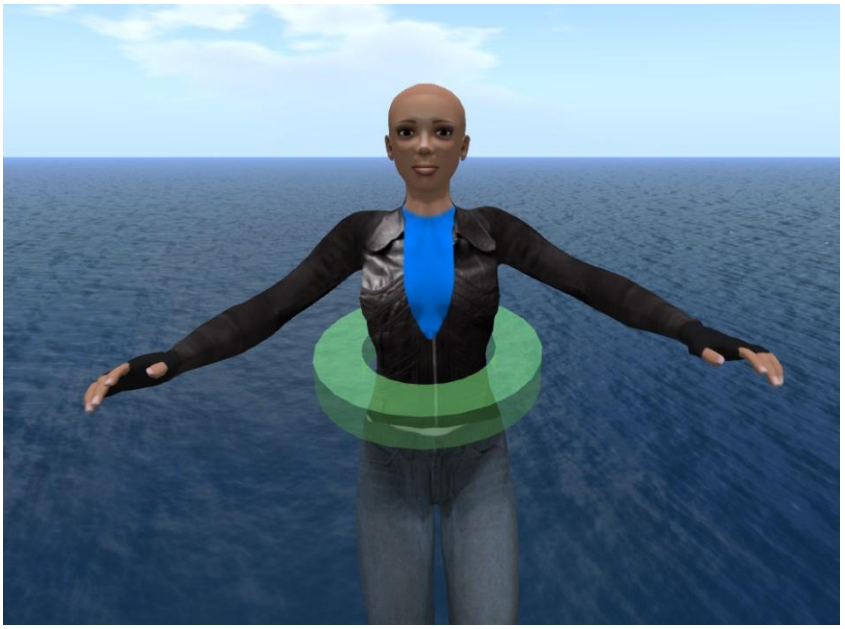
Sounds are a great way to make the Virtual World more interesting and engaging. You can upload .wav sound files. Sounds clips can be used within (scripted) objects and as part of gestures. Current OpenSimulator sound formats are PCM WAVE (.wav) 16-bit/44.1KHz/mono or stereo with a maximum length of 10.00 seconds. To manipulate sounds you can use software like Audacity (free). You can find a large database of CC licensed sounds here: https://freesound.org/

If you use Audacity, you can open a sound file and use the following steps before uploading with a 3D Viewer:

1. Use the "Tracks -> Resample…" option to set the sample rate to 44100
2. Use the "Tracks -> Mix -> Mix Stereo down to Mono" to convert to mono.
3. Export the file as ".wav" selecting the "Signed 16-bit PCM" Encoding

Animations are files that define specific motions for an avatar to execute. The file format used is "bvh" and it contains motion capture data for three-dimensional character. Some basic animations are built-in in Opensimulator and can be used with their name from scripts as we will see in the next chapters. A great variety of common animations for the avatars can be found online. For custom animations, you can use software like QAvimator and BVHacker.

Attachments are 3D Objects (simple prim or linked set) that an avatar can wear on a specific part of their body (for example a hat placed on the avatar's head). You can use any 3D object (simple prim or linked set) as an attachment by finding it on your inventory, right-clicking and selecting the "Attach To" option and selecting one of the available body positions. You can then edit the object's size, orientation, and position and these settings will be saved, so next time you can just double click the object to wear it in the same position.



7. Scripting Introduction

Scripts can make an object move, listen, talk, operate as a vehicle or weapon, change color, size or shape. A script can make an object listen to your words as well as talk back to you, scripts even let objects talk to each other. If you have built in Second Life/ OpenSimulator, everything you can define in the edit window can be defined in a script. All interaction you see between objects or between avatars and objects is via scripts.

Scripting is harder to learn than basic object manipulation, but is very rewarding once you make progress. For creating scripts, it can be helpful to have a local copy of them on your local hard-drive as they're basically just text and edit them with one of the alternate editors.

The LSL Language

LSL is the Linden Scripting Language. This is the language all scripts in OpenSimulator are written in. The structure of LSL is largely based on Java and C, both of which are widely used programming languages in the real world. A script in Second Life/ OpenSimulator is a set of instructions that can be placed inside any primitive object in the world, but not inside an avatar. Avatars, however, can wear scripted objects. LSL scripts are written with a built-in editor/compiler.

To create a script, select an object and go to the Contents tab of the edit menu. Select the 'create script' option and open it. An object can have more than one script files that control it. If you have a linked set, you can have scripts in the ROOT prim, but also in the individual parts of it. In general, LSL commands you run in the ROOT prim, will affect the whole object, while scripts in the individual/child prim only affect those parts.

A script file may contain one or more states, but only one of them will be active at a certain point. A state is a block of code that describes how the object behaves. More specifically, the state contains one or more event blocks that specify when something will happen (e.g., when someone clicks the object) and inside the event block there are the commands that specify the actions that will happen then (e.g., change the color of the object).

If there are multiple states defined, you can use the state command to move from one state to another. Each state can have completely different event blocks, so having multiple states is useful when you want the behavior of the object to radically change at some points.

Here is a very simple example of script:

```
{
  stav {
    touch_start(integer num) {
      llSay(0, "Hi! You clicked me!");
    }
  }
}
```

Events

Let's start with some of the most common events:

- state_entry: Event triggered when you enter the state, including when the script is reset/modified.
- touch_start: Event triggered when a user clicks on the object
- collision: Event triggered when an avatar collides with the object
- sensor: Event triggered when an avatar gets near (specific radius) the object
- timer: Event triggered periodically based on specified interval
- listen: Event triggered when a message is sent in a channel the object waits for messages
- link_message: Event triggered when a message is sent to the specific part of a linked set

Functions

Functions lay inside of events and are either defined by you or are built-in functions. Built in functions start with two lowercase L's such as: llSay(). Functions take "arguments" or values in the parentheses that follow it. LSL as a language uses pass-by-value for all types.

Here are some useful actions you can perform and the corresponding LSL functions to do it.

- Send Chat Message (llSay)
- Change color(llSetColor)
- Change texture (llSetTexture)
- Change Transparency (llSetAlpha)
- Change Position (llSetPos)
- Rotate Object (llTargetOmega)
- An object is given to the avatar (llGiveInventory)
- Object stops/sleeps X seconds between two actions (llSleep)

Variable Types

The LSL language supports the following variable types:

- Integer (an integer number)
- String (a string value)
- Float (a floating-point number)
- List (set of values that can be of different types)

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- Vector (a group of three float values that is commonly used for Positions, Velocity and Colours)

You can define global variables outside of states that will be accessible inside them.

Flow Control

Flow control inside a function or event is similar to other programming languages. You can control the flow of the commands with:

- if / else
- for, while, do-while
- jump, return
- state

Operators

The operators used are also similar to other languages:

- Arithmetic operators: + , - , * , / , %
- Logical operators: && , || , == , !=

8. Advanced Scripting

Objects can wait for messages in specific channels. You can use any channel you want from -2147483648 to 2147483647. Channel 0 is an open channel and is used whenever an avatar writes something in the 'nearby' chat. You can send messages to other channels by writing / and the number of the channel. For example, "/3000 hello" will send the message "hello" to channel 3000. Avatars nearby will not see this message in chat.

Using messages, you can communicate information between different objects. You can also communicate information between parts of the same 'linked' object but you do not use channels for that.

Communication between different objects

To allow an object to wait for messages on a specific channel, you have to use the llListen function first, indicating the channel you want it to listen to and specific filters for the messages that can receive or the the allowed senders (e.g., specific avatar or object). This command is usually called in the state_entry event of the object.

```
integer llListen( integer channel, string name, key id, string msg );
```

To handle the incoming messages, you need to use the "listen" event.

```
listen( integer channel, string name, key id, string message ){ ; }
```

When a message is sent to the specified channel, the commands inside the "listen" event will run. There you can adapt the behavior you want based on the message that was received.

To send a message from another object, you can use the llSay command, indicating the channel number and the message.

```
llSay( integer channel, string msg );
```

Sometimes you may want to send multiple parameters through a message. A solution would be to create a string message that contains all the data you want to send separated by a specific character (e.g a colon ':' character). When you receive the message in the listen event you can split the message based on that character using the 'llParseString2List' command.

```
list llParseString2List( string src, list separators, list spacers );
```

Another way to send a message to a channel is using a dialogue menu for user. The command llDialog will generate a selection menu for a specific user, with a message and some options/buttons. When the user selects one of the buttons, the message is sent to a specific channel.

```
llDialog( key avatar, string message, list buttons, integer channel );
```

Communication between parts of a linked set

Communication between parts of a set uses a similar approach, however you don't have to use channel numbers. You can specify the parts you want the message to be sent.

To handle messages from other parts, you need to add a "link_message" event inside a script of the part that will handle the message.

```
link_message( integer sender_num, integer num, string str, key id ){;}
```

To send a message to another part of the linked set you can use the 'llMessageLinked' command.

```
llMessageLinked( integer link, integer num, string str, key id );
```

The first argument specifies the linked set ID of the particular part you want to send the message or one of the following values (LINK_ROOT, LINK_SET, LINK_ALL_OTHERS, LINK_ALL_CHILDREN, LINK_THIS).

Similar to 'llSay' you send a string message, but you can also send an integer and a key variable which is useful when you want to send multiple information.

In many cases you have some script in the ROOT part of a linked set and want to manipulate some aspects of the other members of the group (e.g their color, texture or transparency). Although this can be done using the above-mentioned approach with messages, the LSL language offers a set of commands that you can use from scripts in the ROOT object to manipulate other parts.

For example, llSetLinkAlpha, llSetLinkColor and llSetLinkTexture can be used from the ROOT object to change the Transparency, Color and the Texture of other parts correspondingly. These commands are similar to the regular ones, but they have an additional argument to specify the parts that you want to manipulate.

```
llSetLinkAlpha( integer link, float alpha, integer face );
```

```
llSetLinkColor( integer link, vector color, integer face );
```

```
llSetLinkTexture( integer link, string texture, integer face );
```

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9. NPC Characters

NPC characters are avatars that are controlled by scripts. They can be used to guide the users, give them information and for other applications. Through the scripts you can have the NPC characters moving around, performing animation, interacting with objects or communicating with other avatars.

Before creating an NPC you need to decide on their appearance. You can configure your own's avatar appearance (including clothes and attachments) and then use the LSL function osOwnerSaveAppearance or osAgentSaveAppearance , to save it as a notecard file.

```
osOwnerSaveAppearance(string notecard):key
```

Put the notecard with the appearance in an object along with some script so it can use it. The script will contain all the code for controlling the behaviour of the NPC character.

You can use any of the events described in previous chapters, to configure when the NPC character will act. There are some specific LSL commands that refer to NPC characters. We present some of them here:

- Generating the character:

```
osNpcCreate(string firstname, string lastname, vector position,
string cloneFrom):key
```

You can select the name of the avatar and the position where it will appear in the world. If the function is successful, it returns an id that you should keep in a global variable, so you can use with the functions that control this character.

