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Digital Games in eLearning Environments

Current Uses and Emerging Trends

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The notion of using games in education is as old as games themselves. In addition, the massive market opened by the digital games industry has caused great interest regarding their specific potential in education. However, this interest is sometimes thwarted by the resistance of traditional educational settings toward technology-enhanced learning and digital games. The future, on the contrary, is much more promising within the eLearning field. This field is in a process of evolution and reinvention, seeking new features and ideas to improve the learning experience. We believe that educational games are a perfect medium for these new directions in eLearning. In this article, the synergies between the new eLearning environments and educational games are explored and reviewed.

Keywords: *adaptation; assessment; collaborative learning; debriefing; educational games; educational process; eLearning; game-based learning; learning design; learning management system; learning object model; learning styles; personalized learning; SCORM; social network; standardization; virtual learning environment; virtual world*

During the past few years, the acceptance of the potential benefits of educational gaming has increased gradually within the research community. For instance, it is widely agreed that educational games can increase the attractiveness of learning, giving an additional boost in the struggle against demotivation and dropouts, two issues that are very often closely related to learning (Parker, 2003). Besides, games can be used to connect specific content and skills with a friendly environment where the student is able to play, probe, make mistakes, and learn (Gee, 2003; Van Eck, 2007).

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Likewise, modern eLearning environments are again becoming a powerful force in technology-enhanced learning. The original idea was that the content could be taken out of the schools and textbooks and put into the Web, where students would be able to access it from the comfort of their homes. Unfortunately, around the mid-1990s this early interest resulted in eLearning systems that were huge repositories of content without student support features. They were usually populated by passive and unattractive content, and students could not find the motivation to use those materials (Levy, 2007). The dropout rates were enormous and some authors started to speak about the failure of eLearning (Zemsky & Massy, 2004). However, at the turn of the century, the boom of Web applications triggered a profound renovation of the eLearning field. These new Web technologies allowed the introduction of new features in eLearning, evolving and thus overcoming the content cemetery model. As a result traditional eLearning environments have been replaced by the so-called Learning Management Systems (LMS; Mayes & De Freitas, 2004).

Modern LMS allow the active participation of instructors in the educational process, giving them the power to track the activity of the students and guide the learning process. They offer communication mechanisms between students and instructor, which promotes the constitution of learning communities where the learning process is cooperative. This fosters the creation of *Communities of Practice*, in which the students learn collaboratively (Lave & Wenger, 1991).

Similarly, the content has also evolved: Now it is no longer passive text-based content, but includes multimedia and interactive elements. These contents can even establish a communication with the LMS to transmit tracking and assessment information, which gives the instructor a much more fine-grained control over the learning experience of each individual student.

In addition, the newest experimental systems offer mechanisms to adapt the content to the needs of different users (Dalziel, 2003; Grapple, 2008), thus customizing the learning experience to different student profiles. In addition, the entire process is done according to widespread specifications and standards that foster platform interoperability.

Remarkably, the requirements of all these new features that are being considered for the forthcoming generations of LMS can be covered by the use of games as the medium to deliver the contents to the students. In this work, we describe and review the potential advantages from three different perspectives: adaptive learning, reflection on the learning process (through tracking, assessment, and debriefing), and collaborative learning.

Limiting Factors and Potential Issues

Even if game-based learning can be a great complement to eLearning, several factors limit their real applicability, and they must be overcome to achieve a generalized implantation of games in these environments.

One of the major issues is the development cost. Michael and Chen (2006) present the results of a survey made during a session on serious games at the 2005 edition of the Game Developers Conference (www.gdconf.com). The survey included questions about the costs of the projects that were being developed at the time and most answers (26.23%) fit into the $100,000 to $500,000 range (with also a significant 14.75% in the $1,000,000-$10,000,000 range). Similarly, the results introduced by Aldrich (2005) estimate costs for the development of a "next-generation simulation" in the 15 to 30 person-years range. These figures are several orders of magnitude above the typical development costs for educational materials. In addition, the diversity of students and application contexts that is usually present in eLearning environments can make the cost factor even more crucial if the content produced can only be used in restricted settings.

