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Games in Higher Education

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Synonyms: Game-based Learning; Serious Game; Learning Games, Simulation Games

Introduction

This entry presents an overview of how and why Learning Games are used in higher education.

Learning Games can be defined as games that are designed to captivate the learners' attention and facilitate their learning process. They have explicit educational purposes and can be used for teaching at all levels of education. All types of games can be used for learning: board games, card games, role-playing games, First Person Shooter games, simulation games, management games, puzzle games, treasure hunts...

The main characteristic of **Learning Games for higher education** is the fact that they are designed to teach specific complex skills taught at university or during professional training programs. Unfortunately, it is not infrequent to observe strong opposition on the part of this target audience to this mode of learning, that these adult students associate with children.

The use of Learning Games in primary school seems natural to teachers and is encouraged by specialists in didactics and neuroscience. This learning technique is much less frequently used in middle school and is almost completely absent from higher education. Yet teachers at all these levels are faced with the same problems, such as lack of motivation and investment, for which games are known to be an effective solution. This entry presents an overview of the games that can be used for higher education and the reasons why some teachers and students still show resistance to this type of learning. The numerous advantages of games for higher education will then be presented, citing games presently used in universities, in graduate schools and for professional training. Finally, this

entry presents the current research questions that need to be addressed concerning the design of games for higher education and the acceptance of these games by teachers.

Accepting Games in Higher Education

Teaching with games

As children, we naturally use games as a pedagogical tool to enhance our emotional, sensory, motor, cognitive, intellectual and social development. This natural process is adopted by teachers in primary schools to teach mathematics, history, art, music and foreign languages (Kamii and DeVries, 1980). This pedagogical approach aims to use game mechanics in order to captivate students' attention and engage them in their own learning process (Dondlinger, 2007). When playing, **the learners become the central actors of their learning process**, a role quite unlike the passive position they occupy, most of the time, in traditional education. In order to win the Learning Game, students need to make decisions based on their newly acquired knowledge. Moreover, the **learners find themselves emotionally engaged** in the game and this facilitates the memorization of their decisions (National Research Council, 2000). Games can therefore be used to facilitate learning certain skills, for which traditional teaching methods are not satisfactory (Mayo, 2007).

What games for teaching?

These past years, many digital Learning Games have been developed. **Digital Learning Games** do not require any physical material and offer many advantages such as adapting to the learner's profile, allowing access to the game anytime, anywhere and displaying infinite patience when it comes to repeating concepts. In addition, the new generation of students are accustomed to playing computer games. An American study carried out in 2000 showed that, on average, students who have obtained an undergraduate degree spent only 5,000 hours reading compared to 10,000 hours playing video

games and 20,000 hours watching television (Prensky, 2001). With the democratization of smartphones and tablets over the last 20 years, this tendency has no doubt been amplified. In 2015, 75% of Americans between 13 and 17 had access to smartphones and more than half had access to tablets (Lenhart, 2015). In this context, it is in our interest to provide tools and methods to help teachers use the attractiveness of video games to facilitate the acquisition of complex skills.

In order to be effective, Learning Games need to offer engaging game mechanics that serve the educational objectives. There are many theories on the best way to choose and integrate these game mechanics with the learning content. The **extrinsic motivation approach**, for example, was very common during the 80s and 90s, when Learning Games were referred to as “edutainment”. With this approach, inspired by the behaviorist learning theories, gaming and learning are treated as separate entities. Indeed, the learners are usually first asked to perform certain educational exercises and, if they succeed, they are given access to a short game or receive points and badges as a reward. This approach met much criticism, and was often regarded as “sugar coating” over drill and practice exercises (Bruckman, 1999). Nevertheless, this approach has become quite popular in higher education these last years under the term “**gamification**”. Indeed, it is easy to gamify existing courses on online platforms used by universities and MOOCs (Massive Open Online Courses) (Gené et al., 2014). Many of these platforms offer plugins to create badges, progress bars, leader boards and they show fun content only if the learners have achieved a certain goal (a certain number of points or activities...). In regards to the limitations of this approach, several Learning Game designers have chosen to explore another direction called **intrinsic motivation approach** (Fabricatore, 2000; Kafai et al., 1998), influenced by the constructivist learning theories. It consists in blending game mechanics with the learning content instead of using them separately. The idea is to choose a game design that is adapted to the educational goal and weave it into the pedagogical activities. According to numerous studies (Habgood, 2007; Lepper and Malone, 1987; Ryan and Deci, 2000), it is this cohesion between learning and fun that truly engages the students in their activity and facilitates the learning process. However, this approach implies creating custom Learning Games in collaboration