- Having a character moving to another position:

```
osNpcMoveToTarget(key npc, vector target, int options):void
```

You specify the id of the NPC that you want to move and the target position that you want it to move towards. The NPC will walk towards that position.

- Having a character starting and stoping an animation:

```
osNpcPlayAnimation(key npc, string animation):void
osNpcStopAnimation(key npc, string animation):void
```

You specify the id of the NPC that you want to animate and the name of the animation to perform. After starting an animation with osNpcPlayAnimation, you can use llSleep to wait for some seconds before using osNpcStopAnimation to stop it. The animation string can be one of the available Internal Animations (use the Animation Name in the table) or an animation file you have added in the objects contents. Animation files use the .bvh format. There is a large collection

of animation files here: https://sites.google.com/a/cgspeed.com/cgspeed/motion-capture

You can also create your own animations using 3rd party software like QAvimator.

- Having a character communicating with messages:

```
osNpcSay(key npc, string message):void
```

You specify the id of the NPC that you want to send a chat message and the text of the message.

You can find more functions to use with NPC characters in the following page: http://opensimulator.org/wiki/OSSLNPC

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10. HUD Elements, Particles, Projectiles

HUD Elements

HUD (Head-up Display) elements are graphics that appear on specific parts of the user's screen and remain there while the user navigates the world. In OpenSimulator you can assign a prim or linked set as a HUD element by simply finding it in your inventory and selecting to wear it (double click for wear, or right click -> Attach Hud -> Preferred Area). You can then edit the object's size, orientation and exact position on the screen and these settings will be saved, so next time you just need to double click it on your inventory and it will appear on that specific position.

The HUD object can have various parts and you can use scripts to implement buttons and other elements on it. The HUD object may be something general that remains with the user all the time, or it may be used for a specific activity only. It is a great way to implement your own dialogue menu for the users, instead of using the llDialogue function. This way you can adjust the exact way that the messages and the buttons will look like. The HUD is also very useful for storing data about the user's interaction in the game and providing relevant information.

A useful event when using a HUD element is the "attach" event, that is triggered when an avatar wears the HUD object. You can use this event to store the wearer's Id or Name.

```
attach( key id ){ ; }
```

Following are two examples, with activities that a HUD element can be used for:

- The user wears an item that displays a small window on his screen with a score (Tokens collected and Prizes earned). While wearing this item he gains token points when he clicks (collects) a specified item or does some specific action. Some objects may award more points than others. Also, while wearing this item, he may lose token points if he triggers some traps (approaching or touching a specified object). Some tokens may only be awarded only if a condition is met, e.g., the user wears or has equipped a particular object/tool or if he has previously earned a specific reward. As an example, the user clicks on a broken bottle and loses points because he was cut. If the user

has previously equipped gloves, then he clicks in the broken bottle and is awarded tokens. In general, any event mentioned previously may trigger as one of the executed actions to increase or decrease the token score of the user.

- The user wears the HUD item and then proceeds to explore the world and solve some quizzes/quests. When he successfully completes a quest, he is awarded with a puzzle/map piece which appears on screen. When all quests are completed, the complete Map is displayed on his screen showing the location of a hidden chamber/treasure.

Projectiles

You can use scripts to implement objects that dynamically generate 3D objects. This allows interesting functionality like throwing projectiles, taking advantage of the Physic's Engine. The corresponding LSL command is llRezObject that generates an object at a specified position with an initial velocity.

```
llRezObject( string inventory, vector pos, vector vel, rotation rot, integer param );
```

Particles

You can use scripts to generate particles. These are images that are emitted from the object in a specific pattern and you can use them to produce effects like smoke, falling leaves, laser beams e.t.c. The LSL function for particles is "llParticleSystem", that can be customized using a list of values.

```
llParticleSystem( list rules );
```

References

https://en.wikipedia.org/wiki/OpenSimulator

http://opensimulator.org/wiki/Main_Page

http://opensimulator.org/wiki/Server_Commands

http://wiki.secondlife.com/wiki/LSL_Portal

https://www.kitely.com/

https://secondlife.com/

http://metaverseink.com/Downloads.html

Virtual Reality for Augmenting Creativity and Effectiveness of training

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Intellectual Output II – Course 5

Game-Based Learning & Gamification in 3D Virtual Learning Environments

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Oppimisanalytiikan keskus, Turun yliopisto

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Course 5 – Game-Based Learning & Gamification in 3D

Questline: Introduction to the Gamification Course

Quest	Task
1. Course Description	Study
2. Learning Objectives	Study
3. Course Structure	Study
4. Course Assessment	Study
5. Recommended Reading	Study
Level	0
Achievement	A Present for Teacher

1. Description

We live in an era where people who have grown up under the influence of Information and Communication Technologies are called 'digital natives' and video games are one of the most dominant 'entertainment' forms. When considering the educational context, one can argue that while learners grow up with digital technologies, a natural decline over the conventional learning approaches is to be expected. In order for the teachers to support their learners it is essential to adjust their instructional methods and adapt them to students' learning styles and preferences.

Games-Based Learning is considered to be one of the most prevalent approaches that can boost learners' motivation and increase engagement. In a similar manner, Gamification is defined as the application of digital game design techniques in non-game contexts (such as business, education). Typical examples of the structural elements of Gamification include points, leveling systems, achievements, quests. Such features have already been applied to many everyday processes including education.

This course is about implementing such systems in ways that generate sustained learner engagement and produce measurable educational benefits. The course is aimed at educators serving both primary and secondary school level (including special needs education). The purpose of the course is to introduce participants to the concepts of Games-Based Learning and Gamification ensuring responsible and successful implementation of digital educational games both in different countries and across school subjects. The course is mainly streamlined to the conduct of gamified activities in Virtual Reality environments (3-Dimensional) but no particular technical skills or game-playing experience are required. Therefore, upon successful completion of this course, participants will be able to:

(1) understand the advantages and disadvantages of Games-Based Learning and Gamification in education.

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(2) identify and assess the potential of the available (serious) games in view of their students' educational preferences and needs.
(3) establish new educational practices by integrating Games-Based Learning features and Gamification strategies;.
(4) integrate ICT tools (such as 3D Virtual Worlds) and custom-made learning interventions in their classroom activities.

2. Learning Objectives

The course explores how Games-Based Learning and Gamification can be integrated in the modern classroom context as a means to increase learner motivation, facilitate engagement, and improve knowledge acquisition/retention. Therein, the main aptitudes that participants should be able to demonstrate at the end of the course are as follows:

In terms of knowledge…

(1) understand the theoretical and conceptual principles of Games-Based Learning and gamification
(2) identify the differences between the (serious) games genres
(3) describe the structural elements of educational games
(4) understand the potential and the risks that the integration of games may bring in teaching and learning.

In terms of skills…

(1) conduct independent research related to educational games and document the key observations
(2) design sample units of lesson plans based on gamification
(3) develop gamified educational activities in 3D educational Virtual Worlds.

In terms of competencies…

(1) determine the roles that students can undertake in digital games
(2) determine the actions that students can perform in digital games
(3) recognise the fundamental Learning Mechanics used for the design of educational games
(4) recognise the fundamental Game Mechanics used for the design of educational games
(5) integrate gamified activities in class to increase students' motivation and make classes more effective.

3. Course Structure

The best way to learn gamification is to do gamification. For this reason, the whole course has been converted into a game. Precisely, the course is divided into 8 units which are denoted as 'Questlines'. Each questline involves different 'tasks' which are denoted as 'Quests'. Successful completion of each questline awards a certificate which is denoted as 'Achievement'. At the same time, your 'Level' increases by 1. Some questlines include 'Challenges' that can help you comprehend your understanding of the material. Beyond the gamification elements, this is a 'flipped' course. Content that would otherwise be delivered in contact time (such as lectures or seminars) is provided through short PowerPoint presentations (10-20 slides), videos (approximately 5 minutes each), and recommendations for further reading (book chapters, scientific manuscripts). One major benefit of this approach is that it frees up contact time from basic content

delivery and offers the opportunity to do interactive exercises, simulations, case studies, discussions, and games—under the aid of the project team—which will greatly deepen your understanding of the topic.

Table 1. Overview of the Gamification course questlines.

Lv.	Questline	Achievement
0	Introduction to the Gamification Course	*A Present for Teacher*
1	Gamified Education	*Spectral Teacher*
2	Classification of (Serious) Games	*Hunger For Games*
3	Classification of Player Types	*Know Your Role*
4	Classification of Student Actions in 3D Virtual Worlds	*Keepin' Busy*
5	Classification of the Structural Elements of Educational Games	*Knowledge Is Power*
6	Classification of the Learning Mechanics	*Learning The Ropes*
7	Classification of the Game Mechanics	*The Mechanar*
8	Exploration of Example Educational & Leisure Games	*Learning From the Best*

4. Course Assessment

Assessment takes place both during and at the end of the course. The intermediate assessment focuses on the intended Learning Outcomes of each questline (Table 2). Following completion of each intermediate assessment, you will receive Experience Points (denoted as 'XP'). The summative assessment concerns the evaluation of your training experience.

Table 2. Overview of the Gamification course assessment tasks.

Assessment	Theme	Evaluation Method	Experience Points
#1	Game-Based Learning and Gamification	Quiz	*100 XP*
#2	Serious Games genres	Quiz	*200 XP*
#3	Player Roles	Quiz	*350 XP*
#4	Activities in 3D Virtual Worlds	Quiz	*400 XP*
#5	Elements of Serious Games	Quiz	*450 XP*
#6	Learning Mechanics	Quiz	*500 XP*
#7	Game Mechanics	Quiz	*500 XP*

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#8	Deconstructing educational games	-	-

Table 3. Leaderboard experience-ranking scale.

Rank	Experience Points	Completion Rate	Title
#1	≥ 1250 XP	50%	Surveyor
#2	≥ 1500 XP	60%	Learner
#3	≥ 1750 XP	70%	Explorer
#4	≥ 2000 XP	80%	Adventurer
#5	≥ 2250 XP	90%	Champion

The maximum Experience Points that can be collected is 2.500

5. Recommended Reading

Chou, Y. K. (2019). *Actionable gamification: Beyond points, badges, and leaderboards*. Packt Publishing Ltd.

Fogg, B. J. (2009). A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology* (pp. 1-7).

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Werbach, K., & Hunter, D. (2015). *The gamification toolkit: dynamics, mechanics, and components for the win*. Wharton School Press.