One of the first things we need is alternative development methodologies that bring the costs in line with educational budgets and that support the maintenance of the contents. One approach is to use low-cost development platforms, like the <e-Adventure> educational game platform (Moreno-Ger, Blesius, Currier, Sierra, & Fernández-Manjón., 2008) or the Game Maker (Overmars, 2004). Other alternatives would include using premade game templates (Aldrich, 2005) or repurposing commercial products for education (Burgos, Tattersall, & Koper, 2007; Van Eck, 2006).

Another line of attack is to provide adaptive and maintainable games, flexible enough to be easily adapted or repurposed for different students and/or settings. This increased flexibility serves two different purposes: it broadens the potential audience for each game (reducing its relative development costs) and it can be used to provide each student with a more suitable game experience. As we will describe later, the notion of adaptable content has been present in the eLearning field for a few years, but games can lead to a revolution by offering new forms of adaptation that are unthinkable with less dynamic content. We discuss this approach in the Assessment and Debriefing section.

It is also important to keep in mind the fundamental role of the instructor in any educational process. Most experiences and literature reviews in game-based learning (Kirriemur & McFarlane, 2004; McFarlane, Sparrowhawk, & Heald, 2002) also identify as a key issue the reluctance of teachers to adopt new educational approaches. Sometimes, this rejection is based on the idea that games can teach, but also mislead. Any instructor willing to embrace game-based learning will necessarily need mechanisms to evaluate how the students are learning.

Many approaches allow the instructor to guide students through the game-based learning experience. Two typical approaches are to have the instructor present during the game session (to discuss with the students what they are learning and to promote reflection) or to hold debriefing sessions after game sessions. However, these approaches can represent a challenge when we consider online education, where physical presence is usually an issue. We discuss how games can open new forms of instructor-directed online learning in the Collaborative Learning section.

Finally, we should also highlight the different technological philosophies of both worlds (games and eLearning). Commercial videogames usually demand top-tier computers, very different in comparison with those we can find in classrooms. Even at home, not all the students would have this kind of sophisticated equipment. State-of-the-art games try to push technology to its limits. To protect investments, the games are usually sold as closed products, in most cases impossible to modify or adapt. The eLearning field also tries to protect the investments in content production but following the opposite approach. The field is immersed in a standardization process that tries to ensure interoperability across as many environments as possible, so that if an educational organization decides to migrate to another eLearning platform, their contents could be reused.

If we want to introduce games in the eLearning field, we need to pay attention to the current standardization initiatives within the field. The current standards were not designed with games in mind, but must be followed to assure the interoperability between platforms. All the potential enhancements that games can bring into eLearning must consider and follow these standards (Figure 1).

In the next sections, we analyze these three perspectives (adaptation, assessment, and collaboration) and then we focus on how to implement them according to current standards and specifications.

Adaptive Game-Based Learning

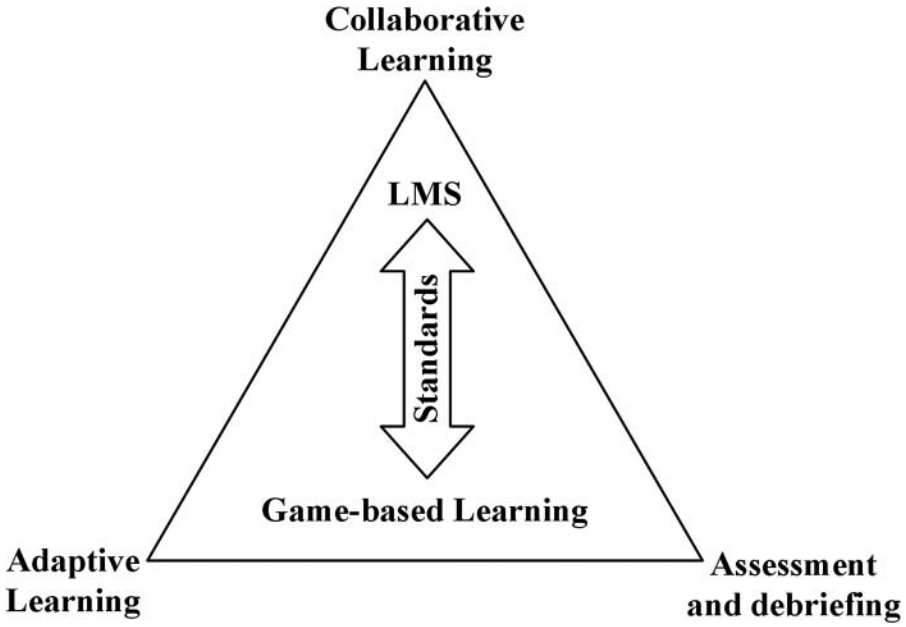
Recent research in the eLearning field has addressed the notion of personalized learning, in which the learning experience is adapted to the requirements of different users and contexts (Ahmad, Basir, & Hassanein, 2004; Chen & Magoulas, 2005). In summary, adaptation is the ability to modify lessons using different parameters and a set of predefined rules, in order to try to cater to the needs of all kind of learners and thus maximize the effectiveness of the learning experience.

