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STATE OF THE ART REPORT

Serious Computer Games in VET

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RESEARCH METHODOLOGY

A major part of the Serious Computer Games as a Teaching Tool Project is to identify and record the level of usage of serious computer games (SCG) in each country and to quantify the needs and potential implementation of serious computer games within the VET programme at Macro level.

This State-of-the-Art aims to identify the usage of serious computer games within VET across the partnership. It identifies significant national approaches to using serious computer games within VET that can be used to maximise the impact and add value to the countries that don't use these techniques already.

The State of the Art report reviews the use and implementation of serious computer games in the worldwide context as well as in the project partner countries.

The analysis method applied is desktop research.

The analysis involved desktop research information from the seven project partner countries – Bulgaria, Italy, Lithuania, The Netherlands, Sweden, Turkey and United Kingdom.

1 Introduction of Serious Computer Games

The general idea of serious gaming is that by employing more fun into a training process people will be more motivated to learn. The phrase "serious games" was coined by Clark Abt in his 1970 book "Serious Games". Abt used his definitions on card and board games, but his ideas are still valid and do apply to computer based serious games. While there are still examples of non-computer assisted serious games, the main focus of the area and of this STAR is now computer games and simulators. The games are constructed in such a way that they have a clear cut educational value, and are not primarily made for entertainment.

Although the entertainment factor is not the main focus of the game, developers must strive to make the game as entertaining as possible without compromising the goal of the game. While coined 32 years earlier, the term serious game did not become widely used until 2002, when the Woodrow Wilson International Center for Scholars in Washington D.C. launched a "Serious Games Initiative" which aimed to encourage development of games addressing policy and management issues. Even though serious game is a relatively new term regarding computer science such games have existed for a long time in form of simulators for vehicle control and other visualization of the real world. Simulating realistic situations provide users with an opportunity to experience new situations without the cost or risk associated with it.

The field of serious gaming is a rather broad field with game objectives spanning over a wide array of areas. The lack of one governing group has led to a lack of clear classifications, and people have made several more or less ad hoc classifications. Development within the serious games and virtual worlds fields have been very swift during the last few years. The advances have not only been in terms of new game ideas and software enhancements, but also within the development of new peripherals for controlling the games.

GPS technologies, sensory equipment and mobile technologies have been integrated into several games to provide the games with a new way of mirroring some real world problems to be solved. Due to the major shift within the field little time has been spent to develop standardised language, tools and techniques. The term serious game now covers a wide array of applications ranging from text-based programs to massive multiplayer virtual worlds with huge amounts of Non Playing Characters (NPCs) each having their own behaviour and artificial intelligence. As it will be discussed later there are several terms being used interchangeably for the area of serious games, and no clear cut definition of what a serious game actually seems to be agreed upon. Among the phrases being used to discuss serious gaming is Educational Games, Simulation, Virtual Reality, Alternative Purpose Games, Edutainment, Digital Game-Based Learning, Immerse Learning Simulations, Social Impact Games, Persuasive Games, Games for Change, Games for Good and Synthetic Learning Environments. There seems to be a lot of efficiency and understanding to be gained from agreeing on

frameworks, theories, vocabulary and design strategies within the field. The approach to studying this relatively new discipline has so far been sporadic and fractional. With the field gaining more recognition from other disciplines (and the general public) there's a shift in the field making it a more serious academic study as opposed to a few years ago where the research mainly consisted of a collection of general ideas, with little or no communication between the researchers.

A major problem with standardising the language has been an assumption that the language used need to be unique from other disciplines. Serious games are a new way to teach, but it is only a technology assisting the already well known field of learning/teaching. A completely new vocabulary is redundant and confusing considering how many disciplines serious gaming draws from. Cooperating with researchers in other disciplines to further expand on existing vocabulary could prove to be a good way to go.

Today's "serious games" are a serious business; as stated by Ben Sawyer, co-founder of the Serious Games Initiative, the *serious games* market is now at \$20 million, and *digital gaming* is a \$10 billion per year industry (van Eck, 2006), and the market is expected to grow over the next decade. As noted by Michael and Chen (2006), serious games are also becoming ever more important in the global *education and training market*, which in 2003 was estimated at \$2 trillion. It is also predicted that "by 2008, 40 percent of U.S. companies will adopt serious games in their training efforts" (ibid., p.xvi).

Serious games can be applied to a broad spectrum of application areas, e.g. military, government, educational, corporate, and healthcare. A key question, when discussing serious games, is what the concept itself actually means. Even a brief survey of the literature soon reveals that there seems to be as many definitions available as there are actors involved, but most agree on a core meaning that serious games are (digital) games used for purposes other than mere entertainment. Another question of interest concerns the claimed positive effects of such games, or of applications from related and sometimes overlapping areas such as eLearning, edutainment, game-based learning, and digital game-based learning. In addition to obvious advantages, like allowing learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc. (Corti, 2006; Squire & Jenkins, 2003), serious games, it is argued, can have positive impacts on the players' development of a number of different skills. Even so, it is not the case that all games are good for all learning outcomes

(Van Eck, 2006). A third question of interest concerns the actors involved, e.g., researchers, game developers, and the consumers, and their roles in this developing market. The aim of this report is to take a closer look at some aspects of these issues. We begin with a brief discussion on serious games and related concepts, and then discusses serious games in more detail, such as different definitions and perspectives on the concept. Then, we turn to the issue of the positive (and negative) effects of these games. In the final section, we identify some (mainly academic) actors in the North American and the European serious games market.

History

Using games for education is not a new concept, and it predates the use of computers as a learning tool. Computer based serious games started appearing in the early 1980s predominantly focusing on war themed games. The field of serious games has broadened a lot the last few years after the sector has matured and hardware required for running the games have become widely available.

In the 1980s and 90s a series of significant improvements to real-time hardware and software techniques realised new possibilities for computer generated images, animations and graphics. The new techniques were widely used in the fields of scientific visualization, movie and TV production, medicine and defence. In some of the sectors the adaptation was hugely successful (animation for TV and movies in particular) while in other sectors much of the efforts resulted in failure. Virtual Reality became a new buzz word that for a while had a lot of early adapters fired up. Unfortunately Virtual Reality failed to live up to the hype. Unrealistic expectations, lack of experience among the producers and lack of foresight into what possibilities Virtual Reality could bring seemed to be major causes why the bubble seemingly burst in the late 90s. Even though the field of serious gaming suffered some setbacks the 80s and 90s did spawn a few games that were rather successful. The skills and insight acquired through making such games as Army Battle Zone (1980, widely considered to be the first computer-based serious game) and The Colony (1988) for the army had a profound effect on later developments. After game developers broke free of the paradigm of targeting their serious games to defence departments the game engines were adopted for use in the commercial sector. Games like Quake, Unreal and Half-life are all first person shooters that were helped along by the investments made in development of serious games for the military. Although quite a few early adapters suffered from premature investments in pricey, overhyped and unstable serious games in the 90s, it was a broad range of people understanding that the technology had its possibilities. People started to understand that in order to achieve the goals set for serious games more focus had to be paid to the pedagogy behind the games, and not only focus on making the games more visually impressive.