Questline: Gamified Education

Quest	Task
1. Games-Based Learning	Study
2. Digital Games-Based Learning	Study
3. Gamification	Study
4. Edutainment	Study
5. Serious Games	Study
Level	1
Boss Fight	Quiz-Based Game
Experience Points	100
Achievement	Spectral Teacher

Games-Based Learning (GBL)—also reported as *Digital Games-Based Learning* (DGBL) when digital games are used—is usually associated with the terms *gamification*, *edutainment*, and *Serious Games*. Whatever definition is opted for, the main idea of this approach remains the same: *students learn through the game instead of how to play the game*. Therefore, the essence of this model is to invoke psychological experiences—similar to the ones that games do through their rich and visual appealing aesthetics—and motivate learners to engage with the learning activities.

The ludic nature that 3D Virtual Worlds have provides fertile ground for gamified learning and training activities. As a result, educators have opted to combine the use of 3D Virtual Worlds in order to perform gamified scenarios spanning a wide diversity of educational contexts and scientific fields. As a matter of fact, a search query across different scientific databases related to "3D Educational Virtual Worlds" returned almost 5.500 results of which, 674 discuss implementations and findings emerging from efforts that have integrated GBL and gamification scenarios. The trend analysis (Fig. 1) illustrates the increasing interest that researchers and educators have toward this direction which is justified after considering the widespread use of 3D Virtual Worlds and the added value of such didactic approaches.

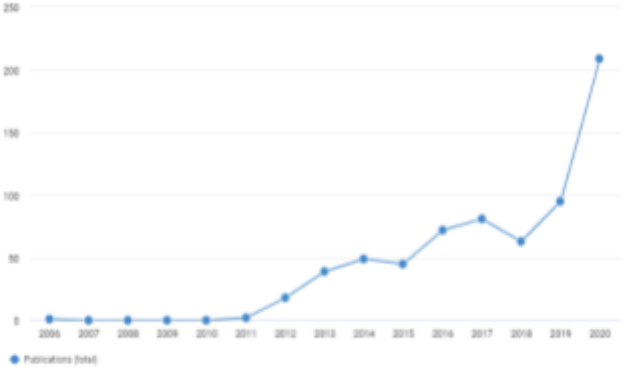

Figure SEQ Figure * ARABIC 1. Trend analysis of manuscripts discussing integrations of GBL scenarios in 3D Virtual Worlds.

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1. Games-Based Learning

Prensky introduced and described GBL as the marriage of educational content and computer games. The GBL activities can be distinguished into two main categories: *(1)* learning directly from [playing] the game (constructivist approach) and *(2)* learning from teacher-driven activities related to the game (instructional approach). Proponents of active construction emphasise the opportunities offered to learners to practice the so-called soft skills (e.g., decision-making, problem solving, communication, collaboration, teamwork) that cannot be easily taught in isolation. Those soft skills can, however, be practiced through coopetition—collaboration with group members and competition between groups—or player-learner experience.

2. Digital Games-Based Learning

Even though DGBL is yet another example of student-centered learning model, researchers suggest that teachers should not isolate themselves from the learning process, but instead opt to foster participation and engagement through direction and support. To this end, digital gamified activities should be implemented with the same affordances required to design and develop virtual games in order to motivate and engage learners. Nevertheless, given that the psychological characteristics or affordances that stem from games are not explicitly defined, various instructional design approaches are framed under the wider *gamification* idea. Therefore, educators are advised to blend the game elements with the instructional activities so as to further extend the context of the game into the physical classroom. There are different factors to consider before adopting a GBL approach. One such factor is the development of a clear understanding of the subjects that DGBL can support, as well as of the skills that can be developed in order to benefit learners. Another factor is the identification of the most suitable game for a given subject, as well as of the learning stage and the instructional method that should be deployed.

3. Gamification

Researchers refer to gamification as the use of game design elements in non-game contexts. This bridging has resulted in a great number of positive outcomes, especially on motivation and engagement, compared to just employing traditional learning techniques. However, despite the reported benefits and applications of gamification, researchers still maintain a high degree of scepticism towards its effectiveness on the learning process. Indeed, balancing between playability and pedagogy is a rather challenging task that educators and instructional designers ought to consider carefully and sensibly.

4. Edutainment

Edutainment is defined as the implementation of technological innovations (e.g., multimedia, computer software) in traditional education, where games whose first purpose is not mere entertainment are introduced, aiming to support learning in its broadest sense.

5. Serious Games

Researchers agree that it essential to employ pedagogical and instructional approaches to maximise the learning

benefits and outcomes. To this end, the Serious Games Initiative aimed at bringing together "[…] *developers, researchers and industrial people, who are looking at ways to use video games and video games technologies outside entertainment*". Although the settings of the Serious (Educational) Games may vary, their norms are framed under the same concept—that is, to engage users in interesting (learning) activities via which they can either experience the premade storyline or even shape its path via their decisions. Supporters of Serious Games promote immersive learning wherein the student-users reach a state of deep learning that enables them to conceptualise, process, and reflect on the subjects under investigation. Prensky bridges further these viewpoints and suggests that the consequences of trial and error (i.e., the failure to achieve the game's goals) can be transformed or translated into feedback on and explanation of the learners' actions. This way, students can evaluate their decisions and take ownership over their future actions. The aforementioned studies grounded the development of frameworks related to Serious Games that have also been employed in conjunction with other established learning models.

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Questline: Classification of (Serious) Games

Quest	Task

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1. Action Games	Study / Explore
2. Adventure Games	Study / Explore
3. Board Games	Study / Explore
4. Puzzles	Study / Explore
5. Quiz / Trivia	Study / Explore
6. Role-Playing Games	Study / Explore
7. Sandbox Games	Study / Explore
8. Treasure / Scavenger Hunt	Study / Explore
9. Simulators	Study / Explore
10. Sports Games	Study / Explore
11. Strategy Games	Study / Explore
Level	2
Challenge	Identify one digital educational game for at least 2 categories. Note your findings on the provided exercise sheet.
Boss Fight	Quiz-Based Game
Experience Points	200
Achievement	Hunger For Games

Different games appeal to different people. In line with this statement, researchers have broadly categorised digital games in terms of their *genre* or *type*. Precisely, Prensky classifies the *game genres* in view of the game's interaction gameplay (e.g., Action, Adventure, Puzzle, Role Playing, Simulations, Sports, Strategy) whereas, other researchers sort the *game types* in view of the way the story (narrative) is unfolded (e.g., Drama, Crime, Fantasy, Horror, Mystery, Science Fiction, War and Espionage). In either case, researchers of all disciplines agree that modern (educational) games take the best of 'all worlds' and incorporate them into a thoroughly entertaining collection of game mechanics and storytelling conventions. Therefore, choosing the appropriate game type for educational purposes depends on the content to be learned and /or the mental processes to be developed.

1. Action Games

In 'Action Games' the player controls a digital personality (avatar), via which assumes the role of a protagonist, who is called to complete a specific mission or fulfill a specific goal. As the sensory-motor skills prevail over the cognitive abilities, the players—while attaining the game objectives—may face unforeseen dangers, pitfalls, and/or manage

dilemmas—framed under different kind of activities (e.g., exploration, racing, shooting)—which usually require the performance of short-term action sequences. When it comes to educational action games, students are called to utilise their common thinking skills to progress through different levels and ultimately complete the game.

2. Adventure Games

'Adventure Games' have more thoughtful gameplay, unfolded via a series of adaptive storylines (plots), which aims at arousing players' mental stimulation. Since adventure games are driven by storytelling emphasis is given on the character development (personal and emotional growth) rather than on the acquisition of new powers or abilities that affect the gameplay. In educational adventure games, students are required to apply their problem-solving skills to collect and combine information or objects which are required to solve the major storyline mystery. The context of the storyline (e.g., the basic environment, the theme of the plot, the involved characters) is usually adjusted to or aligned with the subject under investigation (e.g., mathematics, physics, biology, language).

3. Board Games

'Board Games' are considered to be one of the earliest forms of entertainment. They involve counters moved or placed on a pre-marked surface (playing board) according to a set of rules (e.g., possible moves) and restrictions (e.g., number of players). As a general rule, board games can be divided into three categories: war games, race games, and alignment games. Some board games are based on pure strategy, but many contain an element of chance, and some are purely chance, with no element of skill. Educational board games can help students develop their logical (e.g., pattern sequencing, matching) and critical thinking (e.g., information analysis and interpretation, decision making) skills in addition to the so-called 'soft skills' (e.g., communication, negotiation, teamwork/cooperation) as they require two or more people joining the game.

4. Puzzles

A 'Puzzle' is a baffling or confusing task, with connotations of mysteriousness, that is to be solved. It can be a question or a problem purposely made perplexing enough to intricate the mind and test one's ingenuity. Puzzles are broadly classified in view of their type (e.g., cryptic, logic, math, trivia, word pattern guessing, riddles, mechanical) and difficulty level (i.e., the complexity of the techniques required to reach a solution). When it comes to educational puzzles, students can develop a wide variety of competencies ranging from physical skills (e.g., hand-eye coordination, gross motor skills, fine motor skills) and cognitive abilities (e.g., shape recognition, memory training, problem solving) to enhancement of emotional intelligence (e.g., setting goals, persistence).

5. Quiz / Trivia

'Quiz' is a type of game in which participants test their academic knowledge by answering questions about different topics. A 'Trivia' game or competition is a subcategory of 'quiz', usually organised as part of contests, where participants have to get as many correct answers as possible about insignificant facts of history, culture, art, and science in order to

win. In the context of the wider evolution of personalised learning, adaptive quizzes have gained significant ground as a mechanism to keep students motivated and engaged in their own learning progress throughout the teaching period. From the pedagogical point of view, educational quizzes enable learners to acquire knowledge by building associations between different concepts and gain skills by performing progressively complex actions.

6. Role-Playing Games

In 'Role-Playing Games' players engage in a rich storytelling scenario, rendered in a fictional environment, via which they assume different roles and immerse themselves in the character's situation. The players progress through the game's narrative via a variety of quests, which are usually provided by Non-Player Characters, as well as by competing with or against other players. Players' success is overly dependent on the structured decision-making, which determines the character's development, as well as the accuracy of acting out their role when engaging in the various challenges/tasks. Educational Role-Playing games foster the acquisition of curriculum-related competencies (e.g., Science, Mathematics, Computational Thinking) and further facilitate the development of social (e.g., leadership, teamwork, debating, diplomacy) and intellectual (e.g., responsibility, initiative, organization, self-regulation) skills. In order for such gamified scenarios to be successful, a formalized debriefing session is recommended so as to enable students (players) reflect on the game experience and discuss the skills used to overcome the challenges presented.

7. Sandbox Games

The term 'Sandbox Game' comes from an analogy to kids playing in a sandbox (i.e., a square area filled with sand where children can create anything they wish within it). In contrast to the traditional games—which have predetermined narrative and objectives—sandbox games offer users the freedom to craft the emergent gameplay out of their creativity and imagination. The free play element and the high scalability aspect that such artificial environments offer, provide multiple benefits to users including boost to decision-making, enhancement of self-control, and development of creativity skills. As an education aid, sandboxes provide fertile ground for the conduct of various activities aligned to the principles of the (Social) Constructivism approach (e.g., Project-/Problem-Based Learning).