Adaptation in eLearning

Adaptation is a very complex issue that can be carried out by taking into account diverse aspects. A first consideration is to identify which elements of the learning experience are going to be adapted. From the user interface through the materials to the learning process, many elements can be gauged to suit different users and roles. Another consideration is that adaptation can be carried out according to many different inputs, such as initial levels of knowledge, different learning objectives, user preferences, and even learning styles (Burgos, 2008), as depicted in Figure 2.

Indeed, adaptation is a wide and rich field. The field has evolved from the early 1980s, where computer-based training was used to fully control the flow of a learning process (Tennyson, 1980, 1981), to the concept of Adaptive Guidance, which

Figure 1
Key Benefits From the Integration of Games in Modern Learning Management Systems (LMS)

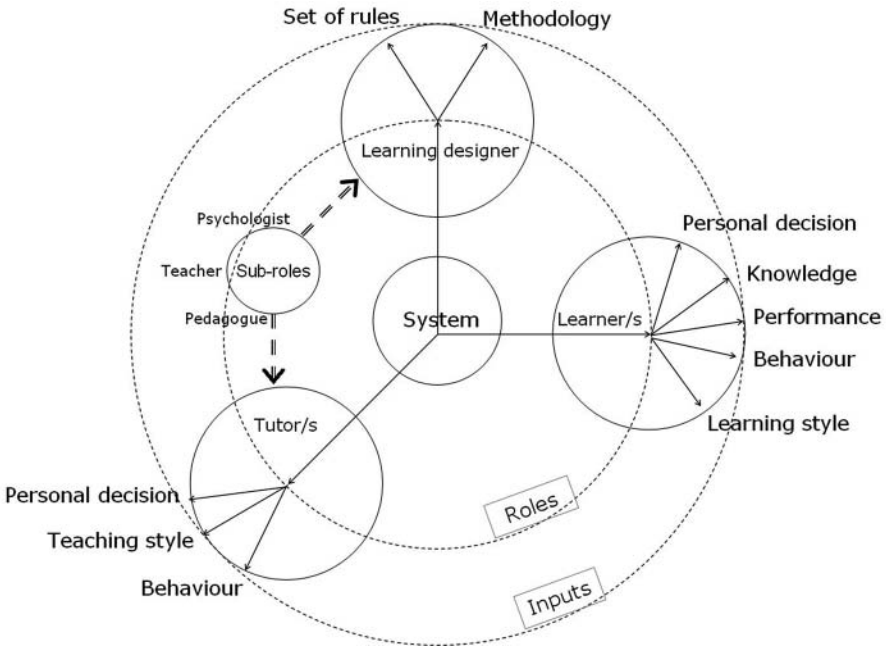


provides rich information and a diagnosis to help learners to take effective decisions about their own learning (Bell & Kozlowski, 2002). Furthermore, many approaches are possible: for instance, incorporating the tutor as a key factor in the adaptation process (Van Rosmalen et al., 2006) or building a blended system strongly supported by AI agents (Wasson, 1997). Both are examples of learning adaptation to the context of each student in order to stimulate their learning process and to encourage their involvement in the process (Fredericksen, Pickett, Shea, & Pelz, 2000; He, Kinshuk, & Patel, 2002).