Serious Games and Related Concepts

This report focuses on the domain of serious games. There are, however, related and sometimes overlapping domains, such as e-learning, edutainment, game-based learning, and digital game-based learning. *E-learning* is a rather general concept that refers to computer enhanced learning, computer-based learning, interactive technology, and commonly, distance learning (Hodson et al., 2001; en.wikipedia.org). *Edutainment* – education through entertainment – was popular during the 1990s with its growing multi-media PC market (Michael & Chen, 2006). In general, edutainment refers to any kind of education that also entertains even though it is usually associated with video games with educational aims. The primary target group was preschool- and young

children, with focus on reading, mathematics, and science. However, edutainment software failed success since it resulted in what has been described as “boring games and drill-and-kill learning” (van Eck, 2006). Computer video games for non-entertainment purposes were developed long before the edutainment era, however, and as edutainment failed to prove profitable – and technical advancements in providing realistic settings grew, and multiplayer gaming developed – the concept of serious games was re-examined during the late 1990s (en.wikipedia.org). With the U.S. Army’s release of the video game *America’s Army* in 2002 (www.americasarmy.com; Gudmundsen, 2006), the serious games movement got started. The same year the Woodrow Wilson Center for International Scholar in Washington, D.C. founded the *Serious Games Initiative*, and the term “serious games” became widespread (www.seriousgames.org/index2.html).

In general terms, serious games are associated with ‘*games for purposes other than entertainment*’ (further discussed below). Serious games encompass the same goals as edutainment, but extend far beyond teaching facts and rote memorization, and instead include all aspects of education – teaching, training, and informing – and at all ages (Michael & Chen, 2006).

Game-based learning (GBL) is described as “a branch of serious games that deals with applications that have defined learning outcomes” (en.wikipedia.org). Others consider game based learning and serious games more or less the same (e.g., Corti, 2006). According to Corti (ibid.), GBL has the potential of improving training activities and initiatives by virtue of, e.g., its engagement, motivation, role playing, and repeatability (failed strategies etc. can be modified and tried again). *Digital game-based learning* (DGBL) is closely related to GBL, with the additional restriction that it concerns digital games. In the words of Marc Prensky, DGBL is the “newest trend in e-learning” (twitchspeed.com/; see also, e.g., Kiili, 2005; Squire et al., 2005). DGBL is, Prensky (2001a; 2001b) argues, based on two key premises; firstly, the thinking patterns of learners today have changed, that is, today’s students are ‘native speakers’ in the language of digital media. Secondly, this generation has experienced a radically new form of computer and video game play, and “this new form of entertainment has shaped their preferences and abilities and offers an enormous potential for their learning, both as children and as adults” (ibid., p. 6). In the next section the concept of *Serious games* is discussed in more detail.

Today, the term serious games is becoming more and more popular. A Google-search on “serious games” renders about 479.000.000 hits [2012-09-30]. The term itself is nowadays established, but there is no current singleton definition of the concept. Serious games usually refer to games used for training, advertising, simulation, or education that are designed to run on personal computers or video game consoles. According to Corti (2006, p.1) game-based learning/serious games “is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills”. When searching the web, a number of different definitions are available.

It could be argued there is no need, for purposes other than purely academic, to define serious games but vaguely. However, while different groups use the very same term they also appear, at the same time, to refer to different things. The term serious game itself came into wide use with the emergence of the Serious Games Initiative in 2002 (seriousgames.org). The website of the Serious Games Initiative provides the following description of serious games: “The Serious Games Initiative is focused on uses for games in exploring management and leadership challenges facing the public sector. Part of its overall charter is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health, and public policy.”

Most web-pages, however, either do not define the concept or describe it vaguely. Commonly, many websites describe serious games as wanting to achieve something more than entertainment, and considers it more of a movement than a defined area of its own. For instance, it has been described as a movement that is “cross-appropriating video game technologies, techniques, structures and tools from the video game industry to other fields of human endeavour (outside of entertainment) like policy and management issues” (digitaldivide.net; en.wikipedia.org). It has also been described as the “use of computer and video games for non-entertainment purposes (i.e., public policy, education, corporate management, healthcare, military)” (minkhollow.ca; see also, e.g., dictionary.laborlawtalk.com; nyteknik.se; svt.se). These descriptions are in line with, e.g., the Internet encyclopaedia Wikipedia, in which serious games are described as:

“...computer games that are intended to not only entertain users, but have additional purposes such as education and training. They can be similar to educational games, but are primarily focused on an audience outside of primary or secondary education. Serious games can be of any genre and many of them can be considered a kind of edutainment, but the main goal of a serious game is not to entertain, though the potential of games to engage is often an important aspect of the choice to use games as a teaching tool. A serious game is usually a simulation which has the look and feel of a game, but is actually a simulation of real-world events or processes. The main goal of a serious game is usually to train or educate users, though it may have other purposes, such as marketing or advertisement, while giving them an enjoyable experience. The fact that serious games are meant to be entertaining encourages re-use...”
(en.wikipedia.org, 20061206)

In Zyda’s (2005, p.26) more formal definition, entertainment is explicitly brought up as an ingredient:

“Serious game: a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives.”

When comparing serious games with just computer games, Zyda argues that serious games have more than just story, art, and software. It is the addition of *pedagogy* (activities that educate or instruct, thereby imparting knowledge or skill) that makes games serious.

However, he also stresses that pedagogy must be subordinate to story and that the entertainment component comes first. The focus on the entertainment component is in contrast with, e.g., the descriptions of serious games accounted for in the recent book *Serious Games: Games that Educate, Train, and Inform* by Michael and Chen (2006), in which they devote a whole chapter on discussing the concept of serious games.

A problem with the term “serious game” itself is that there appears to be a contradiction between its constituents; the terms “serious” and “game” may seem to be mutually exclusive.

The first constituent, “serious”, is according to Ben Sawyer (in Michael and Chen, 2006) intended to reflect the purpose of the game, why it was created, and has no bearing on the content of the game itself. Regarding the second constituent, already Wittgenstein (1953) showed that there are difficulties in defining the concept of a game. There simply are no necessary and sufficient conditions. In Michael and Chen (2006, p. 19) games are described as:

“...a voluntary activity, obviously separate from real life, creating an imaginary world that may or may not have any relation to real life and that absorbs the player’s full attention. Games are played out within a specific time and place, are played according to established rules, and create social groups out of their players.”

