Handbook of Research on Educational Design and Cloud Computing in Modern Classroom Settings

K.C. Koutsopoulos
EUROGEO, Greece

Konstantinos Doukas
Doukas School, Greece

Yannis Kotsanis
Doukas School, Greece

A volume in the Advances in Educational Technologies and Instructional Design (AETID) Book Series

IGI Global
DISSEMINATOR OF KNOWLEDGE

Published in the United States of America by
IGI Global
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Koutsopoulos, K. C. editor. | Doukas, Konstantinos, 1964- editor. | Kotsanis, Yannis
Title: Handbook of research on educational design and cloud computing in modern classroom settings / K.C. Koutsopoulos, Konstantinos Doukas, and Yannis Kotsanis, editors.
Description: Hershey, PA : Information Science Reference, 2018. | Includes bibliographical references.
Identifiers: LCCN 2017017437| ISBN 9781522530534 (hardcover) | ISBN 9781522530541 (ebook)
Subjects: LCSH: Internet in education. | Web-based instruction. | Cloud computing.
Classification: LCC LB1044.87 .H3379 2018 | DDC 371.33/44678--dc23 LC record available at https://lccn.loc.gov/2017017437

This book is published in the IGI Global book series Advances in Educational Technologies and Instructional Design (AETID) (ISSN: 2326-8905; eISSN: 2326-8913)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 15
Playful Education and Innovative Gamified Learning Approaches

George P. Pavlidis
Athena Research Centre, Greece

Stella Markantonatou
Athena Research Centre, Greece

ABSTRACT

In the recent decades, there has been a significant investment in the incorporation of games in the educational practice. This has taken either the form of game-based learning or serious gaming. A literature review on gaming and education results in numerous works tackling different aspects of the approach. Even a simple search on the Web on gaming and learning produces multi-million results. In this work, we try to touch not only the surface of this approach and provide typical game-based learning evaluation results but also to explore its inner workings (offering a modest mixed philosophical and science aspect) and to provide an even more concrete foundation for a playful education.

INTRODUCTION

Playing is an archetypical activity that arises from primordial biological structures existing before the conscience or the capacity for speech; it is not something a person decides to do (Brown & Vaughan, 2010). According to the same study, playing is an activity with specific qualitative features such as (a) it is seemingly pointless, (b) it is voluntary, (c) it is genuinely attractive, (d) it disconnects from the sense of time, (e) it reduces self-consciousness, (f) it enhances improvisation, (g) it creates a desire to go on and on. In addition, playing could include (a) anticipation, (b) surprise, (c) entertainment, (d) understanding, (e) power and (f) balance.From the perspective of neuroscience, several works have emphasized the value of play in the development of the brain. It has been many year now that neuroscientists like Sergio Pellis and Andrew Iwaniuk along with biologist John Nelson in their research (Iwaniuk, Nelson, & Pellis, 2001; Pellis & Iwaniuk, 2002) discovered strong positive association between the size of the brain with the propensity to play in mammals, in general. In addition, Panksepp (see for example in Gordon, Burke, Akil, Watson, & Panksepp, 2003) has shown that participation in playing selectively activates

DOI: 10.4018/978-1-5225-3053-4.ch015

a brain derived neurotrophic factor in the amygdala and in the dorsolateral prefrontal cortex. Near the ending of the twentieth century, Byers (Byers, 1998; Byers, 1989; Byers, 1999), in his research on animal play, speculated that during play, the brain creates a sense of self, through simulation and testing. Play essentially helps in the formation of the brain. While playing the brain is able to experience situations without threatening its physical or emotional integrity. In addition, in as early as 1964, Diamond, Krech, & Rosenzweig (1964) reported the development of rats with larger and more complex brains using play. According to Brown & Vaughan (2010), while playing new cognitive combinations are being created using fantasy, in a way in which a complex brain attempts to self-develop and interpret the world.

Play, in all those researches, seems to emerge as a simulation mechanism in the brain of many species (not only humans). A question naturally emerges from this insight: if playing is a simulation mechanism what is being simulated? An easy answer would be the world, as perceived by each one. According to Metzinger (2009) and his work on the ego and consciousness, there is an objective world out there, but as we try to make sense of it using unconscious filtering mechanisms, we are creating our own interpretation of the world, our own reality tunnel. We are never in touch with the objective reality, as those filtering mechanisms (senses, the brain, experiences and hypotheses) prevent us from seeing the world as it is; we only see what can be seen through the reality tunnel we construct in a process that is totally transparent (invisible) to us. We know the world using reflections, since a (correct) reflection is ultimately what we call knowledge. Each one lives in a virtual or artificial world, with the conscious experience being a virtual reality (or maybe better, a simulation) created by nature as a real-time and ever operative world model that supports the interaction between living organisms. In this world model, the ego is nothing more than a pointer on a space-time map, putting a self on the stage of time and space that defines the now and the where.

Counter to our intuition, according to these and other researches, we seem to be living in a simulation created by our brain and we use play to simulate additional possible realities (virtual, alternative realities) in a protected manner, without even noticing it. So, play could be envisaged as a tool to explore potential realities in an attempt towards understanding of the world and towards self-discovery and self-development. This line of reasoning supports a conclusion that play can become an invaluable tool in education, not only because studies have already highlighted so, but mainly due to the nature of the inner workings of the process of play, towards the self-development and the acquisition of knowledge and understanding of the world.

In the contemporary terminology, the trend towards the integration of play, educational activities and technology is usually summarized as gamification, which connects to a sizeable body of existing concepts and research in human-computer interaction and game studies, such as serious games, pervasive games, alternate reality games, or playful design. The idea of using game design elements in non-game contexts to motivate and increase user activity and retention has rapidly gained traction in interaction design and digital marketing (Deterding, Dixon, Khaled, & Nacke, 2011). Additionally, recent research has focused on playfulness, which relates to the creation of a desirable user experience. Although the research has produced a considerable investigation around the term, playfulness lacks an emerged consensual theory or terminology so far, limiting its scope through being largely associated with any pleasurable experience (Costello, & Edmonds, 2007) or fun (Fontijn, & Hoonhout, 2007), or any interaction that goes beyond utilitarian work and task contexts (Gaver, Bowers, Boucher, Gellerson, Pennington, Schmidt, Steed, Villars, & Walker, 2004; Gaver, 2002; Huizinga, 1950), as already pointed out decades ago.

In this paper we investigate gamification, its relevance to gamefulness and playfulness, its historical origins of the term in relation to precursors and similar concepts mainly within the domain of education.

In this respect, we present in the following sections basic concepts and some historical developments of gamification and game-based learning and we focus on recent innovations towards bridging play and education through state-of-the-art technology and technological approaches that were possible within an ambitious project, project GameIt.

GAMIFICATION

From a positive perspective of play, it seems valid, to adopt an approach that favors gamification in education (as in other fields, also). According to the most widely used definition (see also Scott Nicholson's approach at Brantford Games Network Lab[1]), gamification is the use of specific gaming approaches, techniques and mechanics in various environments and settings in order to attract people in problem solving and contribution. As defined and applied, gamification relates more to games than to play (or playfulness), as play can be conceived of as the broader, looser category, containing games (Robertson, 2010), and denotes a free form, expressive, improvisational, even tumultuous recombination of behaviors and meanings, whereas gaming captures playing structured by rules and competitive strife toward goals (Deterding, Dixon, Khaled, & Nacke, 2011). According to theoretical and empirical studies gaming and playing are two distinct modes, or values of behavior (Barr, 2007). Both academic and industry critiques of gamified applications have emphasized their focus mostly on design elements for rule-bound, goal-oriented play with little space for open, exploratory, free-form play (Alfrink, 2011; Deterding, 2012). According to Deterding, Dixon, Khaled, & Nacke, (2011) it might be the case that the barrier between the two terms is empirical, subjective and social, in a sense that whether someone plays or uses a gamified application depends on one's focus, perceptions and enactments.