Adaptation in Educational Games

Many game genres distinguish games in terms of game design, interaction modes, and narrative style. Different players tend to prefer different genres that better suit their own play style, which allows them to perform better. This fact is parallel to the notion of learning styles mentioned above. Rapeepisarn, Wong, Fung, and Khine (2008) present parallelisms between taxonomies of learning styles and game genres,

Figure 2
Adaptation Model With Inputs and Roles



suggesting that providing alternative games can be a good example of adaptation to suit different learning styles.

On the other hand, videogames are inherently adaptive. Commercial pressure pushes videogame developers to adapt game experiences as much as possible, in order to widen the spectrum of people who would enjoy the game, catering to different gaming styles and skills (thus increasing the range of potential purchasers). In this sense, videogames usually offer different difficulty settings targeting skilled and novice players. In addition, modern videogames have evolved and gauge their adaptation mechanisms, going much further than a simple difficulty level choice by implementing fine-grained adaptation mechanisms that sometimes are even performed transparently to the user in what is called Dynamic Difficulty Adjustment (Hunicke & Chapman, 2004; Robin, 2005). This kind of adaptation has been used in commercial titles such as MAX PAYNE™, where the difficulty is adjusted according to the performance of the player. Other games include similar concepts in their game design. For example, in MARIO KART™ racing games, the players that are trailing in the race receive better bonus items that allow them to catch up and some other *power-ups* tend to penalize the leading players more harshly.

Games have thus proven to be an ideal medium to achieve optimal *flow* experiences (Salen & Zimmerman, 2003), defined as interactions in which the player is deeply engaged (Csikszentmihalyi, 1990). They have thus succeeded in achieving one of the most difficult characteristics of engaging learning activities (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

However, the complexity of games and adaptation also poses significant challenges, and the final goal of providing generic game-based learning solutions that are completely adaptable remains an open research question that is receiving a lot of attention. Carro, Breda, Castillo, and Bajuelos (2002) have proposed methodologies for the creation of adaptive educational games, while Peirce, Conlan, and Wade (2008) have presented a general architecture for the development of adaptive educational games. The European Union is also actively investing in this area through its Framework Programme, with projects such as ELEKTRA (Kickmeier-Rust et al., 2006) or its current continuation 80 DAYS (Law & Kickmeier-Rust, 2008).

Assessment and Debriefing

Assessment of the learning experience is a key part of any learning process, allowing instructors to monitor the performance of the students. Without assessment, instructors' efforts could be completely ineffective as no evidence about the achievement of the learning goals is obtained. In its simplest form, assessment can take the shape of an exam that students must pass at the end of a course. Some more complex approaches would include interviews with the students, home assignments such as writing an essay, or careful observation by the instructor of the progress of the students on a day-to-day basis. The richness of the interactivity inherent to gaming can open new measurement models that represent an improvement over the current state of the art in eLearning environments. The rest of this section presents some potential approaches.

Generation of Play Traces

When students in a modern eLearning environment interact with the content, most systems track their steps and log aspects such as the pages they visit, the tests they take, their grades, and the time they invest in each part of the course (both for content and tests). It is possible to infer a lot of information from these logs (Romero & Ventura, 2006), but the approach also has limitations. For instance, when students request pages of content, the system can log the event. When the students select the next page, the system can compare the timestamps of both events and report the time that the student invested in visiting the page. However, this information does not really tell the instructor how the students interacted with that content. Did they read the content? Did they skim it? Did they simply go for a walk to get some coffee?

Games, however, are not passive content displayed in front of the student. They are complex pieces of software that are executed on the student's computer. Moreover, they are highly interactive content and the interaction is precisely how they transmit the content. With a game, it is possible to monitor and record this interaction between the student and the game, generating a trace of the actions performed by the students during the play sessions that can be used for assessment purposes (Loh, 2007).

These traces can be directly delivered to the instructors in order to let them know how the student interacted with the game for assessment purposes. According to McFarlane et al. (2002), having access to this information is a key factor demanded by instructors when approaching game-based learning.