The authors also note that some people will take exception to this description since it contains no reference to “fun”. Not all consider “fun” an important factor, however, when it comes to games or computer based applications, especially not so when considering their role in learning, and even their use as an educational means is questioned. Stoll (1999), for instance, is critical to “the obsession of turning the classroom into a funhouse” (p.13), and argues that computers, or “teaching machines”, “...direct students away from reading, away from writing, away from scholarship”.

They dull questioning minds with graphical games where quick answers take the place of understanding, and the trivial is promoted as educational. They substitute quick answers and fast action for reflection and critical thinking [...] Turning learning into fun denigrates the most important things we can do in life: to learn and to teach. It cheapens both process and product: Dedicated teachers try to entertain, students expect to learn without working, and scholarship becomes a computer game.” (pp.13-14)

As argued by Squire et al. (2005), however, the important issue is not whether all formal education is turned into a game or not. More importantly, they ask how educational technologists will respond to the “digital native speakers”, i.e., “a generation of students who, raised on interactive games, expect the same kinds of interactive experiences from their educational media?” (p.34). Still others consider fun the prime factor in games and education and, according to Prensky (2001); games should be fun first and then should encourage learning. Fun has also been described a side effect of learning something new (Koster, in Michael & Chen, 2006). Similarly, Michael and Chen (2006)

argue, with regard to serious games, that the main point is to get players to learn something, and, if possible, have fun doing it.

Considering the above characteristics for games, serious games often violate voluntariness in that trainees may be ordered to play a particular game as part of their training. An example could be a military squad leader using a serious game for training before or preparing a mission. Another person using the very same simulation could instead regard it a game.

Therefore, entertainment games used for other purposes can be considered serious games (chess, e.g., while being an entertainment game, has the underlying element of strategic skill training).

Michael and Chen (2006, p.21) define serious games as “*games that do not have entertainment, enjoyment, or fun as their primary purpose*”, a definition clearly in line with the one adopted by, e.g., PIXELearning (PIXELearning.com, 2006-11-14); “*The use of computer game and simulation approaches and/or technologies for primarily nonentertainment purposes*”. Michael and Chen do, however, remark that this is not to say that serious games are not entertaining, enjoyable, or fun, just that there is another purpose (cf. above); the accuracy of the process or effect being simulated for training is of primary importance. Nevertheless, education can be entertaining, but also the reverse is true. “Fun”, however, is neither the only form of entertainment, nor the only way to engage players in a game. Besides fun, there are several elements that contribute to players’ engagement, e.g., play which leads to intense and passionate involvement, goals that motivate, and rules that provide structure (Prensky, 2001, in Mitchell & Savill-Smith, 2004). According to Corti (2006), the motivational virtues of video games are what initially entice training and development professionals to turn to game-based approaches, but there is a lot more to game based learning/serious games than simply using fun as a means to engage learners.

In the present DISTRICT project, we want to emphasise the element of *engagement* in games. As recognised by many authors, serious games is not merely the application of games and game technology for non-entertainment purposes, in domains such as education, health, etc. In our view, games should be engaging and motivating, which is advantageous for, e.g., the development of a variety of skills and abilities. Hence, serious games is here defined as games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it). A game’s purpose may be formulated by the user her/himself or by the game’s designer, which means that also a commercial off-the-shelf (COTS) game, used for non-entertainment purposes, may be considered a serious game.

For the purposes of The Serious Games Showcase and Challenge (sgschallenge.ist.ucf.edu), and the 2006 I/ITSEC Conference (Interservice/Industry Training, Simulation and Education Conference), “game” and “serious game”, were defined as follows:

“Entries will be considered a game if they involve an assigned challenge and employ a compelling form of positive and/or negative reward system. Entries will be considered a serious game if they use the gaming attributes described above to overcome a designated problem or deficiency, and provide appropriate feedback to the user about their efforts.”

The element of enjoyment may seem implicit in this operative definition, but it is also explicitly emphasised in the event’s general description:

“... it is important to clearly define the problem or need that is being addressed, as well as the gaming or game technology solution involved. It is equally important that your entry be not only technologically sound in its development, delivery and user interface, but also engaging, enjoyable, and easy to use; providing a challenging and rewarding experience to the user.”

An adequate question to ask is how serious games differ from entertainment games. Michael and Chen (2006) discuss the issue from a design and development perspective; contrary to many markets for entertainment games, the hardware used in many of the markets for serious games is years old and therefore less than optimal. The serious games market is also more likely to possess a wide variety of hardware and operating systems. Furthermore, this market includes not only experienced gamers, but also possible first-time players and the games must therefore be even more accessible.

Hardcore gamers generally want the richest possible experience from their games. For serious games, however, it is more important that the model or simulation can be used to solve a problem, than providing “rich experiences” of the kind sought by hardcore gamers. Further, for serious games it is essential that the most important elements of learning are in focus, and that the assumptions necessary for making a simulation workable are correct – otherwise the simulation will teach the wrong kinds of skills. Entertainment games, on the other hand, allow players to focus on the fun parts and to use a number of techniques (random numbers, time compression, etc.) for simplifying the simulation processes. In serious games, Michael and Chen (2006) argue, it may be important to rethink the use of such simplifying techniques. For example, serious games should respond more to the conscious decisions made by players than to chance, and therefore randomness may be inappropriate. Another example is communication, which often is perfect (i.e., without delays and misunderstandings, etc.) in entertainment games, whereas some serious training applications should rather reflect that communication seldom is perfect. The differences between entertainment games and serious games are summarised in Table 1.

Table 1. Differences between entertainment games and serious games.

	Serious games	Entertainment games
Task vs. rich experience	Problem solving in focus	Rich experiences preferred
Focus	Important elements of learning,	To have fun
Simulations	Assumptions necessary for workable simulations	Simplified simulation processes

Communication	Should reflect natural (i.e., non-perfect) communication	Communication is often perfect
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What exactly the conception of serious games includes, however, is not all agreed upon. For instance, the essay “*Serious Games: A Broader Definition*” (lostgarden.com), which discusses serious games from a business perspective, criticises descriptions of serious games as being too narrow. According to its author¹, great many groups are interested in serious games, but each group has a radically different understanding of the term. It is also argued there is more value within game development than merely games for “education, training, health, and public policy”, as suggested, e.g., by the Serious Games Initiative’s definition (cf. above).

Hence, there is a need for a definition that includes the core reason for why businesses care. For many people the benefit of games is still questionable, partly due to the lack of overwhelming and concrete evidence showing that games are inherently useful tools, and partly because the broader world still sees games as toys. *Game technology*, on the other hand, is another matter. Stressing the importance of 3D, the author argues that in games it allows users to experience realistically simulated situations difficult to experience in the real world. Furthermore, people get an intuitive understanding that a 3D application replacing a certain real world activity could be of immediate value. In the author’s view, many companies are not primarily looking for games *per se*, but rather 3D applications to solve business problems. However, game developers and designers are fooled by the recent interest in 3D technology, and when business people are saying “game” they are likely talking about a “3D application”. However, not all 3D applications using modern game technology are “games”, and they do not need to be fun or have any learning or reward systems. For instance, as described by the author, there is an application for building 3D airplanes – an application that solves a business problem. However, while the application is “game-like” and uses game technology, it is not a game; “game” is but a name for the application.