Gamification draws its theoretical framework on various disciplines (or sub-disciplines) including self-determination theory/organismic integration theory, situation relevance, universal design for learning, player-created content and user-centered design. Scott Nicholson commented on the distinction between Play and Game using a "playful" mathematical formulation as follows:[2,3]

$$Game = Play + Goals + Structure \Rightarrow$$

$$\Rightarrow \begin{cases} Game - Play = Goals + Structure \\ Play = Game - \left(Goals + Structure\right) \end{cases}$$

Taking game design as an important source of inspiration, several terms compete and overlap within the broader domain of gamification and researchers have already began to study concepts as hedonic attributes (Hassenzahl, 2003) or motivational affordances (Zhang, 2008) of pleasurable products (Jordan, 2002). Jane McGonigal defined Alternate Reality Games as a genre, as games you play in your real life (McGonigal, 2011). Ian Bogost recommended replacing the term gamification with exploitationware (Bogost, 2011). On the other side, the definition of serious games can be stated as "any form of interactive computer-based game software for one or multiple players to be used on any platform and that has been developed with the intention to be more than entertainment" (Ritterfeld, Cody, & Vorderer, 2009). Although the term serious games refer to games that are designed to convey learning material in

a playful setting, serious gaming encompasses any educational utilization of the broader environment of games. This includes all the technologies, practices, literacies and social processes surrounding games, like reviewing games, or designing virtual items, avatars, levels, or whole games.

Building on those concepts and approaches, even new game genres have evolved, which challenge the traditional limits of games, by exploring novel contexts, situations and spaces. Commonly, these which are being called pervasive games are defined as "one or more salient features that expand the contractual magic circle of play spatially, temporally, or socially" (Montola, Stenros, & Waern, 2009); these would include augmented reality games, location-based games, persistent games or alternate reality games: augmented reality games supplement living reality with game representations with the use of digital devices; location-based games bring the game into the public space; persistent games have no ending and run in a real-time simulation setting, thus users enter or exit the game during the course of the day participating in what they encounter in the virtual reality that is presented; alternate reality games draw on everyday life to create narratives and restructure the context on top of reality, providing additional meaning, depth, and interaction upon the real world (Montola, Stenros, & Waern, 2009).

Just as it happened to earlier generations with literature, movies and television, similarly video games have become a cultural medium and source of formative experiences (Deterding, Dixon, Khaled, & Nacke, 2011). In general, media scholars observe a "ludification of culture" (Montola, Stenros, & Waern, 2009; Raessens, 2006). Technologies, references, attitudes and practices flowing from games increasingly permeate society and everyday life, most notably playful identities and playful media practices. Finally, researchers have explored playfulness as a desirable user experience. To this end, Gaver et al. (2004) introduced the terms ludic design, ludic engagement and ludic activities, broadly describing "activities motivated by curiosity, exploration, and reflection".

Gamification is being applied in every day practices, such as participating in events, prioritizing e-mails, reading books, or even brushing teeth, in an apparent goal to turn daily activities into games. Fizek (2014) in an attempt to shed light upon the status of today's games, revises the research perspective from the question "what does gaming look like" to "what does the world look like from the point of view of gaming". Gamification calls attention to phenomena of gamefulness (which should, of course, be considered as complementary to, but distinct from playfulness). It is not an easy task to define the concept of fun, which is temporary in its nature. Juul (2005) observes that there is ultimately no one-sentence description of what brings fun in games. Different games provide different types of enjoyment and different players may even enjoy the same game for entirely different reasons. Costello & Edmonds (2007) with further theoretical work and user studies on video gameplay, developed a Playful Experience Framework (PLEX) that categorizes 22 (originally 20) playful experiences. In order to pinpoint this slippery phenomenon, Zimmerman (2009) refers to gaming literacy, in an attempt to explain how playing, understanding, and even designing games all embody crucial ways of looking at and being in the world. His research adds to the understanding of emergent playfulness. Furthermore, gaming literacy describes the aforementioned practices and creates a framework, which goes beyond the point-based structure and focuses uniformly on the importance of play and meaningful contextual design.

In an attempt to establish that gamification provides a positive contribution or it is so expected, recent studies have concluded that gamification is in general a positive approach (Hamari, Koivisto, & Sarsa, 2014), although there might be some differentiation in personal and contextual level (Koivisto & Hamari, 2014) related with the continuous usage (the more the usage the less the perceived positive value) and the gender (women showed a greater social dimension than men in perceived positive value).

In any case, the study showed there is no difference whatsoever relating to age, i.e. regardless of the age the perceived value of gamification is the same.

Nowadays, computer games are increasingly becoming the preferred medium of play. Various games consoles, computers and portable devices enable users to use them for many hours a day to explore and play using sophisticated gaming technology. This technology includes online gaming, which offers competition or cooperation with players around the world. Even though most games have been developed for fun, some of them have been developed with educational purposes; the later have since long ago been described as games for non-leisure purposes (Hassenzahl, 2003) and as video games with a useful purpose (Hill, Ray, Blair & Carver, 2003), which may include training, education, knowledge acquisition, and the development of skills (Barr, 2007).

A BRIEF HISTORY OF GAME-BASED LEARNING

Since the focus of this work is on education, it should be noted that there is a fine distinction between gamification and game-based learning, since in the second case there is a specific targeting on the learning process that is of our interest. Gamification, in general, is a process that targets the engagement and involvement of people in problem solving and development in various environments and in a pleasing manner. Game-based learning, on the other hand, is a special case of gamification, and educational games are games that are either expressly designed for educational purposes or their educational value emerges randomly or secondarily. These games are being designed to aid in learning about specific subjects, in expanding concepts, in stimulating growth, in understanding a historical event or a culture, in developing a skill while playing. All kinds of games can be used in an educational environment.

Taekman & Shelley (2010) reported, by looking at teaching and learning strategies involved in serious game usage, that well-designed games have the potential to accommodate a wider variety of learning strategies when compared to lectures, books and tutorials.

The use of games to promote student's learning has been based on the motivation aspect that games involve (Bergin & Reilly, 2005), which in turn encourages curiosity (Kumar, 1999) and creates the impression of controlling the learning process. In the literature, the use of games in education has been explored in various aspects. Adams (1998) and Becker (2001) study the case of data structures and programming courses. Other studies included game projects (Huang, 2001), inter-process communication (Reese, 2000), operating systems (Hill, Ray, Blair, & Carver, 2003) and more.

In games (in general), players engage in processes such as proactive/anticipatory, recursive thinking, organization of information, general search heuristics, means–ends analysis, and the generation of alternative solution paths (Pillay, 2002). Game-based learning engages players in learning activities, usually by means of educational video or serious games (Burguillo, 2010). It has already been shown that game-based learning can be combined with similar learning methodologies as Collaborative-based Learning (Slavin, 1980), Problem-based Learning (Hmelo-Silver, 2004; Hmelo-Silver & Barrows, 2006; Merrill, 2007) and Project-based Learning (Barrows & Tamblyn, 1980; Boss, Krauss, & Conery, 2008).