Taking advantage of the high interaction, videogames can provide more fine-grained assessment mechanisms than we could ever expect in traditional education and eLearning. If done carefully, the assessment reports generated through the interaction between videogames and students could help instructors to answer precisely and with little effort questions such as "how much time did the students spend playing?," "how long did it take them to complete a certain task?," "how many attempts did they need to achieve a goal?," and so on. Moreover, the refinement grade of this approach allows not only the measurement of the game-time spent, but even the analysis of how this time was spent (e.g., "Was the student wandering around or trying to solve a problem?," "How many tasks did the student perform?," etc.).

Postgame Debriefing

During a play session with a videogame, a player interacts with the world, obtaining immediate feedback. Note that this is not just something a videogame can do, but something they must compulsorily do. As exposed previously, videogames rely heavily on letting players interact and explore the in-game world freely. While playing, players formulate theories in their minds, test them in the game world, observe the outcome and reflect again on those theories in a very short iterative cycle (Garris, Ahlers, & Driskell, 2002). Nevertheless, while this provides an ideal framework for learning, this approach requires the help of an instructor to realign those students that establish incorrect theories and help them refine their ideas when they are stuck. Educational games also include model simplifications, fictional elements to increase engagement, and game mechanics that sometimes are not part of the lessons.

From the initial uses of simulation for education, debriefing has been identified as a key element in the learning process (Crookall, 1992), with in-depth studies about how to prepare debriefing sessions after the simulations or games are played (Peters & Vissers, 2004; Steinwachs, 1992). Some commercial games keep statistics about the game, which can be used as additional support for debriefing sessions (such as the detailed performance graphs offered by CIVILIZATION™ games), but the instructor will always be a fundamental element in these debriefing sessions.

This is thus a major challenge. While holding debriefing sessions after playing sessions is a relatively straightforward step in traditional schooling, it may be more problematic in eLearning settings. Different initiatives have successfully complemented games with debriefing sections in school settings (Squire & Barab, 2004), but the addition of debriefing sections in game-based eLearning environments is still an open research question.

Grade Assignment and Automatic Computation of Grades

The mere fact of beating a game successfully can be an indicator of the acquisition of a determined set of skills or concepts. In these cases, completing the game (maybe with different levels of success) can translate directly into a grade.

However, it is also possible to devise more complex in-game assessment mechanisms. As we have previously discussed, the assessment of game-based learning sessions can be based on the generation of traces that can track a lot of different parameters in the games (time, performance, tasks completed, etc.). Instead of simply generating those traces, it is possible to assign points to the most relevant actions within the game. A game could then monitor those checkpoints and add/subtract points from the grade while the student plays the game, as described in Moreno-Ger, Burgos, Sierra, and Fernández-Manjón (2008).

These automated grading mechanisms suggest the possibility of using games as improved assessment tools, even in courses that do not use games as a medium to deliver the content. For example, Ramani, Sirigiri, Panigrahi, and Sabharwal (2008) suggest the possibility of using games as wrappers for traditional assessment models, in an attempt to tap into the competitive nature of students. As another example, Burgos et al. (2008) created a course about advanced cooking with a game-based exam in which the student had to try to satisfy the requests of two restaurant customers. The final grade of the course depended on the result of this in-game exam.

Collaborative Learning

Social networks (also called *Communities of Practice*) were first pointed out in 1991 by Lave and Wenger (1991) with the meaning of a group of people that gather around a topic of common interest to share ideas and find solutions. They evolve from the original concept of Virtual Communities, coined by Rheingold (1993). In general, social networks can be identified as groups where some specific features are present: (a) a member of it feels himself to be part of a wider social statement, (b) its users form a network of relationships, (c) the users continuously exchange ideas and contents meaningful to them, and (d) the relationships between the members of the community develop throughout time, building sets of interlaced stories (Durkheim, 1924; Figallo, 1998; Kwoch & Schwier, 1997).