In the author’s experience, most customers need a 3D application that only uses game technology and not game design, for which a simple solution could be to separate *game-based solutions* from other types of *3D applications*. However, the differences are not all clear. For instance, a 3D application user may reach his/her goals by manipulating a tool that has game attributes, even though it is not a game. Also, a training application may be experienced as being “fun”. Despite these uncertainties and border-line cases, the author suggests serious games be categorised into:

- **Games:** applications focused on learning, simulation and fun.
- **3D applications:** applications that use 3D game technology and techniques to solve business problems.

These categories are also said to overlap in that,

- There are 3D applications that are not games
- There are 3D applications that are games
- There are games that are not 3D applications

The author also criticises the fact that many of the websites covering serious games focus much on the game aspect and less so on the technology and process transfer into 3D applications. Hence the author suggests the following definition:

“Serious Games: *The application of gaming technology, process, and design to the solution of problems faced by businesses and other organizations. Serious games promote the transfer and cross fertilization of game development knowledge and techniques in traditionally non-game markets such as training, product design, sales, marketing, etc.”*

To summarise, there are many different terms, that all point to what is here called serious games. Yet, the concept is defined in many ways; definitions agree on some matters, but also vary depending on different perspectives and interests. One issue most definitions agree upon, more or less, is that serious games are concerned with the use of games and gaming technology for purposes other than mere entertainment or “fun”. Such purposes include education, training, health, etc. Although fun and entertainment is excluded in many authors’ definitions, or used for drawing a line between serious and other games, others argue they constitute key components of serious games. In the next section we define our own view on serious games.

Advantages of Games and Serious Games

An important issue when it comes to serious games concerns the acclaimed benefits of their use. Although serious games generally are considered to increase various skills, there may be a lack of evidence, which poses a potential threat to serious games. Disciplined studies of gaming are few, and as Squire et al. (2005, p.34) point out “[t]o date, we actually know relatively little about the consequences of game play on the cognition of those who play them” (cf. Squire, 2002). What we do know is that games, simulated environments and systems, etc., allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc. (Corti, 2006; Squire & Jenkins, 2003). We also know that analyses have been conducted over the years, consistently showing that games promote learning (Szcurek, 1982, VanSickle 1986, Randel et al., 1992, in van Eck, 2006). At the same time, it seems difficult to draw any firm conclusions from studies on computer and video games due to conflicting outcomes (Mitchell & Savill-Smith, 2004). Regarding games and their possible impact on gamers, Mitchell and Savill-Smith (2004) discuss a number of such issues. Possible negative impacts include: health issues (headaches, fatigue, mood swings, repetitive strain injuries, etc.), psycho-social issues (depression, social isolation, less positive behaviour towards society in general, increased gambling, substitute for social

relationships, etc.), and the effects of violent computer games (aggressive behaviour, negative personality development, etc.).

Regarding positive impacts, games can support the development of a number of different skills, as discussed by Mitchell and Savill-Smith (2004); analytical and spatial skills, strategic skills and insight, learning and recollection capabilities, psychomotor skills, visual selective attention, etc., and even violent games can be beneficial in that they provide an outlet to alleviate frustration. More specific positive impacts have been reported, e.g., by Enochsson et al. (2004), who found a positive correlation between experience in computer games and performance in endoscopic simulation by medical students. The better performance of gamers is attributed to their three-dimensional perception experience from computer gaming.

Similarly, in architecture and design, computer games can be used as a means of developing student confidence and abilities in spatial modelling, design composition, and form creation (Coyne, 2003; Radford, 2000). Guy et al. (2005) suggest playing with three-dimensional models as a means for enhancing town planning. Moreover, DeLisi and Wolford (2002) report on how spatial abilities, more precisely, the capacity for mental rotation, can be improved by playing games such as Tetris. Experiments, in which the test group used specially designed software for attention training, has shown that even non-systematic experience with computer games improved attention behaviour of children (Navarro et al., 2003). Further potential benefits of games include improved self-monitoring, problem recognition and problem solving, decision making, better short-term and long-term memory, and increased social skills such as collaboration, negotiation, and shared decision-making (ELSPA, 2006; Mitchell & Savill-Smith, 2004; see also Rieber, 1996). For example, Squire and Steinkuehler (2005) report that playing on-line community games actually is a matter of creating knowledge together, being an activity which fosters various types of information literacy as well as developing information-seeking habits. These activities are examples of required knowledge in order to find information in any library or on the Internet. Other examples are that gamers develop their thinking strategies towards more analogical thinking rather than trial-and-error thinking (Hong & Liu, 2003) and that game elements such as competitive scoring, increasingly difficult levels, and role playing have proven useful in corporate training (Totty, 2005). Yet another benefit is pointed out by Squire and Jenkins (2003), who argue that games can be a powerful way of introducing new concepts and tie together disparate periods of history.

To a large extent the debate concerning negative effects of (violent) computer games resembles the debate on the effects of video violence, and the negative effects of gaming, such as increased aggressiveness, are still under debate. During a survey on gaming experience and driving behaviour, Backlund et al. (2006) found that traffic school students with a high experience in computer games were ranked significantly higher by their instructors regarding their driving skills compared to students with a low experience. However, no evidence was found to indicate that experienced gamers have a worse attitude towards fellow road-users or traffic safety. Another example is Baldaro

et al. (2004) who evaluated short term effects on physiological (arterial pressure and heart rate) and psychological (anxiety and aggressiveness) factors of playing video-games. The study was conducted on expert players and the results indicate short term effects on physiological factors from playing violent games as opposed to non-violent games. However, the results showed no effect on hostility measurements.

According to a survey by Durkin and Barber (2002) there is no evidence of effects on measures of aggressiveness. On the contrary, some experiments actually indicated reductions in aggression. Such ambiguities indicate a need for more investigation.

Despite these (and other) findings, it seems there is no conclusive answer to the question of evidence for the acclaimed benefits and potential consequences of games and game play. Yet, van Eck (2006) argues that the proponents of digital game-based learning actually have “gotten through the message that games in education are beneficial”, and therefore they need a “new message” (p.17-18). He further argues that continuing to preach the effectiveness of games may create the impression that “*all* games are good for *all* learning outcomes, which is categorically *not* the case” (p.18). Subsequently, research now needs to focus on explaining *why* games are engaging and effective and, there is a need for practical guidance regarding *how* (when, with whom, and under what conditions) to integrate games and learning processes to maximise their learning potential. The reason games are effective, in the view of van Eck, is “not because of what they are, but because of what they embody and what learners are doing as they play a game” (ibid., p.18). One of the reasons why games are effective is that learning takes place within a context that is meaningful to the game; learning in a meaningful and relevant context is more effective than outside that context, a point long argued in situated cognition (cf. Rogoff, 2003; Gee, 2004). Similarly, Squire and Jenkins (2003, referring to Card’s 1985 science fiction novel ‘Ender’s Game’) argue that games should be like the places where kids hang out because that is where much learning takes place; “educational games should be like school corridors, where kids experiment, interact, create, and share what they create with others, outside the rigid structures that contemporary games impose” (p.8).