In an extensive technical report by the EU-JRC (Stewart, Bleumers, Van Looy, Mariîn, All, Schurmans, Willaert, De Grove, Jacobs, Misuraca, 2013), three categories of special-purpose digital games developed for learning and participation have been identified following a reasoning biased towards the aims for the learning outcomes. These categories include knowledge transfer, skill acquisition, and attitudinal and behavioral change.

In an analysis of the research in games and learning Alexander, Eaton, & Egan (2010) conclude that the games have the potential to provide learning experiences to users through engagement and motivation. This groups of researchers summarized the attributes of games that make them so appealing in the narrative structure, the vivid images, the plot, the emotional engagement, the exotic events and locations, the heroic character qualities and the immersive role-playing approach. In addition, the researchers identified three modes of integration of games into a classroom, either in a purely educational gaming manner, a gaming and educational content mixture, or a simulation-based curriculum related integration. A conclusion in this work was that an effective way towards game-based learning should borrow qualities and principles from the video games and apply them to the curriculum. This study serves also to highlight the ways games can be utilized by tutors, as expressed by the aforementioned three modes of classroom integration.

In a science education research (Marino, Israel, Beecher, & Basham, 2013) video games have been studied for their impact on 876 sixth through ninth-grade students and 34 teachers from various states in the USA. It is significant to note that all student groups reported preferring to learn science from a video game than any other setting. The authors reported statistical results that indicated an association between reading ability level, disability status, and key areas of interest, their perceptions of their scientific abilities, and whether they would pursue a career in the sciences.

Studies have also been conducted for domains other than science education, like (Lacasa, Martínez, & Méndez, 2008) or (Wiklund, & Ekenberg, 2009) investigating the learning of the English language through playing Lara Croft and World of Warcraft respectively, or like (Pagnotti, & Russell, 2012) focusing on social sciences by playing Civilization.

A significant analysis of the effectiveness of games for learning has been done over the years, mainly highlighting positive outcomes. Of course, there have been cases that challenged the results of those analyses on grounds of limited or inappropriate assessment and evaluation. Recently, All, Nuñez Castellar & Van Looy (2016) made an effort to identify best practices in assessing the effectiveness of game-based learning. The authors report the differences found in effectiveness studies in nearly all aspects of any testing methodology, including the participants, the intervention, the method and the measures used. A major contribution in this work is the definition of best practices. In a large scale review, Boyle, Hainey, Connolly, Gray, Earp, Ott, Lim, Nimaus, Ribeiro, & Pereira (2016) illustrate the increased interest in the positive impact of games since 2004, and emphasize that future research will benefit from detailed experimental studies on game features and their effectiveness in engaging and supporting learning.

It should be stressed that up to this point, no reference to the learning theories and learning mechanics has been given in the current review of existing approaches and evaluations. Learning theories that traditionally included behaviorism, or cognitivism, or constructivism and socio-constructivism and their complex combinations with computer-aided and contingent teaching systems, along with newer and emerging approaches including motivational learning, metacognitive learning, collaborative learning, self-regulated learning and adaptive systems, usually are not being coupled with game based learning approaches that basically focus on the edutainment and motivational aspect. On an attempt to theoretically bring those worlds together, Arnab, Lim, Carvalho, Bellotti, de Freitas, Louchart, Suttie, Berta, & De Gloria (2015) made an attempt to bridge, or better, to map game mechanics to learning mechanics for serious games analysis. They proposed the Learning Mechanics-Game Mechanics (LM-GM) model, to support analysis and design of serious games (in the form of a map) by bridging the various pedagogical and game elements. The authors claim that the model can serve as an evaluation tool for teachers to assess the effectiveness of a game and understand how to implement it in educational settings.

Another dynamic domain that attracts a rather strong interest is that of learning analytics, which according to the 1st International conference of learning analytics and knowledge 2011 includes "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs".

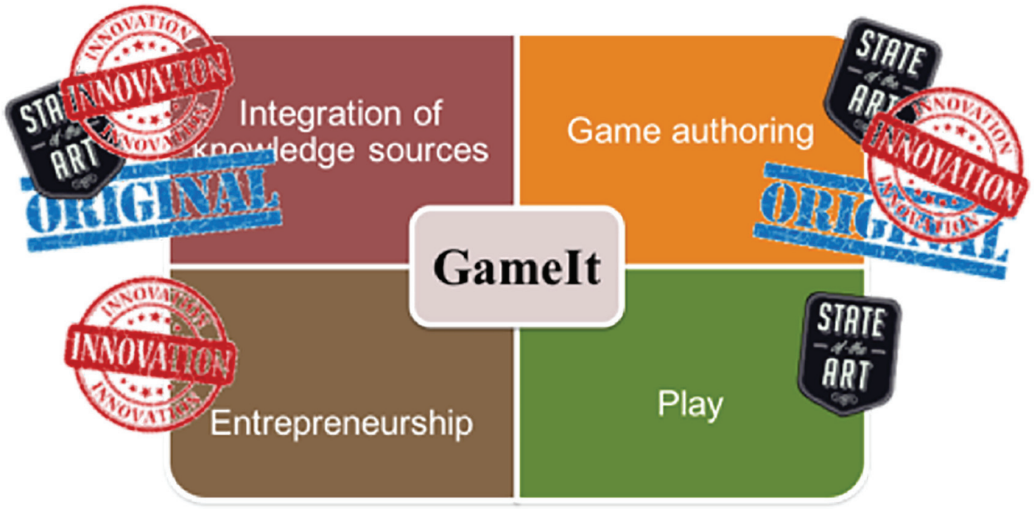
Since the focus of this chapter is specifically on games and learning from the perspective of playfulness no further analysis on learning theories and learning analytics will be included in the subsequent sections. In the following paragraphs, there is a brief account of some major developments in the software of gamification and game-based learning.

The history of gamified learning software begins around mid 1980s, with the famous "*Where in the World Is Carmen Sandiego?*", followed by "*Word Detective"*, "*Math Detective"*, "*Great Chase Through Time"*, and the "*Legend of Zelda"* (Figure 1). Carmen Sandiego was one of the first educational computer games that involved a series of detective missions featuring the unanimous thieving villain created by Brøderbund Software Inc[2]. The titles that followed Carmen Sandiego led to its abandonment around 1997. Other forms of Carmen Sandiego appeared through the years for various platforms, like the *Adventures in Math: The Island of Diamonds*, released in 2012 as a Nintento Wii game by Gamelion Inc. The latest version, *Carmen Sandiego Returns*, was released in 2015 by Houghton Mifflin Harcourt[3] as a social studies puzzle adventure game, aiming to teach about world geography and culture, up to14 years old users, under Microsoft Windows and iOS platforms. The *Legend of Zelda* was a fantasy action-adventure video game series created by Japanese game designers Shigeru Miyamoto and Takashi Tezuka, primarily developed and published by Nintendo[4]. What is remarkable is that Zelda actually made it through today, with a new episode, "Breath of the Wild", being released during 2017[5]. The gameplay incorporates elements of action, adventure, and puzzle-solving, centered on Link, the chief protagonist, who is often given the task of rescuing Princess Zelda and the kingdom of Hyrule from Ganon, the main 'bad guy' of the series. The Legend of Zelda released 17 versions on Nintendo's consoles, selling over 67 million copies.

During the late 1980s more sophisticated educational games started to appear, like *SimCity* (Figure 2), that spawned the major commercial success of *The Sims*. *SimCity* presented its first version as an open-ended city-building video game, designed by developer Will Wright and published by Maxis (now a division of Electronic Arts)[6]. The game initiated several different editions worldwide. On the other side, the gameplay in *The Sims* builds around the task of founding and developing a sustainable city with happy and peaceful citizens, following typical real-life scenarios. Today *The Sims* is available in its fourth version through its own website[7] for various computing platforms. *Simcity* is also available for all major platforms through its website.