8. Treasure / Scavenger Hunt

In the leisure and recreation context the terms 'Treasure Hunt' and 'Scavenger Hunt' are often used interchangeably. While both games require participants to solve riddles and complete missions, a treasure hunt is usually referring to a game which presents a series of challenges, the solution of which provides clues and requirements for the subsequent missions, whereas, in scavenger hunts, the players receive a list of actions that need to perform (e.g., item discovery, object collection). Naturally, the diversity in the gameplay defines the objectives of each game as, in treasure hunts, the main goal is to solve the cryptic clues and complete the final mission which leads to a large prize (the 'treasure') whereas, in a scavenger hunt, each completed task is worth a certain number of points and thus, at the end of the game, the team with the most points is named the winner. Regardless of the version chosen, the educational potential of these

games is endless as they enable students exercise both body (when the hunt takes place in the physical context) and mind (development of social skills, problem-solving abilities, teamwork spirit).

9. Simulators

A 'Simulator' is a computer-generated (artificial) environment used to create a virtual version of a real-world system or a hypothetical model. Simulators share many elements in common with the so-called open-world games (e.g., fully-scaled/real-time world, animated/real characters) yet, their fundamental difference lies on the potential of the former to resemble in a realistic and simplistic way authentic processes and actions that users would otherwise perform in the real-world context. The term 'microworlds' refers to the educational application of simulators or, otherwise, the 'world' in which learners are placed by the teacher for instructional, training or experimentation purposes. The high visual realism that simulators have facilitates the demonstration of abstract concepts (e.g., natural phenomena) and promotes the active participation of students in tasks that involve too high risk (e.g., health and safety) or bear prohibitively expensive operational cost in the real world. Likewise, the high degree of freedom for trial and error enables learners to construct deep understanding of the key concepts under investigation without significant impact on the learning experience (e.g., knowledge acquisition, skills development).

10. Sports Games

The 'Sports Games' genre is one of the oldest genres in gaming history. Electronic sports games simulate the practice of real sports (e.g., extreme, track and field, combat) including the contextual setting (e.g., stadium, arena) and the gameplay setup (i.e., individual, partner- or team-based). Aligned to the competitive nature that sports have, networked (online) sports games usually display a scoreboard or leaderboard to track and illustrate how well the players have performed. From the educational perspective, electronic sports games can be utilised to either teach students about the particular characteristics of a sport (e.g., the rules, the required equipment) or as a means to embed educational tasks in them (e.g., exercises related to specific subjects). In either case, engagement with sports games fosters the development of both motor skills (e.g., dexterity, control of reflexes) and cognitive skills (e.g., team cognition, planning, resource management, communication).

11. Strategy Games

'Strategy Games' are considered to be descendants of war games as they emphasise on players' tactical abilities (e.g., situational awareness, planning, decision-making) and logical skills (e.g., reasoning, correlation) to achieve victory while the element of chance has minimal or no impact at all. Strategy games usually involve a great deal of exploration and economy management which unfolds in the context of different historical themes (e.g., Victorian or Medieval period), events (e.g., World Wars, Russian revolution), and settings (e.g., ancient civilizations). Despite the wide adoption of strategic games in military education and training, the efforts to incorporate such games into the formal education curriculum are limited and scarce. However, after considering that intellectual growth (e.g., strategic planning, perseverance, decision making) is amongst the most notable benefits that (digital) strategy games can facilitate, the

necessity to integrate such alternative educational approaches becomes apparent.

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Questline: Classification of Player Types

Quest	Task
1. **Achiever**	Study
2. **Explorer**	Study
3. **Socialiser**	Study
4. **Killer / Griefer**	Study
5. **Builder (New)**	Study

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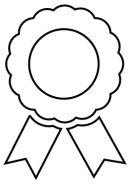
Level	3
Challenge	Take the Bartle test of gamer psychology: https://matthewbarr.co.uk/bartle/
Boss Fight	Quiz-Based Game
Experience Points	350
Achievement	Know Your Role

Researchers have attempted to classify the various player types in accordance with the individuals' personality traits, interests, and preferences. The most widely known taxonomy has been created by Bartle (1996) who categorised players into four main types: *(a)* Achievers, *(b)* Explorers, *(c)* Socializers, and *(d)* Killers. However, ever since, a new player type has emerged describing those people who find strong motivation in creating interactive content; the so-called *Creators* or *Builders* (Kapp, 2012). In either case, the boundaries between those categories are not strictly limited as individuals may express traits belonging to more than one role. Therefore, the descriptions provided below are indicative and should be utilised only as a guide to identify students' motivational traits prior to designing and implementing gamified educational activities.

1. Achiever



Achievers see personal goal setting as the number-one priority. Their main goal is to collect accomplishments, rewards (points, trophies, badges, items, levels), and anything else that make one's progress (status) visible to others. Their main motivation stems from the intrinsic need to be competent. This also defines their primary objective which includes completion of challenging or demanding tasks which often require great time and effort investment. In the educational context, *achievers* can be paralleled to the high-level students who strive for mastery and aim to excel in any given assignment.

2. Explorer

Explorers are free spirits; they find pleasure when discovering new places and features that underpin the flow of the game world. In addition, they strive in mastering the game mechanics and dynamics that govern the functions of the game. Their ultimate goal is to understand the technicalities and uniquenesses of the game so as to craft theories and strategies that can help them and/or other players to take advantage. In the educational context, *explorers* are curious learners who enjoy the learning journey and are attracted by thematic or integrated approaches.

3. Socialiser

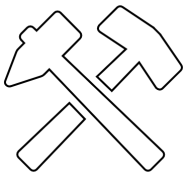
Socialisers are casual players who are foremostly interested in networking with others. They value collaboration and teamwork and prioritise the development of meaningful, long-lasting, relationships. In other words, instead of merely playing the game they prefer to utilise the communicative facilities offered to create social and emotional connections. In addition, they are

usually involved in community-related activities which include administrative and managerial responsibilities. In the educational context, *socialisers* are all about 'fun'. They feel attraction for the social aspects of learning and perform best when engaged in collaborative learning activities.

4. Killer / Griefer

Killers are highly competitive players who like to act on others. Participating in competitions and tournaments (individual or team-based)—with the only intention to win—is the only motivational incentive. Likewise *achievers*, they are attracted by means and ends that lead to reputation and/or status increase and will do anything under their capacity to beat their opponents. *Griefers* (also known as *internet trolls*) like to provoke and cause drama. To satisfy their need for attention they disrupt others' experiences by either harassing or scamming them. In the educational context, *killers* are those students who are not taking anything at face value; they like being challenged and often ask the most questions. On the antipode, *griefers* are those students who demonstrate disruptive behaviour with the aim to disturb the flow of the lesson.

5. Builder (*New*)



Builders can be (arguably) considered an addition to the aforementioned player types. The term refers to those individuals who (solely or together) engage in recreational activities that involve 3D content creation and/or animation, using both native and third-party tools. For *builders*, unlike professionals in the field, monetary compensation is not always the primary goal. As a buzzword, it became more prominent after the emergence of the so-called *metaverse*; a futuristic concept that describes and envisions a persistent, shared, interconnected, 3D virtual space. In the educational context, *builders* can be considered the students who are naturally inclined or interest in arts and crafts.

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Questline: Classification of Student Actions in 3D Virtual Worlds

Quest	Task
1. Exploration	Study
2. Socialisation	Study
3. Collaboration / Cooperation	Study
4. Competition	Study
5. Role-Play	Study
6. Creation	Study
Level	4
Challenge	Identify a gamified task that your students can perform within a 3D Virtual Learning Environment.
Boss Fight	Quiz-Based Game

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Experience Points	400
Achievement	Keepin' Busy

Researchers that have explored the so-called 'educational affordances' of 3D Virtual Worlds (Dalgarno & Lee, 2010) classify the educational potential of these environments from different perspectives (Duncan, Miller & Jiang, 2012; Hew & Cheung, 2010) and points of view (Reisoğlu et al., 2017). While considering the key findings of these works, it becomes apparent that there are many ways to utilise these multidimensional environments in the classroom. Among these, a wide range of teaching methods and learning strategies can be identified covering the whole spectrum of instruction. Although there is a common agreement that *one approach does not fit all*, some activity types have been found to be highly beneficial for most learners. Therefore, the educational approaches elaborated in this section involve a blend of both passive (teacher-centered) and active (student-centered) learning techniques which can be utilised for the didactic of various subjects across different levels.

1. Exploration

"Learning must be an exploration where it is better to discover than to be told". Exploration-Based Learning is one of the most frequently used educational strategies in 3D Virtual Worlds. The knowledge is acquired passively, through observation of the available 3D content, and constructed actively, through interaction with the visual representations. As a didactic approach it is most beneficial in the first phase of the learning cycle where learners develop their theoretical understanding on the fundamental concepts under investigation. This technique can be integrated via scenario-based virtual field trips, guided storytelling, or even free roaming.

2. Socialisation

"Student socialisation is a central element of technology-enabled learning". The presence of avatars and the multichannel communication tools—that 3D Virtual Worlds inherently offer to promote social networking and community development—facilitate information exchange and ultimately foster peer-to-peer knowledge discovery. In addition, the high representational fidelity of graphics and the dynamic nature of these 3D interactive environments can potentially lead to the development of the so-called sense of presence and space which, in turn, make social learning a more realistic and inclusive experience. Indicative examples of educational practices of this nature include participation in virtual meetings, social events, conferences and are framed under the 'Community of Inquiry' concept.

3. Collaboration / Cooperation

"Collaborative Learning, sometimes also referred to as cooperative learning, may be defined as a student-centered approach in which groups of individuals work jointly on a well-defined learning task". Collaborative activities in 3D Virtual Worlds promote critical discourse and increase the incentives for cognitive engagement with the academic content. Typical examples of such activities include joint knowledge production, information exchange, constructive negotiation and argumentation, and participation in procedural tasks. However, given that these environments are mirroring the real-world space, it is important that educators emphasise on the added-value of peer-learning and the

necessity for learners to provide mutual support on the performance of the given interdependent tasks.

4. Competition

"Competition is a key element in many educational games frequently adopted by educators to motivate their students, with reported results related to increased academic performance". In competitive educational environments learners are faced with scenarios that present a series of academically meaningful challenges which are usually conducted under strict timeframes and may involve collaboration with others. Competitiveness in 3D Virtual Worlds can be realised by instilling learners' intrinsic motivation via activities with increasingly demanding tasks that encourage challenge and curiosity and extrinsic motivation via virtual rewards and leaderboards. Notwithstanding the foregoing, competitive behaviour in the classroom has received intense criticism and therefore, the integration of such activities in 3D Virtual Worlds should be driven by pedagogical goals and not purely competitive pressures.