However, as argued by Squire and Jenkins (2003), the outcome of game playing also depends on the goals the player sets for her/himself.

Classification

There are several ways in which serious games are being classified into subcategories and while the general trend seems to be to classify the games purely based on the objective of the game there are other ways of dividing them into subgroups.

To create a taxonomy of the games it would be valuable to look at the type of game play is being featured.

Gameplay

One interesting way of looking at what type of game being discussed is to look at its approach in terms of play. There are two distinct approaches to making a serious game.

Game-Based

Some of the serious games are designed as a game where there are clearly defined goals to reach. In these types of games the player traditionally gets rated according to how many objectives were met, and how well the tasks were met.

These types of games can be won or lost based on the player's performance.

Play-based

The other type of games is the play-based game where there are no defined objectives, no score system and no real sense of winning or losing. The player can navigate freely through the virtual world and can define own goals within the game if desired. While nonserious games also feature these categories, the play-based model is not as frequently used as it is in serious games. Another way of thinking of the games in terms of game play is turn-based versus real-time games. In turn-based games the player performs some task and is then forced to wait for some NPC to counter that action, while real-time games feature a more independent chain of events. The real-time option is by far the more realistic of the two.

Domain

Another way of classifying the games may be via what domain it is intended for. The biggest sectors have for a long time been military and defence, medicine and health care, but applications for the public domain are quickly gaining.

Other domains include advertising, politics, art, religion, culture, research, education, government, general management, organizational behaviour, finance and technology management.

Purpose

Edutainment: Games with primary focus of education or training.

Advergaming: Games with primary focus of making the player aware of a special product.

Infotainment: Games with primary focus of making the player knowledgeable on a particular topic.

Health and Wellness games: Games with primary focus of physical conditioning, as a therapy in treating illness or as a diagnostic tool.

Propaganda games: Games with primary focus of altering the player's mindset or behaviour.

Visual aid games: Simulators providing the user with an alternate way of interpreting a given dataset. Political and Social games: Games with primary focus of informing the public of current political situation.

Mirror or metaphor

The serious games try to mimic the real world in such a way that the user can relate his/her experiences to one certain domain.

In order to achieve this a virtual world is built. These virtual worlds being created can either be a model of real existing environments (mirror), or fictitious places (metaphor).

Serious games within the medical sector require the real world to be mirrored in great detail. Approximations regarding patients computed tomography or magnetic resonance imaging scans is not a viable option, whereas a driving simulator has room for more artistic freedom regarding scenery.

Though the metaphor models do not depict a real place, they are often made with a realistic look.

2 The European and Worldwide Perspective

According to Wikipedia (en.wikipedia.org), main users of serious games are currently the US government and medical professionals. However, other commercial sectors are beginning to see the benefits and are actively seeking development of such tools. Serious games can be applied to a broad spectrum of areas, but, as with almost anything, they can be categorised in a number of different ways. Some categorise serious games into pedagogical, idealistic, politic, or societal games (nyteknik.se, spel.bth.se). Other examples are education, healthcare, national security, corporate management, and more (www.coventry.ac.uk), or education, health, public policy, science, government, and corporate training (usatoday.com). Yet another, but similar categorisation is provided by Zyda (2005), who states that serious games technology can be applied to domains as diverse as healthcare, public policy, strategic communication, defence, training, and education. A number of further (military) application domains are provided in the call for contributions to The Serious Games Showcase and Challenge (sgchallenge.ist.ucf.edu), which has the purpose to identify innovative game based solutions to problems that could affect the Military both today and in the future. A partial list of what is regarded as military missions is provided, which includes medical, maintenance, aviation, combat, leadership, logistics, ship handling, strategic planning, military history, electronics, communications, engineering, flight deck operations, business management, finance, criminal investigation, intelligence/reconnaissance, combat awareness, acquisition, political science, health/nutrition, language and linguistics.

In the following, the categorisation of serious games into a number of markets, provided by Michael and Chen (2006), is adopted. The markets are: military games, government games, educational games, corporate games, healthcare games, and political, religious and art games, of which the first four are described in the next section (for more details, see Michael & Chen, 2006). This way of categorising serious games is very much in line with what is regarded as the core segments of serious games (www.seriousgamessummit.com). Despite such categorisations, notably many games could belong to more than one category.

Military Games

The military has a very long history of using games for training. Among the oldest war games are the board game *Chaturanga* from India and the Chinese *Wei Hei*, both from about four thousand years ago (Michael & Chen, 2006). These games with simple rules, allowing officers to become better planners for battles, have evolved into extremely complex simulators for tanks, helicopters, group training, etc. Along with the development towards more advanced simulators, the relative amount of money spent on games for the military has also changed, and simulation equipment and war games take up \$4 billion (> 3 billion Euro) a year (*ibid.*).

Historically, military simulations have been, and still are dominant, but there is a move towards the use of “commercial off-the-shelf” components in both software and hardware (Michael & Chen, 2006). For the military, game technology allows to create low-cost simulations that are both accurate and engaging, and for a severely lower cost than traditional simulations. The military is also the major user of serious games, but in a near future, the military will not buy static CD-ROM serious games. Rather, they will buy components that allow them to dynamically put together pieces of software and (or) hardware, and thereby set up their own games². There are several commercial civilian war-games used by the military, for instance, *TacOps*, *Brigade Combat Team*, *Decisive Action*, and *Harpoon 3*, and examples of commercial games that have been adapted for military use include *WarCraft*, *Doom*, *Close Combat* and *Operation flashpoint* (Robel, 2004; Michael & Chen, 2006).

The first “serious game”, designed and used for military training, was *Army Battlezone*, designed by Atari in 1980 (en.wikipedia.org). However, one of the most well known, and perhaps the leading example of a serious games application was released in 2002 – America’s Army – which, in contrast to most video games, is free for download (americasarmy.com).

The game emphasises authenticity and, for instance, all weapons and vehicles are strict virtual models of the real thing. Furthermore, unlike other games (e.g., *Halo 2*, *Doom 3*); it is only a relatively small step from virtual combat to the real thing (Grossman, 2005). By autumn 2004, America’s Army had been downloaded over 17 million times, had a community of 4 million registered players, and the number of players increased by 100 000 each month (Michael and Chen, 2006). Obviously, America’s Army is a popular game, and even though violent games is a controversial issue, it has been said “The violence, the combat – we recognize that’s the part of the game people want to play”, but it also “has to be fun...[i]f it’s not fun, you don’t have a game” (Major Chris Chambers, in Grossman, 2005).