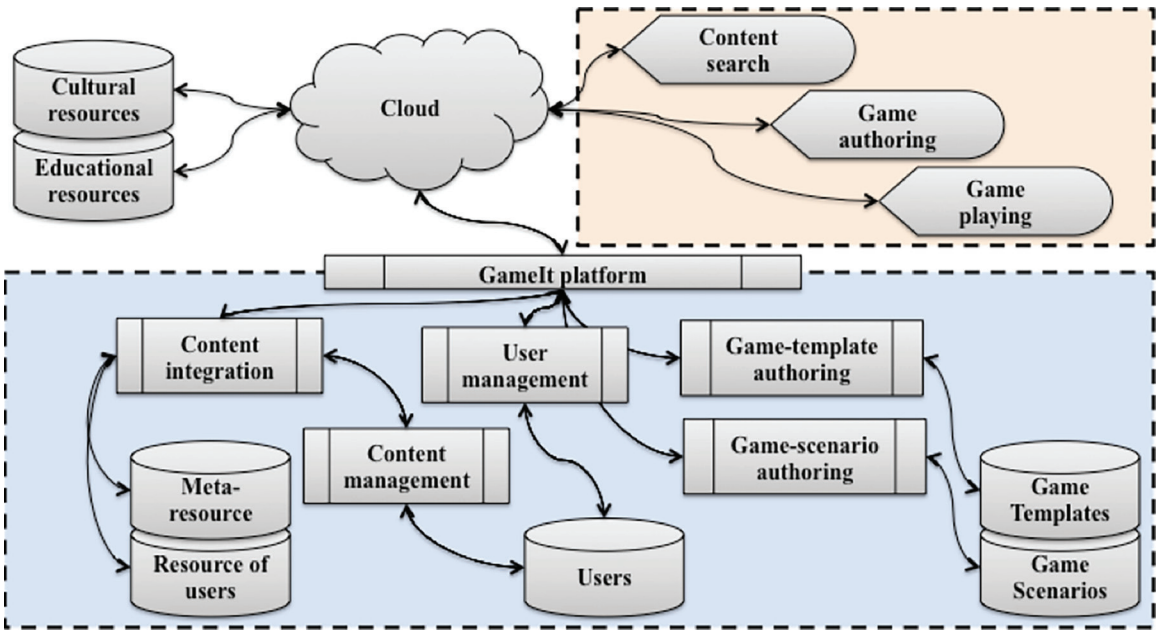
Figure 1. Screenshots from Minecraft games

Figure 2. The GameIt aspects of innovation



Civilization was another landmark software in the early 1990s (Figure 3). *Civilization* was originally developed as a turn-based strategy video game created by Sid Meier and Bruce Shelley for MicroProse in 1991[8], now being released by Firaxis Games (owned by Take-Two Interactive Software, Inc.)[9]. The game's main objective was stated in the subtitle on the cover of the game as to "Build an empire to stand the test of time". The story begins in 4000 BC having the players attempt to expand and develop their empires through the ages from the ancient era until modern and future times.

Figure 3. Overview of the GameIt platform



The era of the virtual worlds was marked by the *Active Worlds* in 1995 (Figure 4). Active Worlds[10] is an online virtual world developed by ActiveWorlds Inc. It is a world simulation that supports multi-user interaction, where users have a digital representative (surrogate or avatar) and are able to explore 3D virtual worlds and environments that others have built. The system allows users to own worlds and universes, and develop custom 3D content, supporting web browsing, voice chat and basic instant messaging.

As 3D graphics technology rapidly evolved in the beginning of the 21st century far more engaging gaming platforms have been created and the *Serious Games* movement appeared around 2002. New games with superior graphics and gameplay, based on the web and supporting multiple players at the same time emerged and lifted the user experience to higher levels of realism. During 2003, *EVE Online* appeared as a persistent virtual world packaged as a massively multiplayer online role-playing game (MMORPG) (Figure 5). The game is within a science fiction space setting, developed and published by Simon & Schuster Interactive (later by CCP Games and distributed via Steam), where users are pilots in customizable spaceships inside a galaxy of more than 7500 star systems. Most star systems are connected to etch other by stargates. The star systems can contain moons, planets, stations, wormholes, asteroid belts and complexes. Players participate in a number of in-game professions and activities, including mining, piracy, manufacturing, trading, exploration, and combat.

Just a year after the release of *EVE Online*, *World of Warcraft (WoW)* appeared as an MMORPG with a huge commercial success (holding the Guinness World Record for the most popular MMORPG by subscribers) (Figure 6). WoW[11] takes place within the *Warcraft world of Azeroth*, approximately four years after the events at the conclusion of Blizzard's Warcraft release *Warcraft III: The Frozen Throne*. WoW is set in the same universe as the Warcraft series of real-time strategy games. It contains