Social Networks and eLearning

In this context, we see nonstructured learning (Wells, 2001) as the associative and spontaneous learning coming from a fluent relationship and without any scheduled behavioral pattern between the members of the social network. Furthermore, the participation of any user depends only on his or her criteria and understanding and not on any kind of imposition or need of adaptation to any work methodology or to any predefined behavior pursuing a didactical or methodological goal. In this manner, both social networks and the nonformal learning or nonstructured learning are based on the existing and growing semantic links among their users (Hoffman, 2005).

Educational Games and Social Networks

In spite of all the research and effort that has been invested in developing and promoting social networks for learning, some of the best examples are the online communities focused on different games that are spontaneously or intentionally developed, fostered, and populated with content. The players gather at online bulletin boards to exchange information, create *fan-sites*,[1] and establish nonstructured learning processes, while following the basic way of relating in a social network.

Most game publishers are becoming aware of the importance of the communities that have been built around the games, and it is becoming more and more common to find publishers investing in support for their player communities. Some games even include the concept of community at the design level, with a high dependence on player-generated content. Two very relevant examples would be SPORE™ or LITTLE BIG PLANET™: Both games base their commercial success on having a community form around them and would have no meaning without player-generated content.

Collaborative Learning in Virtual Worlds

An interesting trend in collaborative learning is the use of virtual worlds in different manners. On the one hand, virtual worlds can be used to immerse students in a learning experience that can combine both game-based and non–game-based contents. In this case, the idea is not to profit directly from the advantages of a game-based learning approach, but to use a virtual, game-based environment to drive the learning experience, helped along by an attractive narrative story that is revealed as the students' progress. Thus students are kept motivated, focused, and concentrated on the tasks that are proposed. Besides, these worlds are used as interfaces for browsing other materials (Chao, 2001; Christoffel & Schmitt, 2002) to keep the immersion at the highest level possible.

For example, QUEST ATLANTIS™ (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005) is a 3D multiuser environment oriented game for children aged between 9 and

Figure 3
Online Lecture Class From Harvard Law School in SECOND LIFE

15 years that combines educational gaming with other lessons. Teachers are entrusted to define the courses as sets of Quests that students must accomplish by carrying out diverse game-based and non–game-based tasks without leaving the game world. Another good example is RIVER CITY™ (Ketelhut, Dede, Clarke, & Nelson, 2006), which follows a similar pattern.

However, the best-known Virtual World is probably SECOND LIFE™ (http://secondlife.com/). SECOND LIFE™ is a 3D virtual world that aims to simulate the real one as realistically as possible. Members (usually known as "residents") use a 3D avatar to interact with the world, carry out multiple tasks typical of real life, meet and talk to other residents of the world, and so on. The interaction in SECOND LIFE™ is so rich that thousands of organizations such as IBM or even political parties have created their own virtual worlds in SECOND LIFE™. Motivated by its ample acceptance, lots of colleges, universities, and other educational organizations have decided to take advantage of SECOND LIFE™ to promote collaborative learning among their students[2] (Figure 3).

These Virtual Worlds are also successfully being integrated with eLearning environments. Still focusing on SECOND LIFE, we find the SLoodle initiative (http://www.sloodle.org), which connects the virtual world with an eLearning system (Moodle), giving the LMS an appealing game-based interface (Kemp & Livingstone, 2006).

The integration of Virtual Worlds and eLearning environments can also serve to support complex educational approaches such as the work by Sancho, Fernández, and Fernández-Manjón (2008a, 2008b) implementing collaborative problem-based learning environments using *Multiverse*™ (http://www.multiverse.net/) and Moodle.

Standardization in eLearning

As we described in the section Adaptive Game-Based Learning, educational games need to be suited to current standardization trends in eLearning. The diversity of eLearning platforms and the requirement of protecting investments in content development have raised a lot of interest in standardization in eLearning, signaling a growing maturity in the field (Friesen, 2005; Liber & Olivier, 2003; Mason, 2005). The numerous platforms and initiatives (both commercial and open source) that are being proposed and developed in the field, along with the need for content maintenance and interoperability, makes standards indispensable to support the interoperability of the systems and contents.

However, the standardization area, which includes *de jure* standards and *de facto* specifications (Sloep, 2002) is difficult to oversee and several guides have been produced to help practitioners understand the terrain (MASIE, 2003).