America’s Army provided a solution to a problem encountered by the U.S. Army in the late 1990s, namely how to reach and recruit new volunteer soldiers (Grossman, 2005). With an investment of 16 million dollars in America’s Army (by the U.S. military), the game has been a success in that it has helped the Army to recruit soldiers at 15% of the cost of other recruiting programs (Grossman, 2005; Michael & Chen, 2006). Furthermore, besides recruiting volunteers, the game has also helped pre-training them, and with later modifications and extensions it has also been used by active soldiers to, e.g., prepare for missions (Michael & Chen, 2006). Another benefit (for the Army) of this particular game is that its target audience has found it to be a major source of information and knowledge about the Army; it is reported that 30% of Americans between the ages 16 to 24 claim to have learned some of what they know about the Army from this game (Grossman, 2005).

From a military perspective, video game playing (more generally) has a number of advantages, such as improved hand-eye coordination, improved ability to multitask,

ability to work in a team using minimal communication, and willingness to take aggressive action (Michael & Chen, 2006). Many previous simulations and games have concerned combat, but more recent efforts also concern skills such as foreign languages and cultural training, and future application areas for the military field include massively multiplayer online games (MMOGs) and virtual reality trainers (ibid.).

Government Games

Training and simulation within the government range from a municipal level to a national level. Governmental games may concern a number of different kinds of tasks and situations, like different types of crisis management, for instance, dealing with terrorist attacks, disease outbreaks, biohazards, health care policy issues, city planning, traffic control, fire fighting, budget balancing, ethics training, and defensive driving (Michael & Chen, 2006; Squire & Jenkins, 2003). A major advantage of computer simulations is that they allow scenarios to be run repeatedly. They can also be carried out with varying degrees of severity, at different locations, etc., often with low costs in personnel and material resources. Simulation games also allow different types of first responders, e.g., fire fighters, police, and medical personnel, to practice situations that are too dangerous, impossible, or too expensive to carry out in reality to practice handling events that are otherwise dangerous, impossible or expensive to train on.

Educational Games

Educational games did not come into wide use until the 1990s with multimedia PCs, even though such games were created and used long before. At the time, educational games and other software evolved into “edutainment”. However, interest in edutainment soon decreased, partly because of the (poor) quality of the games themselves, and partly because of a growing interest in the Internet (Michael & Chen, 2006). The problems encountered in edutainment are reflected in phrases such as “edutainment, an awkward combination of educational software lightly sprinkled with game like interfaces and cute dialog” (Zyda, 2005, p.29), or “most existing edutainment products combine the entertainment value of a bad lecture with the educational value of a bad game” (Squire & Jenkins, 2003, p.8).

With the general renewed interest in serious games, game developers have moved from “skill-and-drill interactive learning paradigms towards situational and constructionist approaches” (ELSPA, 2006, p. 17). Games in education is gaining acceptance, but their use is not widespread, and it is a controversial issue (ELSPA, 2006; Michael & Chen, 2006). Educational games is also faced with the challenge of providing research evidence of the acclaimed benefits, which currently is “complex and thinly spread”, possibly because the study of games and gaming relates to several different disciplines; “as a result of the diversity and complexity of games themselves, and the range of perspectives taken by researchers, there are few hard and fast findings in the literature” (Kirriemuir & McFarlane, 2004, p.2).

Despite the “few hard and fast findings”, research is showing positive effects of games as educational tools. Games can support development of a number of various skills: strategic thinking, planning, communication, collaboration, group decision making, and negotiating skills (Kirriemuir & McFarlane, 2004; Squire & Jenkins, 2003; see also Gee, unpublished manuscript). However, “hard facts and evidence” is for future research to provide. There is also a number of concerns to consider in order to realise the full potential of games as educational tools: resources (many schools have computers that are too old for new games, technical support, time for teachers to familiarise themselves with the game, etc.), how to identify the relevance of a game to statutory curricula, difficulty in persuading school stakeholders to the potential benefits of computer games, etc. (ELSPA, 2006; Sandford et al., 2006).

3 Legislation and Policy at national level in United Kingdom, Bulgaria, Italy, Lithuania and Sweden

National education policy concerning Serious Computer Games/ innovative technologies

The research showed that there is a big variety concerning serious computer games integration in education among the partner countries. The official policy documents in the major cases mention ICT, but do not specify the educational games. However there is positive attitude in all policy documents, even without clear underlining this particular area:

Sweden

There is no explicit national policy but it could be derived from the on-going assignments that the Government gave to the National Agency for Education in 2009. The tasks given to the agency are:

- Knowledge dissemination about the use of ICT in the teaching and learning processes, about digital tools and learning resources
- Support the development of communication between schools, pupils/students and homes
- Monitoring the development, research and other national and international studies
- Maintain and develop the dialogue with all stakeholders i.e. other agencies, interested organisations, vendors and other parties concerned
- Promote the safe and critical use of ICT
- Perform regular follow-up studies At the local level ICT policies are common according to follow-up studies. These are decided at the municipal level (sometimes at the school-level).

In the decentralized Swedish school system the responsibility for ICT is shared. The role of the Government and its Agencies is to promote the use of ICT in education, mainly by supporting the municipalities and independent schools in their tasks. The Agencies promote the use of ICT in education by developing user-friendly ICT tools for in-service competence development and school improvement as well as by stimulating the educationalists to increase their knowledge and competence. There is also follow up-studies made regularly every three years at national level. The responsibility of the municipalities/independent schools is to provide access to computers and Internet in schools as well as to ensure that practitioners i.e. teachers are skilled in using ICT as a pedagogical tool. At the school level the responsibility is to choose methods and means

to achieve the overall goals stated in the Education Act, the curriculum and other guiding documents.

Bulgaria

The topic of the “serious computer games” is not included in the national legislation of the Republic of Bulgaria, but the interest towards it as well as the application in practice find more and more place in the educational policy of the country and in practice. Educational games or the so called “serious games” are applied more and more as an important educational instrument at schools and in some companies.

Lithuania

The use of ICT tools in education is determined by the national „Strategy for the Information and Communication Technologies Implementation into General Education and Vocational Education and Training for 2008-2012”. IT curriculum in vocational training schools is relevant to 9-10th grade IT course in compulsory education. It seeks to summarize and structure students’ skills, to teach them to use acquired abilities purposefully, to orientate students in reasonable usage of technologies. This stage consists of 4 activity fields: information editing with computer; text documents: creation, editing and publishing; internet and internet services; data managing and presenting with data application.