Figure 4. The backbone of the backend system of GameIt

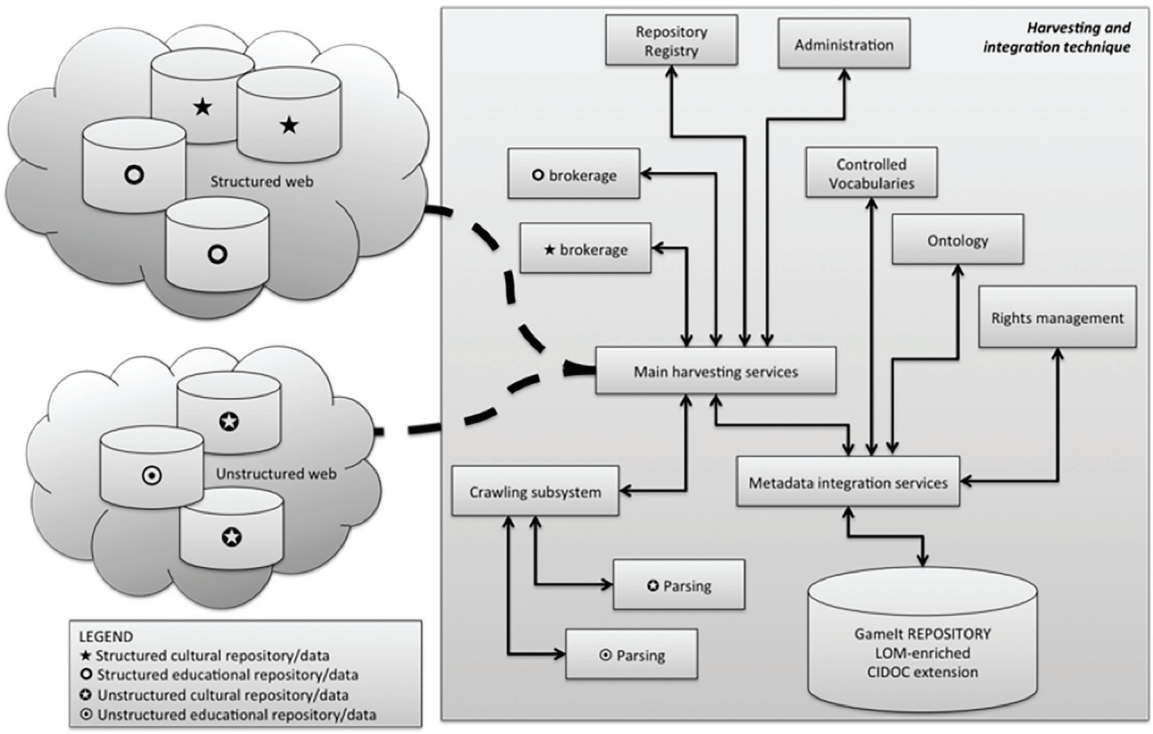


Figure 5. The knowledge management system as meta-resource

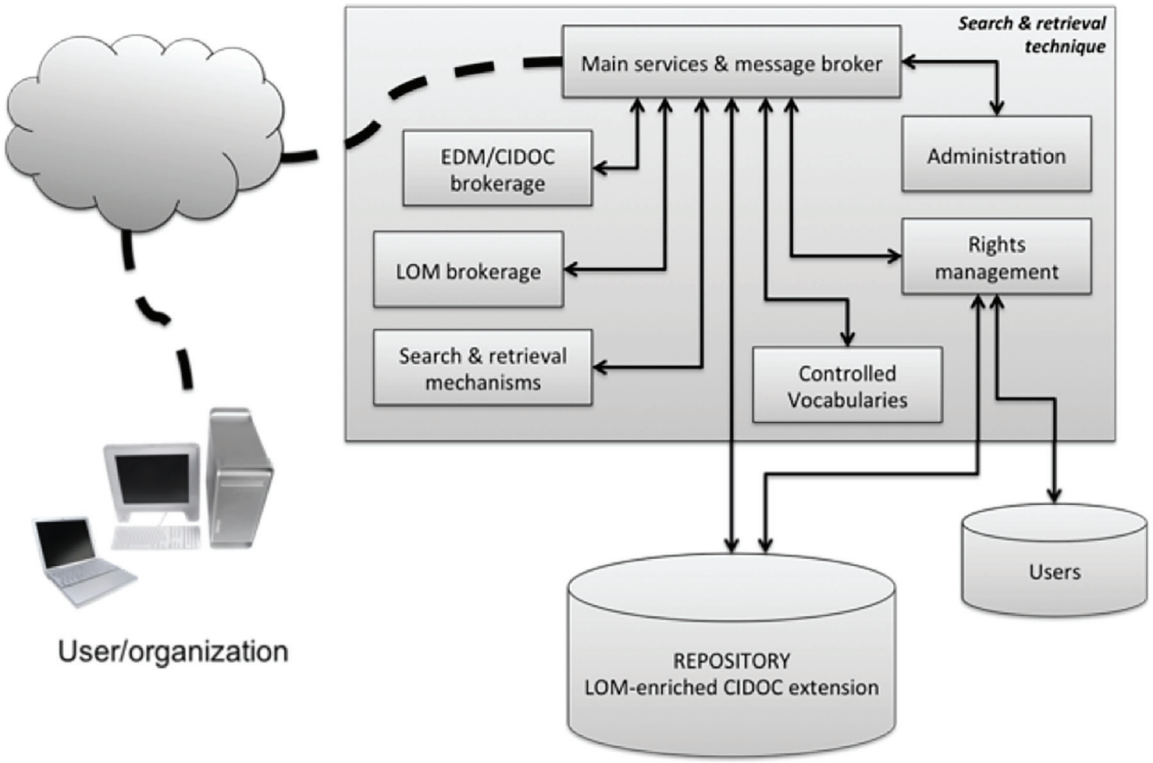
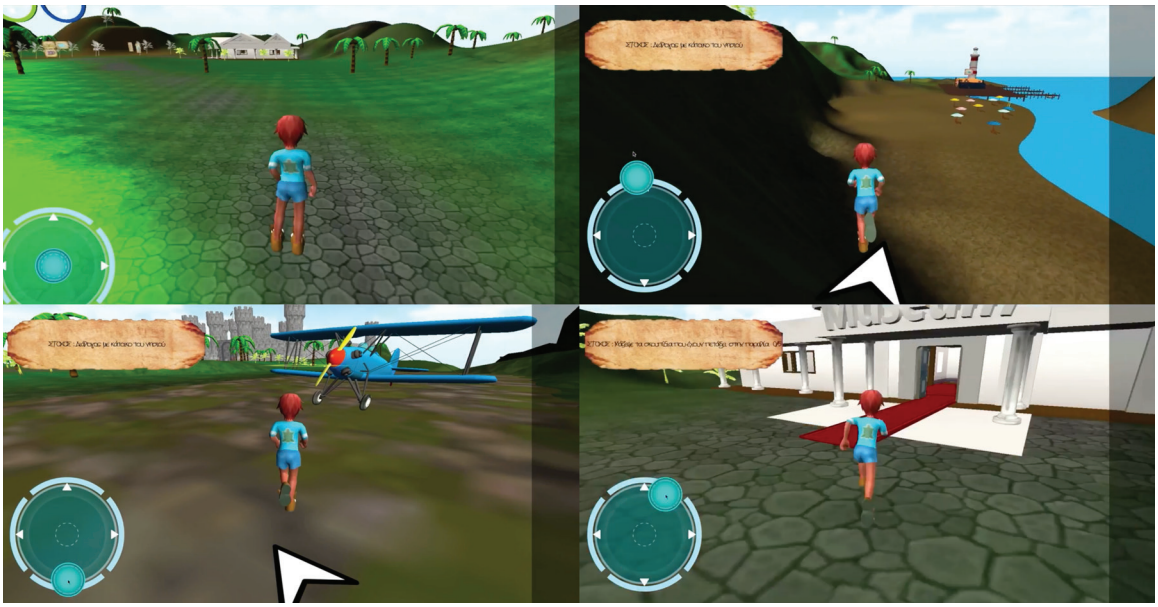


Figure 6. Screenshots from the initial iOS implementation of the GameIt virtual island



elements from fantasy, steampunk, and science fiction. The setting takes players in a 3D representation of the Warcraft universe. Locations have variable weather including, among other things, rain, snow, and dust storms. As with other MMORPGs, players control a character avatar within a game world in first/third-person view, exploring landscapes, fighting monsters, completing quests, and interacting with non-player characters (NPCs) or other players. As characters become more developed, they gain various talents and skills, choosing from a variety of professions, such as tailoring, blacksmithing, or mining, while being able to learn secondary skills (archeology, cooking, fishing, and first-aid). Characters may form and join guilds, allowing to exploit several benefits.

As technology and approaches continued to develop other software made their way to the market of gamified learning. The *Brain Age*, a puzzle game, appeared around 2005. The *Wii Fit* made a breakthrough in the industry in 2007 by introducing innovative ways to make the users/players be a lot more engaged in the game activities, and really initialized the era of multi-modal interaction (gesture and voice-based at the beginning). In 2009, the *Gamestar Mechanic* became online to provide online game building mechanisms for students (Figure 7).

Around 2010, gamification becomes even more pervasive and starts to be largely incorporated in course design and curriculum development. Currently the big thing in the field is *Minecraft*, released in 2009, which changes the paradigm by reducing the graphics realism while providing significant possibilities for the users to create their content and share it online (Figure 1). Minecraft enables players to build constructions out of textured cubes in a 3D procedurally generated world. Activities in the game include exploration, resource gathering, crafting, and combat. Multiple gameplay modes are available, including a survival mode, a creative mode, an adventure mode and a spectator mode. Minecraft is an open world game that has no specific goals for the player to accomplish, allowing players a large amount of freedom in choosing how to play the game, while supporting an achievements system. The gameplay is first/third-person. The core gameplay revolves around breaking and placing blocks. The game world is composed of rough 3D objects arranged in a fixed grid pattern and representing different materials, such as dirt, stone, various ores, water, lava, tree trunks, etc. Inside a game, 20 real-time minutes represent a full day cycle in the virtual world. Players encounter various non-player characters (mobs) either hostile or not.