In this section we discuss the relation between game-based learning and two important standardization aspects: how to standardize individual units of content and how to integrate games into standardized complex learning experiences.

Standardizing Games for eLearning Environments

Some of the aspects that can be standardized are how to package the content so that it can be moved from one system to another or how to annotate the content so that it can be discovered and retrieved from content repositories. These features enable the application of the Learning Objects Model (Balatsoukas, Morris, & O'Brien, 2008), which envisions the possibility of storing content as self-contained units that can be deployed in any standards-compliant LMS.

If educational gaming is to be integrated in eLearning environments, the games must follow the rules of the field. In this sense, it is mandatory to pay attention to the standardization of content in order to guarantee the interoperability of educational games with these systems. In this context, the effort carried out by the IMS Global Consortium has achieved significant impact with the IMS Content Packaging specification (IMS CP; IMS Global Consortium, 2004). The specification establishes a standardized format for the packaging and distribution of Learning Objects. Most of the commonly used LMS have facilities to import and export IMS CP contents, such as Moodle (Dougiamas & Taylor, 2003), Sakai (Farmer & Dolphin, 2005), or WebCT/BlackBoard (Goldberg & Salari, 1997). This widespread adoption

suggests that IMS CP may be taken as a preferred standard when it comes to packaging content, including educational games.

However, the idea is not only to deploy individual Learning Objects. Newer trends propose learning experiences that present sequences of Learning Objects to the students dynamically, by selecting the most appropriate ones depending on previous results. Two of the most popular approaches in this sense would be IMS Learning Design (IMSLD, 2003), which is focused on modeling the learning flow and the related activities to be carried out by a single learner or by a group of users in different roles; and ADL SCORM (Sharable Content Object Reference Model; Advanced Distributed Learning, 2004), which is focused on single-user itineraries. However, both approaches attempt to support the notion that the outcomes of one specific activity should be able to affect the behavior of subsequent activities.

Adaptation, Assessment, and Standards

When external systems are introduced in an eLearning environment, their use is often isolated from eLearning systems. Obviously, this is a risk when introducing videogames in eLearning systems. If we create a course containing several activities and one of them is a game, the game will be executed separately from the main flow. The students will play the game, but no connection is established with the previous activity or the following. In this sense, the educational game is another Learning Object but with a lack of interaction with the rest of the setting and is unable to influence the learning flow. In terms of communication, the game is seen as other more static resources, such as a document, a video, or a link to a Web page.

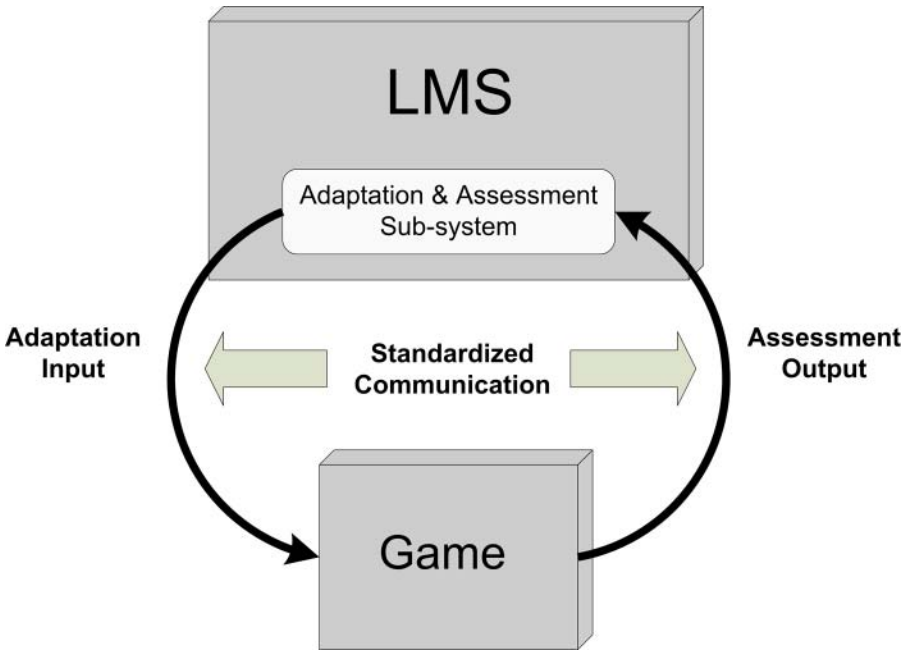
On the other hand, closer integration based on standards such as IMS Learning Design or SCORM allows for pedagogical improvements as well as a better contextualized learning path (Burgos et al., 2006; Richards, 2005).