The department of the Ministry of Education and Science - Centre of Information Technologies for Education are selecting and presenting appropriate applications in the database of educational resources: <http://portalas.emokykla.lt/Puslapiai/SMP.aspx> While digital educational tools are recommended to use in education there still a big demand for appropriate digital learning tools. Using of serious games is a new approach in Lithuanian VET system and much advanced in students’ motivation to study in VET schools.

The Netherlands

There is no national educational policy concerning SCG. However there is a tendency to stimulate the use of new techniques.

Italy

There are some governmental (The Education Ministry) indications about the use of technologies and computer in the educational process. They were written to improve teacher knowledge and in order to realize the 2000 Lisbon Strategy directions. The last national education policy document we could find is dated back to 2002.

The current extent of Serious Computer Games usage in VET

Sweden

None knows about this. But a general opinion is that using ICT and Serious computer Games within VET education depends mostly on the interest of the teacher. If you have an active and interested teacher the possibilities for using this in the education is higher than if you have a teacher who prefers not to.

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Bulgaria

More and more companies invest in the re-qualification of their staff by the help of computer games which are specially designed for their needs and through them the members of the staff learn. In the bigger companies the percentage, which is invested in this, is 10-20% of the budget which is intended for re-qualification. These **games** are ideal for encouraging strategic and economic way of thinking, as well as skills for

planning. It is even suitable for schools to educate by “**serious games**”. Children play and for each correct answer, for each correct letter they are rewarded. The efficiency of education through games was proven long time ago. Even adults learn more quickly and easy. This is not something new, but nevertheless schools don’t use much of this knowledge. They could profit from this genre of games much more. “**Serious games**” are very good for learning languages or for school subjects like History. The first research has proved the success of these games. Yet, these games can’t be equally successful at all types of educational activities. Especially if social skills are concerned, for instance, “**serious games**” can’t be so useful. If a sales assistant wants to learn how to be more polite with the clients -somebody’s personal example would be more useful. What is more – the screen could restrict the movement of the learner. For example, if a doctor would like to learn how to perform a heart operation he would rather need practice in pathology.

A successful example of a “**serious game**” is “**Techforce**”, where players can deal with metal particles which could inspire their interest in metallurgy as a profession. Costs for such a **game** amount to between several thousand and several million euros for a game with 3D environment and play time approximately 30-40 hours. Games for Gameboy or portable games-consoles are very cheap to be developed. Its accessibility makes education entertaining.

When reviewing the problems of university students who qualify to become teachers and work with serious computer games the following main difficulties/problems/barriers have been identified, which are connected with pedagogical training of future teachers. These were grouped in four areas: administrative, organizational, contents and those which are connected to the **students** – their motivation, activity, qualification, etc. The three groups of interviewed people who have taken part in different ways with different tasks and competencies in pedagogical training and practice – hence assessing from a different professional perspective – have identified different problems which pertain to the above mentioned areas. This has allowed looking for the cross-section where the problem areas meet and the differences in the opinions of the interviewed people at a later stage of the research. According to the opinions of university teachers who supervise students’ training the following problems are the most frequent:

- Problems with administrative character
- Problems of organizational character
- Difficulties connected with the contents of teachers’ practice
- Difficulties/Problems connected to the students.

Young teenagers could be extremely difficult to motivate. Teachers will immediately see the potential of the game, especially if it is played online, and thus they will attract and motivate their students.

To understand why computer games engage attention, first, we have to understand why people play games. For the recent years the research on motivation has reached

development in its efforts to explain why people behave in a certain way. Researchers who have investigated theory of motivation since the time of Maslow (1970) explain this behaviour from the point of view of human needs and desires. In the theory of self-motivation Ryan and Deci (2000) distinguish between the different types of motivation based on different reasons and aims which lead us to action.

Taking into consideration methodology we could discuss whether games in changing reality give us external or inner motivation. Inner motivation comes from awards concerning the action itself – the pleasure from playing the piano for instance. According to Ryan and Deci the students have been told to be inner-motivated when they take up a certain activity without expecting “visible award apart from the activity itself”. Research has shown that inner motivation is usually connected to high educational achievement and pleasure. Among main researchers who deal with the theory of motivation are Heider, Bandura, Ryan and Deci. Usually students have inner motivation if:

- their educational achievements come as a result of inner factors which they can control themselves (for example, the invested personal time and efforts);
- they think that they can be effective in researching the desired aims;
- they can effectively take part in the process of learning instead of memorizing by heart to receive good marks.

Games in changing reality give respond to these expectations, for example the game “The Tower of Babel” includes award system and a tower which has to be built, e.g. a system of external motivators, which students who prefer to be externally motivated, will like. While students are playing they can watch their tower become higher - which functions as a visual motivator. However, they can’t see the rest of the towers and in the alpha version of the game they don’t see the building of the world tower constructed with the efforts of all the players either. Students may know how many points the other participants in their group have, but they can’t see who the winner is. In fact in this game all the participants are winners.

The Netherlands

There is not a lot of real SCG use in VET in the Netherlands. What you see is that teachers use simulation programs and call it a game. In the case the teacher is enthusiast, you will find more use of SCG, it is based on the individual choices of the teacher.

Italy

Serious Computer Games are not well known or promoted for VET age groups in Italy. The main intent in using technologies is: increase of attention abilities, simulation of real situations, linguistic or mathematic recovery courses.

The most effective mechanisms to bring a change in practice

Sweden

Teacher training within this i.e. why SCG is a good complement within VET, how to use it and how to continue and develop the skills/knowledge received is most important!

Many teachers also think that ICT within education is very important. This because they think it increases the students motivation, learning and also problem solving. Using ICT within education is also good for students with special needs.

Priorities in Sweden are also:

- Curriculum development
- Digital learning resources
- ICT for learners with disabilities/special needs

Bulgaria

Malone and Lepper (1987) introduce a theoretical frame of the factors which influence the inner motivation while creating educational computer games. According to them inner motivation consists of four individual factors: challenge, imagination, curiosity and control, as well as three interpersonal factors: mutual work, competition and acknowledgement. Interestingly, these factors also describe what a good game looks like – no matter what its educational qualities are. Although inner motivation is highly recommendable, many of the activities in which students take part are directly influenced by external motivators (Csikszentmihalyi & N, 1989). Unfortunately there are proofs that external motivators can lead to performing a narrow range of activities reducing the interest in the relevant topic in long-term perspective. While learners who are motivated by inner factors usually demonstrate bigger persistence, desire to work, active application of strategies and successive memorizing of key information (Guthrie *et al.*, 1996). Therefore, external motivators must be supported by inner motivators; otherwise the expected results are not likely to be achieved. According to research of the last two decades one of the most serious problems is that: when using only external motivation - the effect on students' development is opposite to the expected one (Lepper & Hodell, 1989).

It would be especially effective to train trainers, as well as to create inner motivation for using “Serious games” in teachers' practice.