RECENT INNOVATION IN GAME-BASED LEARNING

Apparently as the technology of computer games evolves and as more and more people from the educational community embrace the benefits of play in education, there is a growing bond between gaming and education, towards a playful education (Pavlidis, 2015).

In an attempt to enhance the paradigm of gamification in education (game-based learning), *Project GameIt*, a Greek national funded project, built on a vision to create a single "… integrated and easy-to-use educational game development platform that supports and adapts educational principles and scenarios, and uses content from remote repositories, while providing support for commercialization…" (Pavlidis et. al., 2015). The one and only thing that GameIt did not attempt to change was the user interface model for players, which are identical to contemporary gaming experiences, the typical first/third-person perspective. GameIt tried to challenge and change all other aspects in game-based learning by contributing with

- A new approach towards the content and content integration, based on international standard in metadata and open linked data
- A new model and incentive for creators to create complete interactive playful educational material using a simple player-like interface
- A new business model in education, where several levels of commercial exploitation are being supported, using the paradigm of the mobile app stores, adequate for content, for educational scenarios, educational templates and games commercialization

It has to be clear that the main target in GameIt was the creation of a simple intuitive and content-rich game authoring and playing cross-platform framework. The approach is based on a novel knowledge integration and game development paradigm, contemporary gaming technologies and effective entrepreneurship, as graphically summarized in Figure 2, in which the four basic elements of GameIt are marked according to their contribution or level of innovation ('original' denoting a new development, 'innovation' denoting an innovative approach and 'state-of-the-art' denoting the state of the technology used). All these innovation aspects of GameIt have been presented in detail in scientific publications, which are provided in references, so in the following paragraphs the main concepts are being briefly listed to highlight the major contributions.

An overview of the GameIt platform, which also includes the basic functionalities is shown in Figure 3. The innovative knowledge management system includes a subsystem to accommodate management of external resources of cultural and educational content along with the management of user content stored in GameIt.

A number of different user groups have been defined in GameIt to support the various functionalities of the platform and the commercialization potential, including the system administrators (responsible for the integrity of the overall system), the knowledge creators (that can contribute content), the game designers (that create gaming scenarios), the game creators (that create games), the players and the visitors.

A significant contribution of GameIt lies in the attempt to incorporate learning theories into the game-based learning setting, which is one of the first attempts in the domain. The underlying pedagogical framework has been defined on the basis of theoretical concepts related to the domains of Digital Game-Based Learning and Gamification, well-documented benefits of constructive alignment, detailed definition of involved roles, and theoretical concepts related to the formation and operation of communities of practice (Panoutsopoulos et. al., 2015). This capability of GameIt has been practically encoded in its ability to represent game templates and game scenarios, which are closely related to pedagogical frameworks drawn from the learning theories.

A New Model for the Content, Content Integration and Knowledge Management

The knowledge integration subsystem of GameIt represents a novel and innovative approach towards the integration of remote resources into a single searchable knowledge system to support the creation of educational games, based on state-of-the-art technologies and international standards. The knowledge integration model is based on a novel merging of CIDOC-CRM (ISO 21127:2014) and LOM (IEEE 1484.12.1:2002) to seamlessly support cultural and educational resources primarily for educational usage (Markantonatou, et.al., 2016).

CIDOC-CRM is an ontology that provides definitions and a formal structure for the description of concepts and relations primarily targeted to (and initially created for) the documentation of cultural con-

tent. The CIDOC-CRM ontology is formally expressed as an object-oriented semantic model that can be converted to machine-readable forms like RDF, KIF, DAML+OIL, OWL. The ontology is adequately expressive to document the properties and life-cycle of objects that are the result of human intellectual activity, such as the learning objects. On the educational best practices front, Learning Resource Exchange (LRE) is an international repository extensively used by the European educational community, and is technically a combination of IMS LODE Information for Learning Object eXchange specification (ILOX) with IEEE Learning Object Metadata (LOM) Standard for Learning Object Metadata. LOM is the most prominent among standards for educational content, and defines and describes learning objects and resources, facilitating retrieval. Although widely adopted, LOM lacks all the necessary metadata for the learning objects stored in LRE, in which learning objects are defined as any digital material used for teaching or learning. Several versions of a learning object might exist, each one in different formats and in various copies.

In GameIt the knowledge integration was based on the unification of these two data schemas, of which CIDOC-CRM is an ontology. GameIt derived a new ontology, the CIDOC+LRE, to offer interoperability among databases and repositories compatible with CIDOC-CRM and LOM. The approach included the unification of classes and properties of the two schemas that could be unified and the introduction of new classes and properties in cases that unification was not possible. Technically, the top class of CIDOC+LRE is the CRM Entity_LRE WORK, which unified the top class E1 CRM Entity of CIDOC and the top class WORK of LRE/LOM. As CIDOC-CRM does not support learning objects, a new class LO was defined in the new ontology, as a subclass of class E90 Symbolic Object of the original CIDOC ontology, which originally includes sets of signs of any nature that may serve to designate something, or to communicate some propositional content. This new class LO has been defined as a 'sister' of E73 Information Object and E41 Appellation. The ontology was completed with a set of controlled vocabularies. For LRE, vocabularies have been drawn from the Vocabulary Bank for Education – VBE. For cultural objects, there are several controlled vocabularies, but in GameIt controlled vocabularies compatible with the Getty Vocabularies have been used. A detailed description of the new ontology can be found in (Markantonatou, et. al., 2016).

The overall schema was practically converted into a database management system, which was populated with data by harvesting the appropriate content from remote resources like Europeana and the Greek Photodentro, along with Getty and Getty-compatible vocabularies.

This novel data model and database is supported by the backend technologies of the GameIt platform, the backbone of the system, which is responsible for the data 'engineering' so that data can be made available to the game authors to create their gaming scenarios. A diagram of the data harvesting and integration functionalities is depicted in Figure 4. Apparently, this knowledge management system could be viewed as a meta-resource, as it integrates and enhances metadata from cultural and educational resources as shown in Figure 5.

At its current implementation, the GameIt knowledge subsystem provides integrated search capabilities on popular resources such as the Greek educational resource *Photodentro* and *Europeana*. In addition, it supports search in the internal GameIt repository that includes user-generated content. This part of the platform (the knowledge management back-end subsystem) can be accessed online through http://authors.gameit.gr.

A New Model and Incentive for Creators and Learners

Another novelty within GameIt is the game authoring subsystem. This represents an innovative approach towards a cross-platform educational game-authoring environment based on state-of-the-art gaming technologies. This game authoring system supports the creation of game templates and complete game scenarios based on educational templates and contemporary educational approaches for effectively any kind of subject, exploiting digital content provided by the knowledge integration system. The front-end of the platform (the game authoring interface) can be accessed through http://scenarios.gameit.gr and at its current implementation supports the creation of educational games through the definition of a scenario description and goals and a selection of site/building within the virtual island where actions will take place.

The workflow of the main game authoring approach includes some basic steps, starting with the definition of the game scenario and the objectives, the selection of locations in the virtual world, of parameterized educational mechanisms, of 3D content to be used, of the actual educational content, the manipulation of the content and objectives, the testing of the game and publishing, all within specifically provided wizards and a WYSIWYG[12] authoring interface that guarantees that the creator experiences what the users will face. This workflow includes a feedback loop in order for creators to be able to re-design their games according to user feedback.