with teachers and game designers, a very costly process that is not always possible. By combining both approaches, maximum efficiency can be obtained.

It is important to understand that the effectiveness of a Learning Game depends not only on the characteristics of the Learning Game artifact, but also on the way it is used (Sanchez et al., 2017). Therefore, the game mechanics and the educational content do not necessarily need to be embedded in the Learning Game artefact itself. For example, teachers can use basic exercises in a fun context by distributing rewards, setting up battles between groups or introducing the concept with a story... The other extreme is also possible: using a pure game, such as *Assassin's creed*¹, for educational purposes (teaching History²).

Resistance to Learning Games

The use of Learning Games in the context of higher education is subject to many forms of resistance. First of all, the use of games with adult or young adults can be problematic because they often view games as futile and only fit for children (Eyster, 2008). This opinion is sometimes shared by colleagues and superiors. Teachers who use Learning Games therefore need to prepare a flawless argumentation that shows how their Learning Games will help students reach the given educational goals.

Another critical concern is the student's evaluation: is it fair to evaluate learners according to their scores and actions in the Learning Game? The nature of games, as defined by Caillois (1961) implies that playing can only be done free willingly and the actions taken in the game should not have any consequences on the real world. Using a Learning Game to grade students therefore contradicts the very notion of play.

¹ Assassin's Creed Ubisoft, <https://assassinscreed.ubisoft.com/>

² <https://www.youtube.com/watch?v=TAeut18BHOA>

Finally, it is unrealistic to believe that one Learning Game will suit all students. We all have different player profiles (Seeker, Survivor, Daredevil, Mastermind, Conqueror, Socializer and Achiever)³ and therefore do not necessarily like the same types of games (Nacke et al., 2014). This must be kept in mind when designing Learning Games: it is best to choose game mechanics that cover several player profiles.

Even though the use of Learning Games faces resistance in higher education and requires complex multidisciplinary design skills, many have proven their efficiency in various domains. In the next section, the advantages that games can offer for higher education will be presented and illustrated with examples of games presently used in universities, graduate schools and professional training programs.

³ BrainHex questionnaire <http://survey.ihobo.com/BrainHex/>

Advantages of Games for Higher Education

An opportunity to simulate and manipulate

Computer games have the advantage of offering adaptable virtual environments that are very useful for recreating specific situations and simulating the context in which learners will use their skills. This is particularly advantageous when the context is impossible or very difficult to reproduce because of its costly or dangerous nature. For example, *The Resuscitation Game*⁴ is used to teach medical procedures and reanimation technics for neonatal resuscitation. *Rail Simulator*⁵ (Figure 1) allows future train drivers to validate their management and driving skills. Virtual Reality is one of the latest advances in simulations. This technology immerses the learners in an interactive virtual world and allows them to practice their orientation and manipulation skills. Virtual reality is also used for simulating stressful situations in order to help learners control their emotions (Marfisi-Schottman et al., 2018; Ponder et al., 2003).