Lithuania

During the last years a need of a new policy for implementing information and communication technology (ICT) in education has emerged. The Strategy for ICT implementation in Lithuanian education has been developed. Teaching and learning information technology (IT) course in schools is one of the most relevant issues in information society. However the goals and nature of the IT still have to be introduced

into curriculum. It should be developed links with other school subjects and estimates the relationship between the compulsory IT course and the integrated parts as well as elective modules. The issues of general competencies essential for a contemporary citizen and the role of ICT in their development are also important.

The Netherlands

The curriculum is built up around a group of competences, and written on the bases of a detailed description of the profession to learn (so called qualification dossiers). When you want to implement a game in VET schools, it is important to point at the part this dossier the game is aiming. Than the teacher should have a lesson plan, on how to use the game. The closer the game and its topics are related to reality AND the qualification demands for the profession, the more interesting it will be to use it in class, so the more chance to have it implemented.

Italy

Surely the most effective mechanism to bring changes would be more teacher training workshops and more recent computers and technologies in Italian schools. Normally technologies at school are ten years in late compared to present.

4 Education and SCG related resources at national level

Serious Computer Games and technology-led project work in relation to VET

Sweden

It is very hard to answer this question because there is no easy way to get a good overview of this. But at Swedish universities there are many programs and courses concerning this. In this following link you can see a map over Sweden and how many universities that have education within games/gaming.

<http://sverigesradio.se/diverse/appdata/isidor/files/1646/11615.pdf>

<http://www.skolverket.se/skolutveckling/itiskolan/reportage/yrkesutbildning/spel-1.139908>

Above is a link to an article about using computer games within VET, (business).

<http://www.skolverket.se/skolutveckling/itiskolan/reportage/yrkesutbildning/teknikprogrammet-1.139909>

Above link is how they use Internet programs/education within VET (technics).

As I have understood this is also a lot up to the teachers! There are many teachers using games within their teaching but I got no answer to the question so I can not really list any projects on this. <http://www.his.se/nyheter/dataspelande-skapar-utbildningsmojligheter/>

Above is a link to an interesting report on how computer gaming open up for other education possibilities.

<http://dspace.mah.se:8080/handle/2043/9993>

Above is a report on how good it is to integrate computer games in science education.

The Netherlands

There are a few projects concerning SCG in VET, EnerCities.EU is one of them. There has been a project “Enterprice” about an entrepreneur’s game. On the next link, you’ll find games used in VET schools:

<http://www.games2learn.nl/Categorie:Games-BVE>

Bulgaria

Although in practice they are not used enough, the interest in developing and using them is significant. Here are examples of relevant projects:

Project ENERGY-WISE

The main aim of the project Energy Web Interface for Skills Enabling (ENERGY-WISE) is to improve the ability of European small and middle enterprises to improve their efficiency as final consumers of energy. Teaching techniques for energy management envisage administrative and technical education of energy managers, construction operators and other people who are responsible for energy efficiency with possibilities

to save energy reducing carbon emissions while achieving the targets of their organizations and saving money.

The project ENERGY-WISE is based on technologies for education through games and other materials for electronic learning which are similar to the projects developed within the Programme Leonardo da Vinci InTeLS (<http://www.intels.biz/>) and YENTELES (<http://www.yentels.com/>). It is grounded on the bases of the lessons learned by the partners in the projects InTeLS and YENTELES and the basic technological platforms developed by them.

Project YENTELES

The main purpose of the project YENTELES is to offer young people in Europe educational programmes which stimulate innovative ideas and to stimulate them for starting their own companies. We perform this through developing a complex of educational materials based on simulation/computer game which will facilitate reaching of entrepreneur skills which are necessary for preparation and starting own businesses. The project is aimed especially at young people who have chosen not to follow the traditional way to higher education but prefer professional careers.

The course for electronic learning YENTELES and the relevant game have been translated and adapted for testing in the four partner-countries of various regions of Europe – The United Kingdom, Spain, Sweden and Bulgaria - in order to guarantee wide application.

The partners in YENTELES intend to popularize the project's results in the other parts of Europe and to research the possibilities for its future development so that they become applicable to as many young people as possible in Europe.

Lithuania

There is an educational portal consolidating all educational recourse available for formal and informal education: eMokykla (eSchool). The portal aims to provide access to educational resources and electronic services to educators, parents and students: <http://lom.emokykla.lt/public/index.php>

Italy

We couldn't find any explicit project about SCG on the net. Maybe there are experiences somewhere, but the use of computer games in education is not consciously promoted.

Conclusions

Computer games are essentially software that encourages the users to use higher-level cognitive skills in order to resolve conflicts, seek optimal solutions and visualize a given problem. The ability to create specific characters and create storylines filled with humour and/or drama can help create memory hooks that make the user not only remember what happened, but also why it happened. Regardless of the type of problem the user is trying to solve understanding the why's as well as the what's greatly increase the ability to learn, and the flexibility to apply that knowledge to other problems.

The lines between serious games and non serious games have been blurred in some extent. Commercial games made with entertainment as a main focus are becoming more and more lifelike as the technology and knowledge of the fields improve.

One challenge of serious gaming is that a computer does not think for itself. While the advances of artificial intelligence have come a long way, it is not possible for a computer to completely mimic the seemingly randomness of human interaction. Multiplayer games have a distinct advantage in that players can explore the game world as a team and have the same human interaction as they would have in their domain.

Serious games are not just developed by programmers. In order to make the game world as true to the domain it is covering it is necessary to cooperate tightly with experts from other fields.

Serious games research in the US seems to be more "visible" than in the European countries, a plausible reason being that research in the US has matured to a level not yet reached in many European countries. Not all actors in these regions are represented though, for a number of possible reasons. For instance, some research may not (for whatever reason) have been made available in the first place. Also, an important factor is in which language research is made available (not all researchers, universities, etc., have English as their first choice of language).

Within Europe, serious games research is most clearly discernible in the UK, with boundary crossing research established at many locations and geographical areas. Besides the UK, serious games research appears to be mainly concentrated to the Scandinavian countries, in which such research to some extent already has been established, but also is in a strong developmental phase. Similarly, it can be expected that we will see a substantial growth in serious games research and number of various actors in several regions over the next few years.

References

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<http://www.smm.lt/en/vtlll/docs/2000-2008-VET-development-LT.pdf>
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ANNEX II: QUESTIONNERE FOR THE STATE OF ART AT NATIONAL LEVEL

Country:

Partner:

1. What is the national education policy concerning Serious Computer Games/ innovative technologies at your country? Can you list any concrete national legislation documents related to innovative ICT, i.e. SCG use in education?
2. What is the current extent of Serious Computer Games usage in your country for VET age group?
3. What is the current extent of Serious Computer Games and technology-led project work in relation to VET in your country?
4. Can you give references or links concrete projects and related SCG recourses?
5. What are the most effective mechanisms to bring a change in practice (e.g. involvement of educational policy implementers, teacher training workshops, etc...)?