This approach is the key point that connects the notions of using games for adaptive learning (see Adaptive Game-Based Learning section) and the tracking and assessment facilities that can be supported by educational games (see Assessment and Debriefing section). The LMS can provide adaptation input to the games and receive assessment information from them for future adaptations (Figure 4).

Conclusions

Games are a powerful force in technology-enhanced learning, and they have been for years. At this point, the academic discussion about their actual effectiveness for learning is reaching a crucial point: According to Van Eck (2006), educational gaming has finally caught everyone's attention. However, as described in the previous section, some issues prevent their effective application. On the other hand, eLearning is a key element for life-long learning, having become crucial to keeping

Figure 4
Standardized Communication Between the Game and an Adaptive Learning Management System



and improving job positions, and the professional career. In addition, now that universities and other educational centers are massively adopting eLearning systems to support and complement traditional lectures, the importance and complexity of these systems is increasing rapidly.

The integration of online Web-based learning and educational gaming can result in mutual benefits. On the one hand, the modern LMS can be a vehicle to deliver the games to the students, acting as a deployment platform, and as a repository of the outcomes of the games, thus allowing instructors to keep control of the learning experience. On the other hand, the introduction of videogames in online learning environments can increase their attractiveness. Besides, the currently deployed eLearning infrastructure will facilitate the transition toward learning experiences where games are used naturally along with other content, reducing some of the barriers that the field is facing.

In this article, we have outlined both the potential benefits of the convergence between game-based learning and online learning and also its current limitations. To fully realize this potential, we need further studies regarding how to effectively use

their educational advantages (adaptability, assessment, social networks) and how to overcome the technical barriers (standards compliancy and development costs).

Some major obstacles also hinder the application of games in education, such as teachers rejecting games out of a fear that technology may replace them or teachers who do not want to find out that they know less about the topic than their students. The reluctance of teachers to use videogames is also related to one of the most intangible and difficult-to-resolve issues, which is the social perception of games. Although games are being embraced by players in all age ranges and genders (ESA, 2007), games are still perceived by a large sector of society as mindless toys for young male kids. The impact of violent games in the media (with often biased coverage) is not helping overcome this bad image. The solution for this kind of rejection is not easy due to the lack of real literacy about the game medium (Squire, 2005) and remains one of the foremost aspects that must be tackled.

Fortunately, in the past 3 years we have been experiencing the beginning of a new expansion in gaming. Mostly led by Nintendo's desire to approach "nongamers", we are now seeing titles and game mechanics designed to engage broader segments of the population. The game DS TRAINING FOR ADULTS™ (released as BRAIN AGE™ in the United States and BRAIN TRAINING™ in PAL regions) has been very successful in targeting all demographic groups. This is also the case of the Nintendo Wii™ platform, which tries to simplify the control schemes for the games in order to target the broadest possible audience.

In the future, game-based learning may or may not become a revolution in our educational processes and this will depend on how carefully we design and implement these approaches. As we have described in this article, the potential is great. Unlike television or the earlier multimedia approaches, games are not only a new medium to deliver the same information that we delivered before. Games may be the ideal medium to apply many of the ideas that are currently being discussed in pedagogy (adaptation, collaboration, constructivism, embodiment, etc.), and the current eLearning infrastructure may be the starting point for the revolution.

Notes

1. A fan-site is a nonofficial Web site developed by players to describe the game, offer tips, and communicate with other players. It is common to find fan-sites that surpass the quality and traffic of the official sites for the games.

2. For more information on the educational uses of SECOND LIFE, check out http://secondlifegrid.net/programs/education.

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