Figure 1. Train Simulator (Electronic Arts) used for training train drivers (source <https://www.origin.com>)

⁴ The Resuscitation Game (Imaginary), <https://www.youtube.com/watch?v=0aDzjJTWUsc&feature=youtu.be>

⁵ Rail Simulator (Electronic Arts), <https://www.origin.com/fra/en-us/store/rail-simulator/rail-simulator>

Enhanced emotional engagement

Learning Games have the power of involving students in their own learning process with game mechanics such as competition, rewards, social recognition — and many more — that enhance motivation and activate the students' capacities (Dondlinger, 2007). Learning Games offer much more than a simple simulation environment. They offer the possibility of creating role playing games based on complex scenarios with stories and quests. Thanks to these mechanics, learners can project themselves into a character and are emotionally engaged in the action of helping this character attain his/her goal. Throughout the game, the character will need to master various skills to fulfill his/her objectives. Many educational games offer such engaging scenarios. *Starbank The Game*⁶ (Figure 2) for example is used to train new bank employees, *Les aventures de Casey Warren*⁷ is used to train employees in data security.



Figure 2. *Starbank The Game* (BNP Paribas), used to train bank employees (source <http://serious.gameclassification.com>)

⁶ StarBank The Game, <http://serious.gameclassification.com/EN/games/14090-Starbank/index.html>

⁷ Les Aventures de Casey Warren, <http://blog.seriousgame.be/les-aventures-de-casey-warren>

Relief from routine

Using games is a good way to break the routine that sets in after several months of class. Introducing this teaching method changes the usual dynamics of the class and gives a second chance to the students who feel they are too far behind or that have given up all interest in the class. The games also require a set of new skills (communication, organization, tactical planning) that are not usually put forward in class. This provides teachers with fresh insights into their students as learners (Kirriemuir and Mcfarlane, 2004). Games also create a break, a state of “relaxed attention” that enhances learning (Thiagarajan and Thiagarajan, 2003). *CheckiO*⁸ (Figure 3), for example, offers a new approach for learning Python and JavaScript programming languages.



Figure 3. CheckiO used for teaching computer programming (source <https://checkio.org/>)

⁸ Checkio, <https://checkio.org/>

A new student-teacher relationship

Games can also be designed to help teachers. It is possible to integrate certain repetitive tasks into the games such as the explanation of certain concepts or corrections. This gives the teacher more time to interact with the students, to advise them, and help those in need. The student-teacher relationship is therefore redefined.

In addition, when it comes to training adults, who already have professional experience, games can turn out to be better suited than traditional training (Federation of American Scientist, 2006; Mayo, 2007). This can be explained by the fact that adults find it difficult to “go back to school” and accept criticism from a teacher, who is often younger than them. Learning Games offer an original, less academic way of learning. In addition, the games can be designed so that all forms of judgment come from the game and not the teacher. In *Laboratorium of epidemiology*⁹ (Figure 4), the hospital’s chief doctor asks the students to write an essay. These essays are actually corrected by the teacher but, the fact that the comments are delivered by the chief doctor gives them more weight and eliminates remonstrance (Ney and Balacheff, 2008).



Figure 4. *Laboratorium of Epidemiology* (source <http://loe.ujf-grenoble.fr>)

⁹ *Laboratorium of Epidemiology*, <http://loe.ujf-grenoble.fr/content/story>

A means to evaluate, track and provide feedback

Finally, Learning Games offer the technical means to track the student's actions and automatically evaluate certain skills, a feature which is very important in higher education and professional training (Carron et al., 2008). These tracks can also be analyzed in real time and presented on a monitoring platform for teachers and students themselves. Finally, these tracks can also be used to automatically adapt activities according to the learner's level in order to keep him or her in a state of constant motivation (Oostendorp et al., 2014). For example, the V3S Virtual Reality training platform offers dynamic situated feedback and progressive learning scenarios by adapting the complexity of the situations to the learner's activity and level (Barot et al., 2013). The *Reviateck* simulators (Figure 5) also analyzes the usage tracks to provide personal feedback on technical and non-technical skills (Huguet et al., 2016).