The gaming part of GameIt (Play) is based on a first/third-person gaming approach using cross-platform gaming technologies that practically implement the game scenarios being developed by the game authoring system. At the current platform implementation, the games created in GameIt are played on a virtual island. The island consists of various building and spaces to implement any educational game scenario; it is cross-platform and was implemented using the Unity 3D game engine. Within the current framework students are asked to accomplish four (4) kinds of tasks, including data collection, answering to questions, talking to island natives and flying a plane. Figure 6 shows some screenshots from the initial virtual world implementation specifically ported for a smart mobile device operating system (iPad iOS version).

A New and Viable Business Model in Education

In overall, the whole construct of GameIt was built to support entrepreneurship using morn commercialization techniques and include both business-to-business (B2B) marketing and business-to-client (B2C) approaches. The adopted exploitation plan that reflects the novel entrepreneurship part of GameIt targets both developers and end-users, focuses mainly on developers (as players are already covered by the exploitation of the adopted state-of-the-art gaming technologies), and was inspired by the mobile app stores model. In this model developers have a prominent role in developing educational game templates and educational game scenarios. All these are based on well-established pedagogical approaches and can be supported by model-templates that already exist in GameIt.

In overall, game authoring is based on game templates, games scenarios and the content. Developers can distribute their games through the GameIt platform either for free or for a fee. They can also distribute their game templates. In addition, educational content creators can also benefit from the system, as they are able to commercialize their own content, which in turn can be a part of one or more games. The platform can support a number of different contracting schemes, including multiple types of licenses for access, creating, using and re-using content, templates, scenarios and games, either for developers

and creators or for users/players. Within this model, tutors, educators or interested developers are encouraged to become creators having the incentive of selling or sharing their intellectual property, their content and their games to a large community of users and other creators. The approach forms a web of interconnections, interactions and possibilities that may bring a new viable business model in education.

CONCLUSION AND FUTURE PERSPECTIVES

Research has already pointed out the significance of play in humans. Play is a strong mechanism for simulating, testing and learning, and thus is partly responsible for self-development and understanding of the world and the mechanics and dynamics of reality and life. In this respect, play, although a broad concept without specific goals and scopes, when limited and reshaped in the form of gaming, has already been employed in educational settings and learning environments, and has already proven to be rather engaging and effective.

In this work, we tried to identify and summarize some of the reasons for which education and play should be integrated, as implied by various researchers in a wide range of disciplines. An obvious practical approach and mechanism to bridge play and education could definitely be the technology. In an attempt to present the complete picture we tried to clarify the terminology in the field, which seems overwhelmed by terms like play, game, gamification, game-based learning, educational game, serious game, gamified approach, game mechanics, and more. In addition, we also presented a summarized history of gamification and game-based learning and provided a view into the innovations that are being made available today by exploiting the wealth of information on the Web and the enormous computational power in personal computers, even in personal smart mobile devices. The latter has been demonstrated by a presentation of an ambitious project with which we have been recently involved. This was project *GameIt*, a project that focused on multiple innovations to provide a seamless integration of education, gaming and technology, both for the students and the teachers, with an emphasis on open linked data, international standards, integration of learning theories into game-based learning settings, and a potential to further innovation and exploitation.

Innovations in game-based learning are far from being exhausted. New ideas and approaches appear all the time. Innovations stem from a number of challenges, ideas and theories. Learning theories will eventually make their way to the game-based learning domain, which is viewed as closely relating only to the motivational approaches. Practical implementations of theories in interactive virtual world settings infused with playful aspects are really challenging and promising at the same time. Novel narratives and storytelling techniques are the target of current research and development in various settings and application environments, from education and lifelong learning to cultural heritage. Digital content is being created in vast amounts and international standards are starting to be adopted by more and more users, developers and organizations. Novel techniques originating from artificial intelligence and multi-agent systems are also being tested and adapted for virtual world enhancements and vivid realism in the virtual experience. In addition, recent advances in machine learning, through the development and exploitation of deep learning, is also expected to contribute to the experience offered by game engines that particularly simulate real-life settings. Adaptive approaches, personalization and self-regulated learning will greatly benefit from these approaches and developments. The future research will eventually bring together effective teaching, playful learning and a balanced load of electronic and tangible (real-world) tools and methods, in a transparent way, for all the users.

REFERENCES

Adams, J. (1998). Chance-it: an object-oriented capstone project for CS-1. In *Proceedings of the 29th ACM Special Interest Group on Computer Science Education (SIGCSE) Technical Symposium on Computer Science Education* (pp. 10-14). doi:10.1145/273133.273140

Alexander, G., Eaton, I., & Egan, K. (2010). Cracking the code of electronic games: Some lessons for educators. *Teachers College Record*, *112*(7), 1830–1850.

Alfrink, K. (2011). New games for new cities. Retrieved July 31, 2017, from http://whatsthehubbub.nl/blog/2011/05/new-games-for-new-cities-at-futureeverything

All, A., Nuñez Castellar, E. P., & Van Looy, J. (2016). Assessing the effectiveness of digital game-based learning: Best practices. *Computers & Education*, *92*, 90–103. doi:10.1016/j.compedu.2015.10.007

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., de Freitas, S., Louchart, S., & De Gloria, A. et al. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391–411. doi:10.1111/bjet.12113

Barr, P. (2007). *Video Game Values: Play as Human-Computer Interaction* [Doctoral Dissertation]. Victoria University of Wellington.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: an approach to medical education, (Springer Series on Medical Education)*. New York: Springer.

Becker, K. (2001). Teaching with games: The minesweeper and asteroids experience. *Journal of Computing in Small Colleges*, *17*(2), 23–33.

Bergin, S., & Reilly, R. (2005). The influence of motivation and comfort-level on learning to program. In *Proceedings of the 17th workshop on psychology of programming - PPIG'05* (pp. 293–304).

Bogost, I. (2011). *Persuasive games: exploitationware*. Gamasutra.

Boss, S., Krauss, J., & Conery, L. (2008). *Reinventing project-based learning: your field guide to real-world projects in the digital age* (1st ed.). International Society for Technology in Education.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., & Pereira, J. et al. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*, *94*, 178–192. doi:10.1016/j.compedu.2015.11.003

Brown, S., & Vaughan, C. (2010). *Play: How it changes the brain, Opens the Imagination, and Invigorates the Soul*. J P Tarcher/Penguin Putnam.

Burguillo, J. C. (2010). Using game theory and Competition-based Learning to stimulate student motivation and performance. *Computers & Education*, *55*(2), 566–575. doi:10.1016/j.compedu.2010.02.018

Byers, J. A. (1998). Biological effects of locomotor play: general or specific? In M. Bekoff & J. A. Byers (Eds.), *Animal play: evolutionary, comparative, and ecological perspectives*. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511608575.011

Byers, J. A. (1998). The biology of human play. *Child Development*, *69*(3), 599–600. doi:10.1111/j.1467-8624.1998.tb06227.x

Byers, J. A. (1999). Play's the thing. In *Natural History* (pp. 40–45).

Costello, B., & Edmonds, E. (2007). A study in play, pleasure and interaction design. In *Proceedings of DPPI 2007* (pp. 76- 91). ACM Press. doi:10.1145/1314161.1314168

Deterding, S. (2012). *Playful Technologies. Depletion Design. A Glossary of Network Technologies*. Amsterdam: Institute of Network Cultures.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining "gamification". In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments.* ACM. doi:10.1145/2181037.2181040

Diamond, M. C., Krech, D., & Rosenzweig, M. R. (1964). The effects of an enriched environment on the rat cerebral cortex. *The Journal of Comparative Neurology*, *123*(1), 111–119. doi:10.1002/cne.901230110 PMID:14199261

Fizek, S. (2014). *Why fun matters: in search of emergent playful experiences. Rethinking Gamification*. Meson press.