5. Role-Play

"Role-play is a form of experiential learning where students adopt different personas and work through a given scenario together, interacting in their assumed roles". Role-play can take different forms (e.g., game-based, simulation-based, problem-based) in accordance with the primary learning objectives (e.g., learning of concepts/rules, information-recall, problem-solving) set forward by the instructional designer/educator in charge. Role-play in 3D Virtual Worlds can be designed under the following conditions: *(a)* scripted-mode, where the steps of the scenario are predefined and the user(s) only control its progress or (*b*) free-mode, where there are no predefined steps and the user(s) are responsible for shaping the narrative of the scenario. In either case, the role of the educators is vital both during and especially after the completion of the session where the students debrief and reflect on the experience.

6. Creation

"Maker culture draws upon a more participatory approach than traditional learning, encouraging learners to collaboratively engage with others as they learn through the creation of new items". The so-called 'maker era' represents a diverse group of individuals who are interested in creative arts and crafts (e.g., 3D printing, modification of equipment, one-of-a-kind designs). In construction-oriented 3D Virtual Worlds learners are provided with vacant land and the freedom to create/programme anything they would like, using the native modeling tools and the respective scripting language. As an educational approach it has been found to be more appropriate in activities and tasks that involve design and animation of 3D prototypes as well as for the creation of digital posters or concept maps.

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Recommended Reading

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Questline: Structural Elements of Educational Games

Quest	Task
1. Game Objectives	Study
2. Learning Objectives	Study
3. Results & Outcomes	Study
4. Storyline Scenario	Study
5. Interaction	Study
6. Rules	Study
7. Freedom	Study
8. Challenges & Conflicts	Study
9. Resources	Study

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10. Aesthetics	Study
Level	5
Challenge	Identify a digital educational game of your preference, deconstruct its key structural elements, and note your observations.
Boss Fight	Quiz-Based Game
Experience Points	450
Achievement	Knowledge Is Power

Game engineering involves multidisciplinary work and that makes it hard to design them; let alone blending educational concepts and transferring them into 3D Virtual Worlds. To mitigate this burden, Prensky provides an exhaustive list of elements that Digital Games-Based Learning instructional designers and educators should consider when preparing such interventions. On the grounds of his work, we present and elaborate the themes that should be considered when designing 3D gamified interventions.

1. Game Objectives

The *game objectives* determine the goals and the actions that players need to achieve and attain respectively, in order to progress within the game. Some common game objectives include collection of objects, puzzle solving, chasing/racing or even escaping. A useful practice in designing goals is not just having one end-goal, but a series of sub-goals that help guide the player. The completion of a game objective is typically communicated through audiovisual feedback (e.g., trophies, badges, points, sounds) or by unlocking access to new content.

2. Learning Objectives

The *learning objectives* define the actual knowledge and the intellectual abilities that instructors want the students to acquire while playing the game. By making the goals easily observable enables students to better understand what should learn and facilitates the evaluation process from the teachers' end. The best way to design such goals is by applying action verbs during the formulation process (c.f. Bloom's taxonomy). A way to formulate learning goals is to structure the sentence the following way: "After playing [name of the game] you should be able to [description of the learning objective]".

3. Results & Outcomes

Both of the abovementioned design elements are contributing to one particular goal; the attainment of meaningful *results* and thorough (learning) *outcomes*. Regardless of the chosen method or approach to evaluate the effectiveness of the intervention (i.e., inside or outside the 3D Virtual World), educators and instructional designers should ensure that evidence is collected with regard to the knowledge and skills' gains that students have realised both after the completion of the learning activities (immediate evaluation) and over the course of time (retention evaluation). It is also

important to ensure that, when hands-on activities are simulated within the virtual environment, students have acquired the necessary understanding to transfer the acquired skills in the real-world context (i.e., empirical evaluation).

4. Storyline Scenario (Narrative)

The *storyline scenario* describes what happens during the interaction time. There are many ways to communicate the game *narrative* (e.g., text, multimedia) but the end goal remains the same; it should present a story that involves substantial challenges and opportunities for the learners to unfold their existing or newly acquired knowledge. Likewise, the degree of importance varies and depends greatly on the game genre. For instance, a simulation or a puzzle game may require quick actions from the end-user with possible time constraints. On the other hand, an exploration game includes storyline elements and therefore, more time may be required to reach the end-game.

5. Interaction

To facilitate *interaction* and promote active engagement, instructional designers should follow the principles of the available theoretical models such at the Multimedia Learning Theory or the INTERACT model. The following guidelines describe the basic steps that should be followed when designing the interactivity channels:

- *Establish the interactivity requirements*: determine the environment in which the users will interact, define the activities the users will perform, and the methods available to facilitate interaction.
- *Design alternative solutions*: explore different ways to interpret and satisfy the interactivity requirements.
- *Prototype design*: prototype the most promising idea and perform a preliminary evaluation with a small group of students.
- *Prototype evaluation*: analyse the findings emerged from the previous step to assess the degree that the proposed requirements have been met, to identify any limitations, and to find out any additional changes that may be required.

6. Rules

The game *rules* tell the players how to behave. Instructional designers have the authority to determine and interpret the game rules in accordance with the interactivity requirements and the wider scope of the game. The game rules should be bound to the central concept, instead of simply framing it, and should be explicitly reported upfront in a concrete and compact way. The enforcement of the game rules in the gameplay impacts players' motivation and satisfaction in addition to guiding and assisting them to finish the game. For this reason, special caution should be taken to not overwhelm the target audience with too many conflicts or choices. For instance, if the students should follow a specific path, hints should be displayed on the screen so that they can explore the map. Likewise, special operation modes may be integrated to determine students' progress and provide feedback.

7. Freedom

In the Game-Based Learning context, *freedom* encompasses the following concepts: *(a)* the freedom to choose to play

the (educational) game and *(b)* the freedom within the (educational) game environment. Enabling learners to control their learning approach and the learning process, respectively, promotes motivation and facilitates knowledge acquisition/retention. However, this does not imply that students should be simply left on their own. Educators should encourage learners to consider the adoption of the educational game as part of their practicing routine whereas, the integration of well-defined game rules, provide the means to control the degree of freedom learners' have within the game. As a generic guideline, offering learner a moderate degree of freedom (either way) has been found to be fundamental toward autonomous learning.

8. Challenges & Conflicts

The game *challenges* define the effort that players have to put to achieve their personal goals whereas, the game *conflicts*, intensify the degree of the challenge. Even though the game conflicts do not necessarily constitute a learning factor, they remain one of the key-elements that motivate players to engage. The effort required to overcome the challenges can be either physical/kinesthetic (testing players' accuracy, reaction time, endurance) or cognitive/nonkinesthetic (testing players' decision-making, problem-solving skills, spatial reasoning). Physical/kinesthetic challenges are usually performative, as the player has to perform a sequence of known actions correctly in a specific time frame, whereas cognitive/nonkinesthetic challenges are exploratory, requiring the player to make decisions and predict their outcomes.

9. Resources

A *resource* is anything that can potentially help a player alter the state of the game. All games involve some sort of resource collection, as a means to develop the game economy (e.g., currency, tokens), or resource management, as a method to influence the gameplay experience (e.g., points, options). The nature (limited, renewable, exchangeable,) of the game resources is usually dependent on the game genre whereas, the complexity of acquiring and utilising them, is defined by the game rules. In either case, the decisions of the players influence the progress and eventually the outcome of the game.

10. Aesthetics

In the context of game design, *aesthetics* refer to the player experience. Players experience the aesthetics first and then immerse with the game flow (dynamics, mechanics). The design of the characters as well as that of the surrounding environment describe the emotional responses that the game developers aimed at evoking when the players interact with the game system. Game designers have classified the fundamental aesthetics types in accordance with the emotions they evoke as follows: *sensation* (sense-pleasure games), *fantasy* (make-believe games), *narrative* (drama games), *challenge* (obstacle course games), *fellowship* (social framework games), *discovery* (uncharted territory games), *expression* (self-discovery games), and *submission* (pastime games). Depending on the theme of the educational game more than one aesthetics approach may be utilised.

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Questline: Classification of Learning Mechanics

Quest	Task
1. Action / Task	Study
2. Educational Tutorial	Study
3. Demonstration	Study
4. Assessment / Feedback	Study
5. Reflect / Discuss	Study
Level	6
Challenge	Choose 2 Learning Mechanics and provide a brief description of an educational intervention in a 3D Virtual Learning Environment.
Boss Fight	Quiz-Based Game
Experience Points	500
Achievement	Learning The Ropes

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"*Learning Mechanics* are patterns of behaviour or building blocks of learner interactivity, which may be a single action or a set of interrelated actions that form the essential learning activity that is repeated throughout a game." Their key principles are grounded on established learning theories or models and constitute the medium that 'translates' the learning goals into gameplay elements. Every educational game has Learning Mechanics that govern the rules and the interplay modalities used to motivate and engage players to complete the game and ultimately expand their knowledge and/or develop their skills. In this questline we map and discuss the key-elements of the most widely adopted learning mechanisms that can be utilised across different educational levels and contexts.

1. Action / Task

In digital learning scenarios students are expected to perform a set of repetitive *actions* in order to complete the given *tasks*. Educational games framed under this category are mainly relying on the principles of Problem-Based or Task-Based Learning whereas, in cases where the students are required to work together to achieve a common goal, it could also be related to Collaborative Learning. Depending on the nature of the educational task students can develop a wide range of cognitive (e.g., planning, critical thinking, problem solving), technical (e.g., knowledge development on new or practicing of already known techniques) or social (e.g., knowledge, information, or opinion exchange) skills. Educational activities associated with this mechanic include role-playing, paired/group discussions, exploration, and observation and other 'hands-on' activities.

2. Educational Tutorial

Educational tutorials are instructor-guided and/or self-paced activities that enable learners to acquire theoretical knowledge or consolidate their practical skills. As a Learning Mechanic it draws from the principles of the Constructivist/Constructionist models and occasionally involves collaboration among students (e.g., on course assignments). Depending on the nature of the educational subject, they can be *discussion-based*, where the focus is on the deeper exploration of the course content through discussions and debates, or may involve *hands-on* activities, where the emphasis is on the development of practical skills. In either case, the added-value of this approach is also on the opportunity offered to learners to participate in (follow-up) *questions and answers* sessions. For the integration of this mechanic, the use of diverse multimedia resources is recommended (e.g., PowerPoint presentations, videos, Non-Player Characters).

3. Demonstration

3D Virtual Learning Environments enable educators to *demonstrate* (direct instruction) abstract topics and concepts that are difficult or even impossible to be explored in the conventional classroom. Educational games framed under this category are mainly relying on the principles of Behaviourism, when simulating scenarios that highlight the relationships between 'cause and effect', or on the Experiential Learning approach, when the students are requested to observe and imitate the actions that the educator in charge performs. In cases where the educational activities involve interplay between the students (e.g., competition, collaboration/cooperation), this approach can also be linked to the Social Learning theory. Educational activities associated with this mechanic include simulations, 3D modeling and programming, scenario-based virtual field trips, and guided explorations via storytelling.