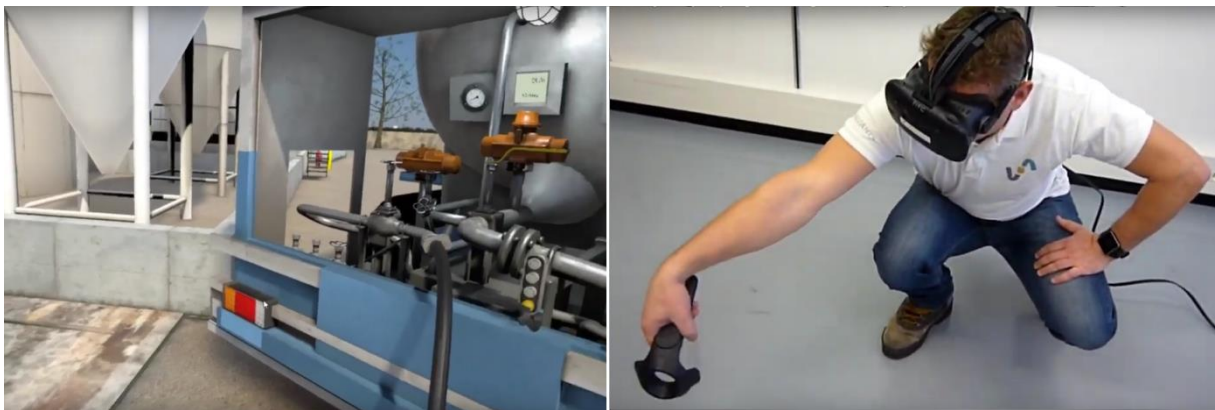


Figure 5. *Reviateck* simulator for learning technical procedures and social skills (source <https://reviatech.com>)

Current Research Questions

Learning Games have much to offer for higher education. However, there remain a number of important issues that need to be addressed before university teachers and professional trainers willingly adopt them. In this section, some of the current limitations and major research questions related to the specificities of Learning Games in higher education will be identified. First of all, research on methods to facilitate the design of custom Learning Games for specific higher education skills will be discussed. Then, the latest research on how to help university teachers resist the skepticism of their students and colleagues when they want to use games in their classes will be presented.

Methods and tools to create custom Learning Games

Specialized websites offer access to Learning Games libraries^{10,11,12}. They allow teachers to both find existing Learning Games, they can integrate into their courses, and to share their own Learning Games. These libraries are quite successful with middle school teachers because there is a large body of teachers that are interested in the same learning content, and therefore have the same educational needs. In higher education however, the curriculum is not as precise and teachers create their own pedagogical activities. In this context, it is very difficult to find Learning Games that fit all their requirements.

In order to help teachers create their own custom Learning Games, several researchers have proposed methods and tools such as *ScenLRPG* (Mariais et al., 2012), *Player-VG* (Padilla Zea et al., 2011) and *LEGADEE* (Marfisi-Schottman et al., 2010) to help them communicate and collaborate with game experts.

¹⁰ Serious Game Classification, <http://serious.gameclassification.com>

¹¹ GooseChase EDU platform, <https://www.goosechase.com/edu/game-library/>

¹² S'cape <http://www.scape.enepe.fr/>

Although working with game designers is ideal, it is often too costly and complicated to organize. Teachers can therefore use Learning Game authoring tools, which allow them to create digital games on their own, without any computer programming skills. Here are a few examples of authoring tools for specific Learning Game types: *eAdventure* for creating simple point and click games (Moreno-Ger et al., 2008), *Storytec* (Mehm et al., 2010) for puzzle games and *JEM iNVENTOR* (Karoui et al., 2017) for educational mobile treasure hunts. These editors allow teachers to become independent and capable of improving their Learning Games year after year, adapting them to the new curriculum or a modification in the student profile.