4. Assessment / Feedback

Beyond the conduct of activities that facilitate learning, designers and practitioners can also integrate *assessment* related tasks as a means to enable learners acquire insights related to their learning progress and advancement. In Serious Games, learner assessment can be continuous (e.g., proceeding from level to level), with scaffolding difficulty (e.g., completing more demanding tasks), and stealth (i.e., embedded in the gamified activities). These elements ensure that the experience of flow remains unaffected while also allowing educators to obtain useful information related to learners' knowledge and skills construction. A typical approach to facilitate assessment in digital learning environments is by capturing, recording, and extracting learners' behaviours through the user (digital) logs. Following completion of an assignment unit it is important to also consider the provision of *feedback*. In the context of gamified activities in 3D Virtual Worlds, feedback can be provided both during (e.g., failure/replay, provision of hints/help) and after the game (e.g., reflection moments, watching others playing, review of recent activity). The nature of the feedback can take multiple forms (e.g., text, audiovisual) and can be used either in isolation or as a combination.

5. Reflect / Discuss

Following completion of the educational tasks, educators need to provide opportunities for critical *reflection* and *discussion*. As a process, it can take place outside the game context (debriefing) and may include reflective diaries, mentoring, and game critique. Beside the direct benefits that this process has for learners, it also enables instructional designers to evaluate whether the choice of games met students' motivation and interest, the particular elements they liked more and the aspects of the games that challenged them the most, as well as how they managed to overcome the presented challenges. Discussion-based, group-oriented or peer-to-peer, reflection can be carried out with more advanced learners based on a set of predefined guidelines.

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Questline: Classification of Game Mechanics

Quest	Task
1. Quest	Task
2. Turns	Study
3. Quests	Study
4. Rewards	Study
5. Leaderboards	Study
6. Non-Player Characters (Optional)	Study
Level	7
Challenge	Choose 2 Game Mechanics and provide a brief description of an educational intervention in a 3D Virtual Learning Environment.
Boss Fight	Quiz-Based Game

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Experience Points	500
Achievement	The Mechanar

"*Game Mechanics* are constructs of rules and feedback loops intended to produce enjoyable gameplay. They are the building blocks that can be applied and combined to gamify any non-game context." Different Game Mechanics are used to leverage players' motivational incentives and willingness to engage. For instance, the motivation driver for the collectors may be addressed with points and badges and the motivation for the achievement hunters may be addressed by leaderboards. In a similar manner, failure mechanics are utilised to communicate in a playful manner the actions that players should and should not perform. In a holistic gamification design, a combination of different motivational drivers may be at play yet, when learners are confronted with several game mechanics elements, it may be difficult to focus on the learning objectives.

1. Turns

"In *turn-based* games, game flow is partitioned into well-defined and visible parts, called turns." Turn-based games allow players to 'pause' the game world before making an action. However, not all game turns are alike. In some games players may be allowed a period of analysis (time) before performing a game action whereas, in other occasions turns may represent longer periods such as years, months, weeks or days. For instance, in wargames, the amount of time each turn represents is usually specified. On the other hand, in sports games, a turn represents the 'one action play' that players can perform during their round but the amount of time varies. The most widely adopted approaches in the educational context are the *timed turns* and *time compression* which aim at adding time pressure to players to think and commit their actions.

2. Quests

"A *quest* is a task in video games that a player-controlled character, party, or group of characters may complete in order to gain a reward." In quest-based educational games the players engage in interrelated activities which are usually involving movement across different action points. The successful completion of a quest or set of quests (questline) leads to the attainment of a concrete objective or reward. As an educational approach, Quest-Based Learning, is structured as a sequence of briefing, action, and debriefing. For this reason, the integration of this method, especially in 3D Virtual Learning Environments, is usually associated with the conduct of activities that involve problem-solving, as the student-players need to successfully address the posed challenges, as deriving in the given quests, in order to progress and eventually win.

3. Rewards

"*Reward* systems can be viewed as player motivators or as compromises for easing disappointment". The reward mechanisms can be classified into the following categories: *(a)* the extrinsic motivation rewards (badges, points, physical or virtual goods), which are responsible for attracting users' interest in the experience, and *(b)* the intrinsic motivation rewards (progress bars, notifications, social status in leaderboards), which ensure the user's long-term engagement. Similarly, the delivery system can take different forms such as: *(a)* random rewards, *(b)* fixed reward schedule, and *(c)*

time-dependent rewards. Some of the most notable types of rewards include tokens, achievements, feedback messages, experience points, item granting, and content unlocking. Players can use the obtained rewards to make game progress or as a means to demonstrate their knowledge advancement to instructors and peers.

4. Leaderboards

"A *leaderboard* is a game design element consisting of a visual display that ranks players according to their accomplishments; when used in an educational setting it serves as a way for students to directly compare their own performance with that of others." The structural elements of leaderboards can be divided into two levels: *(a)* the *macro* level (overall performance) and *(b)* the *micro* level (performance at specific tasks). Despite the differences observed regarding the provided information at each level, the key structural elements remain similar. Considering the educational context, a typical leaderboard usually displays information related to students' identity (name or nickname), followed by their ranking, which is defined by either their learning progress (e.g., points, tasks completed) or performance (e.g., grade, budges earned).

5. Non-Player Characters (Optional)

"*Non-Player Characters* (NPCs) play an important part in many games, presenting the story line and serving as quest givers to the user who goes on an adventure." In the educational settings, NPCs (also known as Pedagogical Agents) are integrated as a means to facilitate the learning processes by providing learners additional

instructional support and guidance, especially during the absence of the teacher or instructor. The key design elements and characteristics of the NPCs are decided following a three-tier approach which includes: *(a)* the global design level which concerns the appearance of the NPC (human/non-human, animal, cartoon) and the motion capabilities (static/animated), *(b)* the medium design level which regards the technical aspects of the NPC (role, behaviour, auditory output) and *(c)* the detail design level which relates to the visual presence of the NPC (gender, age, clothing).

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Questline: Exploration of Example Educational & Leisure Games

Quest	Task
1. **World of Mathematics**	Exploration
2. **World of Physics**	Exploration
3. **Playground**	Exploration
Level	8
Challenge	Identify the key instructional design elements of 2 educational games of your choice and note your observations.
Boss Fight	Play the example games!
Achievement	Learning From the Best

As the gamification course comes to an end, we saved the best for last! In the final questline you become a 'student'! Go out in the open (virtual) world and play the educational games we have designed for different educational subjects (mathematics, physics)! Will you manage to beat your peers? Good luck!

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Virtual Reality for Augmenting Creativity and Effectiveness of training

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Intellectual Output II – Course 6

Design & Development of A 3D Learning Activity

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Co-funded by the Erasmus+ Programme of the European Union


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Course 6 – Design & Development of A 3D Learning Activity

Part 1: Instructional Design in 3D Virtual Worlds

Designing and integrating learning experiences in 3D Virtual Environments differs from the approaches that educators and instructional designers use to create activities in the physical classroom context or even in other (2D) digital learning platforms. Even though, no explicit theories or models have been developed to contextualise Virtual Learning, educational researchers have successfully employed the core instructional design principles with positive results on learners' motivation and engagement. Therefore, in this course, we provide the information and guidelines as well as the assets required to design, develop, and integrate a 3D learning scenario / activity in the provided 3D Virtual World (OpenSimulator). Educators are greatly encouraged to follow each one of the provided steps while also performing the necessary actions in parallel. As a starting point, think and deconstruct the key instructional design elements that Figure 1 illustrates.

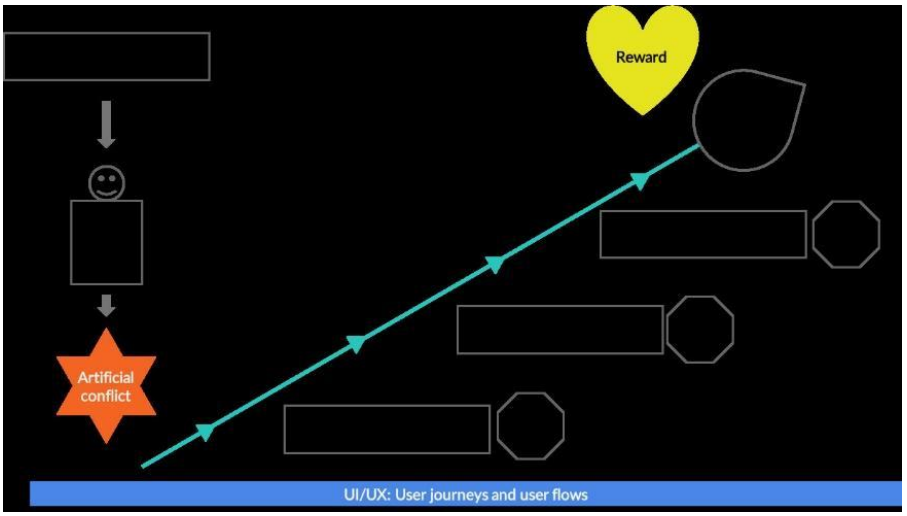

Figure 1. Instructional design strategy map. [Source: https://www.linkedin.com/pulse/how-set-up-gamification-strategy-increase-conversion-juan-david]

1. Defining the Learning Goals and the Learning Objectives

The first step is to identify the primary learning goals / objectives that your students need to attain. Having a clear understanding of what you wish to accomplish and how the 3D Virtual Learning Environment is going to help you

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achieve this goal, play crucial role when defining the Learning/Game Mechanics. You can establish multiple goals / objectives but you should be specific. To facilitate the goal setting process you can use the SMART (Specific, Measurable, Achievable, Relevant, Time-bound) method. As a starting point, you can ask yourself the following questions:

- What do your students need to learn during their Virtual Learning gamified experience?
- Are there any specific knowledge areas they need to explore, skills they need to master, or tasks to perform?

2. Designing the Learning & Assessment Activities

After determining the learning goals/objectives, you should specify the *subject matter*, the approach that will be used to convey the information, the sequencing of the learning materials, and the assessment approach. To facilitate this process, you can use a storyboard, sketches, or a detailed outline that highlights all of the main points.

3. Preparing the Gamification Strategy

Once you have identified the learning goals/objectives and the context of the educational activities/assessments, it is time to create a roadmap of the *gamification strategy*. The following steps summarise the key concepts that you should consider while designing your gamification plan:

- **Step #1—Know Your Audience**: No gamification strategy is guaranteed to work across all learners. Therefore, while designing your gamification strategy, you should consider your target audience (students) including their needs and wants.
- **Step #2—Consider the Content**: Although instructional designers tend to 'convert' the available educational content into a gamified package, not all the educational material can be gamified. Therefore, while designing gamified interventions, you should perform multiple viewings/revisions of the available material without, however, dismissing its original format.
- **Step #3—Outline Important Actions**: Predefined gaming routines make learners to lose interest soon enough. Therefore, to motivate consistent participation and long-term engagement, you should let your learners control some elements of the experience. Indicative examples include: options to customise avatars' appearance, adjustment of the environment settings, opportunities for role-play, trade-off choices, and branching scenarios (consequences of decisions).
- **Step #4—Maintain Continuity:** Learners tend to be more enthusiastic when knowing that the overall narrative is consisted of multiple 'episodes'. Therefore, it is important to ensure that the learning experience is a continuous and cohesive journey.
- **Step #5—Provide Constant Feedback**: In educational games feedback can be provided in many ways (hints, tips, comments, recommendations) and forms (badges, trophies, leaderboard ranks). Providing constant feedback makes the learning process more vivid and intuitive but special attention should be paid not to overwhelm or over-reward learners as the essence of both may as well be trivialised.

4. Determining the Gameplay Approach

Defining the *gameplay* is a two-step process; first, you should identify which Learning/Game mechanics you are going to integrate and then you should decide how you want to integrate them into the actual gameplay. Concerning the selection of the appropriate gameplay mechanics, you can choose from: *(1)* avatars (with the option for the students to edit the appearance of their persona), *(2)* storylines (integration of the learning content into a fictional story), (*3*) quests (little tasks or quizzes), *(4)* points (experience, skill, reputation), *(5)* progress bars (study process, ongoing status over the attainment of a goal), *(6)* levels (in conjunction with experience points), *(7)* rewards (virtual or physical prizes), *(8)* badges (visual awards of achievement), *(9)* leaderboards or performance graphs (ranking lists displaying students' completeness), and *(10)* feedback (rapid, positive, encouraging). Regarding the structure of the gameplay, the main decision to be made concerns the play setting (single / multi- player). To account for the needs of all the different students a blend of both collaborative (team-based) and self-guided (individual-based) activities should, ideally, be provided. Finally, while defining the gameplay structure, it is important to remember that the use of multiple mechanics may distract learners from the subject matter.

5. Collecting the Required Assets

To achieve your instructional design goals, you should have the *right tools* on hand. As a starting point, you can explore some of the freely available *gamification templates* [1] in order to get additional guidance and support on how to design your gamified educational scenario. Accordingly, you can obtain 3D content from the relevant *asset libraries* [2], the community repositories which offer *3D models* [3] for free as well as the *open educational resources repositories* [4]. Finally, there are many open-source *authoring tools* (e.g., Scratch4SL) [5], that can facilitate the integration process of the game mechanics, by helping you to create pieces of working code (scripts) without requiring prior knowledge in programming languages.

Indicative sources:

[1] https://www.pinterest.com/jpdlwhite/gamification/

[2] https://www.outworldz.com/

[3] https://free3d.com/

[4] https://blog.inf.ed.ac.uk/atate/2021/07/19/open-educational-resources-vue-and-openvce/

[5] https://scratched.gse.harvard.edu/resources/scratch-4-second-life.html#:~:text=Scratch%20for%20Second%20Life%20(S4SL,snapping%20together%20Scratch%20programming%20blocks

6. Sketching the Procedural Instructions

In a similar manner to the traditional teaching approach, activities performed in 3D Virtual Learning Environments should have clear and explicit *procedural instructions* so that students can follow the steps and successfully complete the given exercises. The best way to provide such instructions is via a brief presentation (PowerPoint slides). The following roadmap details the most important information that should be enclosed:

Step #1—Overview of the Exercise: Students are often resisting using procedural instructions. To attract their interest and ensure that their cognitive load will be increased more gradually, it is essential to deliver the information of the respective exercises with adequate scaffolding. Start by providing general information about the educational game, continue describing the knowledge or the skills that students will develop/practice, conclude with the main goals and objectives they need to achieve.

Step #2—Overview of the Game Setup / Gameplay: In this stage you should detail all the information related to the user interface and the conflict mechanisms (learning/game mechanics). Ensure that you include ample of illustrations to facilitate the development of students' understanding and conceptual knowledge transfer.

Step #3—Overview of the Evaluation System: The final step includes a brief description of the assessment mechanisms. Depending on the nature of the exercise/game you may use different approaches to evaluate students' knowledge (score, tasks completed) and demonstrate their performance (leaderboards, badges).

7. Creating the Supportive Learning Resources

Beyond the procedural instructions, it comes handy to offer learners the opportunity and the incentives to review the relevant learning content (e.g., theory) before engaging in any kind of 'hands-on' practical activities. As with the previous case, preparing a small set of PowerPoint slides (uploaded on a virtual board) or offering learners handout notes (physical or digital) will boost their confidence and increase their success rate.

8. Performing an Evaluation of the Intervention (Optional)

"A gamification strategy is only successful if you can prove that is successful". Although educators naturally *evaluate* their teaching-and-learning practices (e.g., tracking learners' engagement, monitoring students' progress), performing such an action in a 3D Virtual Learning Environment is more challenging. Nevertheless, the following ways can enable you to assess (in approximation) the impact of your educational intervention, including that of the gamification elements and the particular activities that have been the most and the least challenging for your cohort:

- **Badges**: If you decide to integrate badges, as a means to award learners for successfully completing a task, you can setup an educational competition and, at the end, gauge the learning outcomes that individuals have achieved based on the total number of gathered badges.
- **Ranking on the leaderboard**: In a similar manner to the previous example, integrating a leaderboard (displaying, for example, points collected or ranking) can also help you determine how well your learners have performed.
- **System logs**: If you are technically-savvy you can collect and extract system log data (e.g., online time, time spent on tasks) which can further help you identify the strengths and weaknesses of your gamification strategy.

Based on your evaluation findings you can (intuitively) provide your learners with additional support and guidance as needed. In addition, you may wish to alter your gamification strategy if particular methods or approaches are not as impactful as others. Notwithstanding the foregoing, educators and instructional designers are reminded that evaluation is an iterative process and thus, should always aim at re-assessing and re-evaluating your instructional methods.

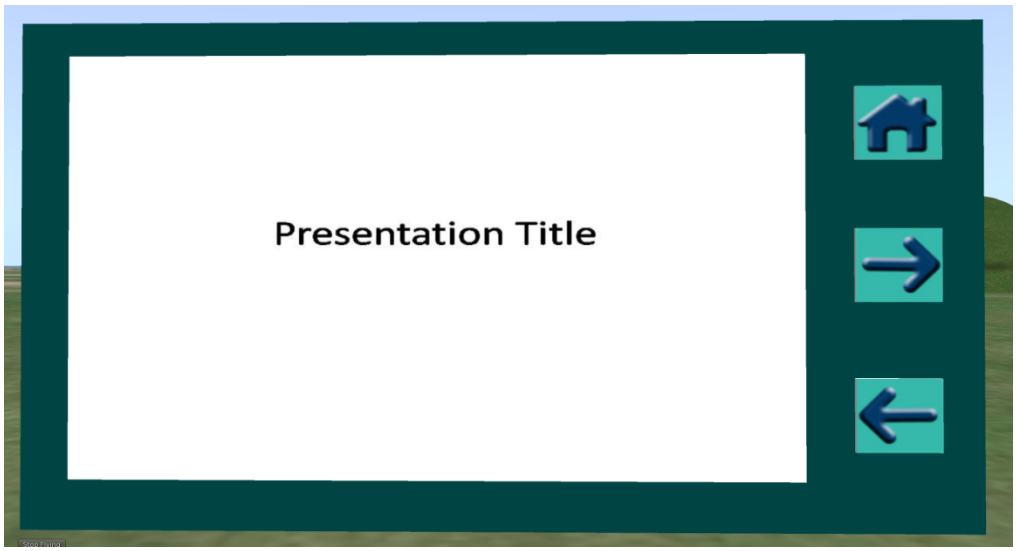
Part 2: Educational Game Development

In this section we will describe and provide material for specific learning activities that you can use within a Virtual World created with Opensimulator. It is advised that you have previously studied the “3D Worlds” course, so you are accustomed to Opensimulator and the LSL scripting language.

Attached to this course you will find an archive with the material for each activity type. They include textures, scripts and 3D objects you can use to implement the described activities. We also provide an .iar file that you can directly import in your avatar’s inventory, to allow generating these activities in your own world. In most cases you only need to prepare some presentation files with the text you need, upload it as images in the Virtual World and make slight adjustments to the provided scripts. In this guide we only give you some basic instructions to use our implementations, but if you have studied the material of the “3D Worlds” course and the LSL scripting Language, you should be able to tinker with the objects and their scripts to make more advanced modifications according to your needs.

1. Displaying Theory through Presentation Panels

In this activity users in the Virtual World will be able to view and control a presentation panel with the theory.



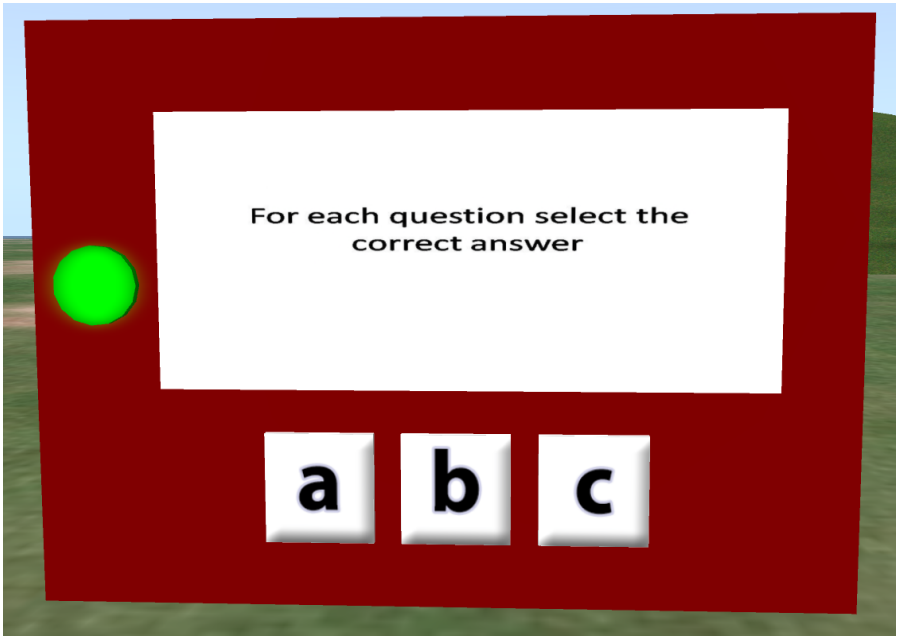
In our simplified approach, there is a screen that displays the current slide and three buttons to go to the next, previous and initial slide.