An interesting approach, also called **game modding**, consists in asking players to create new levels for existing games. This movement appeared in the gaming industry with the famous *Counter Strike*, a “mod” of the game *Half Life*, designed by two players (Kücklich, 2005). This concept provides several advantages for Learning Games (El-Nasr and Smith, 2006). The first advantage is that students are much more likely to create the type of game that they like when following the latest trends (escape games and choose-your-own-adventure type games). The second is the fact that the students will need to acquire a deep understanding of the knowledge and competencies that should be integrated into the Learning Game. Thirdly, teachers then have a large selection of Learning Games to choose from or build on for their future classes.

These methods and authoring environments have certainly facilitated the creation of custom Learning Games, but the process remains very complex and time consuming for results that are not always satisfactory. Even though the authoring tools allow teachers (or students) to create their own Learning Games, it is very difficult for them to imagine a gameplay that is fun and that also serves their pedagogical objectives. They might therefore use game mechanics that are not at all adapted to their educational goals. For example, the latest trend is to create Educational Escape Games, even though its core game mechanics (time pressure, mini-puzzles, stress) does not create the right conditions for learning. This type of game, however, is a well-adapted alternative to a quiz in order to

verify if the students have understood targeted concepts. The know-how required to select the best game mechanics and create a pedagogically effective Learning Game remains difficult to pinpoint, even for experienced Learning Game designers.

Help teacher convince game skeptics

The negative perception of games in higher education is an important issue. While some university teachers have never been more enthusiastic about Learning Games, the majority remain very skeptical or even openly opposed to such teaching methods, which they see as a waste of time. In this context, it is very difficult for teachers to try using Learning Games, if they are not 100% convinced it is going to work. This implies knowing about game mechanics, the way they can be used to attain educational goals and having several successful examples of Learning Games in mind.

Half a dozen MOOCs on Learning Games and gamification have recently been put online to help teachers acquire such knowledge. For example, MIT offers a MOOC entitled “Design and Development of Games for Learning”¹³, the University of Rotterdam offers a MOOC on Serious Gaming¹⁴ and the University of Pennsylvania offers a MOOC on gamification¹⁵. Le Mans University¹⁶, in France, also offers a course to help teachers create their own Learning Games with the help of pedagogical engineers.

The student’s skepticism toward games can be changed if the teachers clearly explain the educational objectives of the Learning Games and why they have chosen to use a game instead of a classical teaching method. There is a difference between mastering the rules of a game and understanding the educational concepts embedded in it. This is why a phase of reflection and debriefing is necessary after the Learning Game (Garris et al., 2002). This debriefing serves several purposes such as clarifying the educational purpose of the Learning Game (Aldrich, 2005), fostering

¹³ <https://www.mooc-list.com/course/design-and-development-games-learning-edx>

¹⁴ <https://www.coursera.org/learn/serious-gaming>

¹⁵ <https://www.coursera.org/learn/gamification>

¹⁶ <https://lium.univ-lemans.fr/en/ludifikaction/>

metacognition (Lederman, 1992) and facilitating knowledge transfers to other domains and real situations.

Some teachers push the concept even further by asking their students to write an “astonishment report” on their experience playing the game and the skills they acquired. This concept is inspired by management methods (Vigier and Bryant, 2009). The evaluation of the students is based on the quality of their essay and not on their actions in the Learning Game. This evaluation method seems effective as it allows the students to learn, without being penalized by errors made in the game, and encourages post analysis and self-reflection on the learning outcome.

Educating teachers about game mechanics and how they can be used for teaching and encouraging them to brief/debrief their students are both good ways to help teachers convince Learning Game skeptics among their students and colleagues. However, the best way to convince these skeptics is to provide hard proof that Learning Games enhance learning. The question of evaluation is extremely complicated and has yet to be dealt with. The usual pre and post knowledge tests, carried out with a control group, that does not play the Learning Game, contain too many variables and can easily be flawed.

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