We provide a simple powerpoint file as an example. Our suggestion is to use a large font, so the text is clear within the 3D World. Also avoid any links or effects. You then export the presentation as images. In powerpoint this is done by going to “Save As” and selecting the JPEG file type. You should now have a separate JPEG file for each presentation slide.

Upload these images in your avatar's inventory and then transfer them in the screen prim of the Presentation Panel, so they can be used by the "screenControl" script.

2. A simple Quiz Activity

In this activity, users can take a quiz with multiple choice questions. In our simplified implementation there is a screen that displays the question, three buttons for answers (a, b, c) and a button that starts the activity.



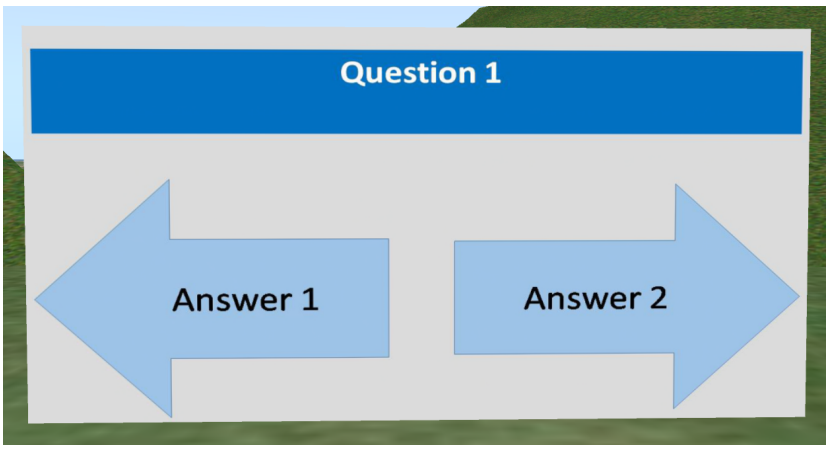
First you need to prepare a presentation file with the questions (we have provided a template file). Similar to the previous activity, export the presentation file as individual JPEG images and upload them in your avatar's inventory.

Transfer these images in the root prim, replacing the sample images there. Then open the "Control" script and adjust the following parameters:

- minCorrect: determines how many correct answers are needed to consider the activity successful
- correctAnswers: adjust what is the correct answer for each answer
- screenTextures: include the names of the image files with the questions

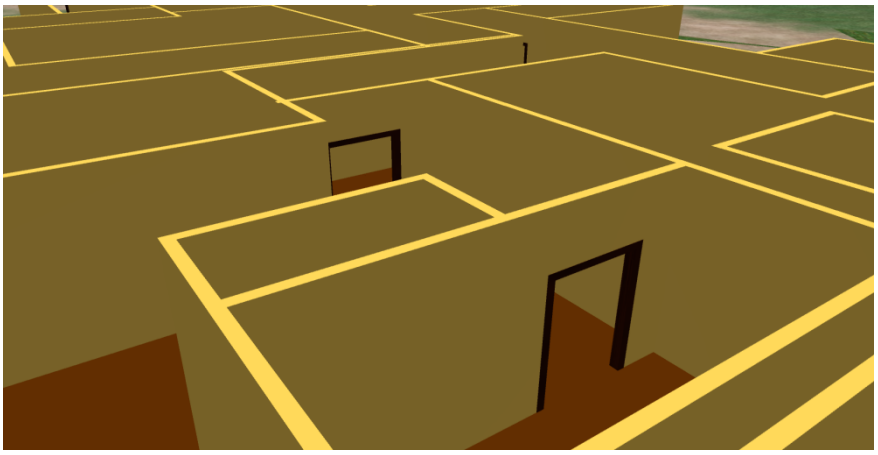
3. Using a Maze activity for a Quiz

This is a different approach to offer a quiz activity. The user enters a Maze and reaches various crossroads where they have to select the direction to follow. To determine which direction is the correct one, they have to answer a question with two possible answers that correspond to the two available directions (left, right).

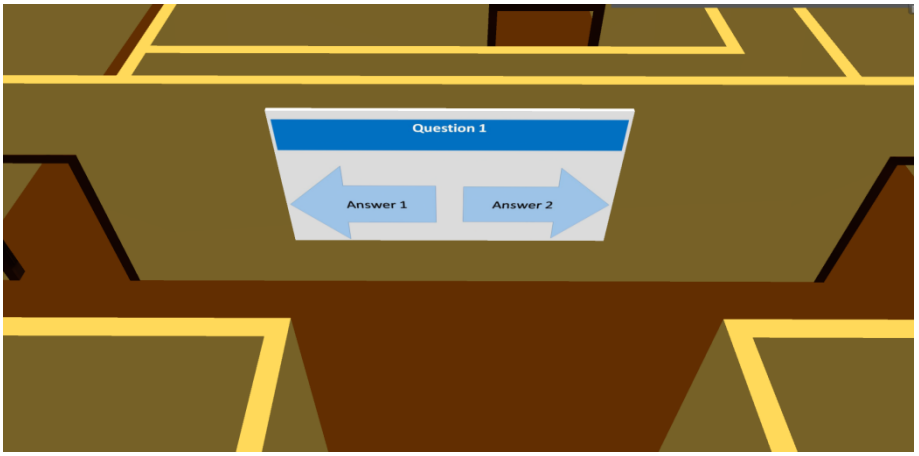


First you need to prepare a presentation file with the questions (we have provided a template file). Similar to the previous activity, export the presentation file as individual JPEG images and upload them in your avatar's inventory.

You can design your own maze, with the layout you prefer, but we also offer an implementation of our own that you can use.



You do not need any scripting for this activity. Just prepare some panels with the textures of the questions and place each one at one of the crossroads.



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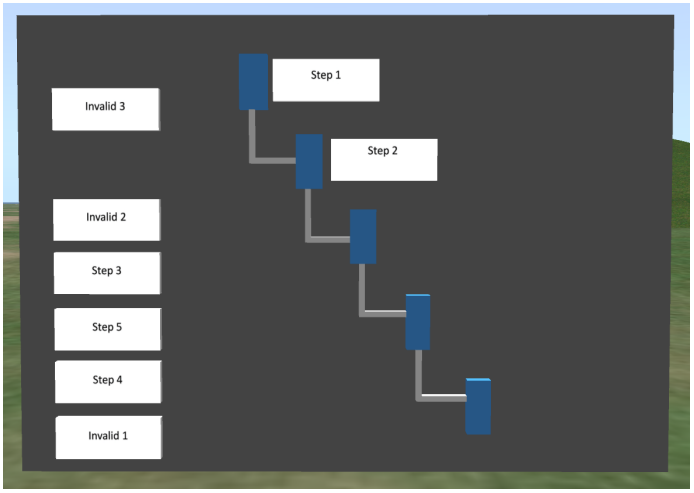
4. Sorting Activities

In this activity the user will have to sort some items, by selecting them in the correct order. In our simplified implementation there is a set of items on the left in a random order. Whenever a user selects the item that is expected according to the required order, the item appears on the right.



First you need to prepare a presentation file with the text of the individual items (you can also use images instead). We have provided a template file that you can use. Similar to the previous activities, export the presentation file as individual JPEG images and upload them in your avatar's inventory.

Finally, use these images to change the textures of the individual cards.

5. Matching Activities

In this activity there are two columns of items (cards) and you have to select each one from the left and then the matching one on the right column. In our implementation we use different colors and transparency to highlight which item is currently selected and which items have already been matched.

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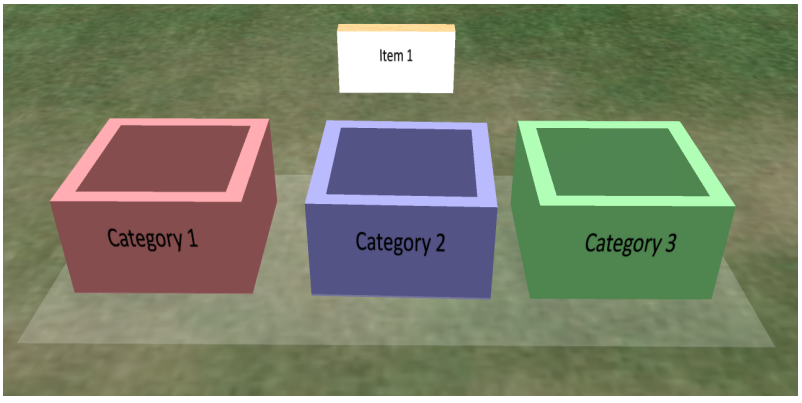
First you need to prepare a presentation file with the text of the individual items (you can also use images instead). We have provided a template file that you can use. Similar to the previous activities, export the presentation file as individual JPEG images and upload them in your avatar's inventory.

Finally, use these images to change the textures of the individual cards.

6. Classifying Activities

In this activity, there are three boxes corresponding to categories, and for each card that appears above them, you have to select one of the boxes to classify it. When the correct box is selected, the card moves inside the box, and then the next card appears to be classified.



First you need to prepare a presentation file with the text of the individual items (the cards and the categories). We have provided a template file that you can use. Similar to the previous activities, export the presentation file as individual JPEG images and upload them in your avatar's inventory. The images for the cards should be numbered with a common prefix (e.t.c Slide1, Slide2, Slide3 …).

Transfer the images that correspond to cards in the "root" prim. Then open the "main" script file and adjust the

following parameters:

- box1Cards: set the number of the cards that should be classified to the 1st box
- box2Cards: set the number of the cards that should be classified to the 2nd box
- box3Cards: set the number of the cards that should be classified to the 3rd box
- In line 15, edit if necessary the common prefix of images
- In line 66, adjust the code according the number of cards you want to classify

Finally use the images for the categories to change the texture of the boxes.

7. Multimedia

Opensimulator allows you to set a web page as the texture for an object's face. If you already have some webpages with activities for the users, you can easily integrate them on panels in the 3D World, allowing the students to interact with them with their avatars. You can also use pages from video streaming sites like Youtube, to display videos inside the 3D World.

You need some simple panel prim for this activity (we provide an object you can use). Select the face of the object that the web page will be displayed; go to "Textures", select "Media" and "Choose". Provide a valid URL of the webpage you want to display.

8. NPC Characters

In this activity, there is an NPC character, controlled by scripts, that the user can interact with, to receive information or as part of an assessment activities. Here we provide you with a simple prototype script that you can use as a starting point. You place the script in a prim object and the NPC character will appear next to it. In our simplified approach, the user will greet the user, whenever he collides with the object that contains the script.

You can edit the appearance of the avatar by replacing the “appearance” notecard with one you generate on your own (there are details in the corresponding chapter of the “3D Worlds” course).

Then you can study the “npc” script and make adjustments according to your needs. Instead of using the “collision_start” event, you could handle the “listen” event and implement various behaviors of the NPC character according to the message they receive. This way you can connect the NPC with any other activity, implement complicated dialogues with the user and much more.

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