Fontijn, W., & Hoonhout, J. (2007). Functional Fun with Tangible User Interfaces. In *Proceedings of DIGITEL'07* (pp. 119-123). IEEE.

Gaver, W.W. (2002). Designing for Homo Ludens. *I3 Magazine*, 12.

Gaver, W. W., Bowers, J., Boucher, A., Gellerson, H., Pennington, S., Schmidt, A., & Walker, B. et al. (2004). The drift table: designing for ludic engagement. In *CHI'04 extended abstracts on Human factors in computing systems* (pp. 885–900). ACM Press. doi:10.1145/985921.985947

Gordon, N. S., Burke, S., Akil, H., Watson, S. J., & Panksepp, J. (2003). Socially-induced brain fertilization: Play promotes brain derived neurotrophic factor transcription in the amygdala and dorsolateral frontal cortex in juvenile rats. *Neuroscience Letters*, *341*(1), 17–20. doi:10.1016/S0304-3940(03)00158-7 PMID:12676333

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work? – A Literature Review of Empirical Studies on gamification. In *Proceedings of the 47th Hawaii International Conference on System Sciences*, Hawaii. doi:10.1109/HICSS.2014.377

Hassenzahl, M. (2003). The Thing and I: Understanding the Relationship Between User and Product. In M.A. Blythe, K. Overbeeke, A.F. Monk and P.C. Wright, eds., Funology: From Usability to Enjoyment. Kluwer, New York, 31-41.

Hill, J., Ray, C., Blair, J., & Carver, C. (2003). Puzzles and games: addressing different learning styles in teaching operating systems concepts. In *Proceedings of the 34th ACM Special Interest Group on Computer Science Education (SIGCSE) Technical Symposium on Computer Science Education* (pp. 182-186). doi:10.1145/611892.611964

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235–266. doi:10.1023/B:EDPR.0000034022.16470.f3

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-based Learning*, *1*(1), 21–39. doi:10.7771/1541-5015.1004

Huang, T. (2001). Strategy game programming projects. In *Proceedings of the 6th Annual Consortium for Computing Sciences in Colleges (CCSC) Northeastern Conf. Computing Small Colleges* (pp. 205-213).

Huizinga, J. (1950). *Homo Ludens: A Study of the Play Element in Culture*. New York: Roy.

Iwaniuk, A. N., Nelson, J. E., & Pellis, S. M. (2001). Do big-brained animals play more? Comparative analyses of play and relative brain size in mammals. *Journal of Comparative Psychology*, *115*(1), 29–41. doi:10.1037/0735-7036.115.1.29 PMID:11334216

Jordan, P. W. (2002). *Designing Pleasurable Products. An introduction to the new human factors*. London, New York: Taylor & Francis.

Juul, J. (2005). *Half-Real: Video Games Between Real Rules and Fictional Worlds*. New York: The MIT Press.

Kitchen, G. B., & Humphreys, J. (2014). Serious games in medical education. Do they have a role in anaesthetic training. *Trends in Anaesthesia and Critical Care*, *4*(2), 63–66. doi:10.1016/j.tacc.2014.03.001

Knight, J. F., Carley, S., Tregunna, B., Jarvis, S., Smithies, R., de Freitas, S., & Mackway-Jones, K. et al. (2010). Serious gaming technology in major incident triage training: A pragmatic controlled trial. *Resuscitation*, *81*(9), 1175–1179. doi:10.1016/j.resuscitation.2010.03.042 PMID:20732609

Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. *Computers in Human Behavior*, *35*, 179–188. doi:10.1016/j.chb.2014.03.007

Kumar, D. (1999). Curriculum descant: Pedagogical dimensions of game playing. *ACM Intelligence Magazine*, *10*(1), 9–10.

Lacasa, P., Martínez, R., & Méndez, L. (2008). Developing new literacies using commercial videogames as educational tools. *Linguistics and Education*, *19*(2), 85–106. doi:10.1016/j.linged.2008.02.001

Marino, M., Israel, M., Beecher, C., & Basham, J. (2013). Students' and teachers' perceptions of using video games to enhance science instruction. *Journal of Science Education and Technology*, *22*(5), 667–680. doi:10.1007/s10956-012-9421-9

Markantonatou, S., Minos, P., Tzortzi, K., & Pavlidis, G. (2016). Metadata for the learning objects that contain cultural objects. *International Journal on Mediterranean Archaeology and Archaeometry*, *16*(5), 53–61.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. Penguin.

Merrill, M. D. (2007). A task-centered instructional strategy. *Journal of Research on Technology in Education*, *40*(1), 33–50.

Metzinger, T. (2009). *The Ego Tunnel – The science of the mind and the myth of the self*. Basic Books.

Montola, M., Stenros, J., & Waern, A. (2009). *Pervasive Games: Theory and Design. Experiences on the Boundary Between Life and Play*. Amsterdam: Morgan Kaufmann.

Pagnotti, J., & Russell, W. B. III. (2012). Using civilization IV to engage students in world history content. *Social Studies*, *103*(1), 39–48. doi:10.1080/00377996.2011.558940

Panoutsopoulos, H., Pavlides, G., Markantonatou, S., Economou, V., Mysirlaki, S., Papastamatiou, N., & Kotsanis, I. et al. (2015). Create It' – 'Share It' – 'Game It': the case of a web-based digital platform for creating, sharing and delivering gamified educational scenarios. In *Proceedings of EDULEARN15 Conference*, Barcelona, Spain.

Pavlidis, G. (2015). Towards a playful education. In *Proceedings of the International Symposium Virtual Archaeology: Museums and Cultural Tourism VAMCT 2015*, Delphi, Greece.

Pavlidis, G., & Markantonatou, S. (2015). GameIt and a new paradigm on gaming in education. In *Proceedings of the International Symposium Virtual Archaeology: Museums and Cultural Tourism VAMCT 2015*, Delphi, Greece.

Pellis, S. M., & Iwaniuk, A. N. (2002). Brain system size and adult–adult play in primates: A comparative analysis of the roles of the non-visual neocortex and the amygdala. *Behavioural Brain Research*, *134*(1), 31–39. doi:10.1016/S0166-4328(01)00455-7 PMID:12191789

Pillay, H. (2002). An investigation of cognitive processes engaged in by recreational computer game players: Implications for skills of the future. *Journal of Research on Technology in Education*, *34*(3), 336–351. doi:10.1080/15391523.2002.10782354

Raessens, J. (2006). Playful Identities, or the Ludification of Culture. *Games and Culture*, *1*(1), 52–57. doi:10.1177/1555412005281779

Reese, D. (2000). Using multiplayer games to teach interprocess communication mechanisms. ACM Special Interest Group on Computer Science Education (SIGCSE), 32, 45–47. doi:10.1145/369295.369321

Ritterfeld, U., Cody, M., & Vorderer, P. (2009). *Serious Games: Mechanisms and Effects*. London: Routledge.

Robertson, M. (2010). Can't Play, Won't Play. *Hide and Seek*, Retrieved July 31, 2017, from http://hideandseek.net/2010/10/06/cant-play-wont-play

Slavin, R. E. (1980). Cooperative learning. *Review of Educational Research*, *50*(2), 315–342. doi:10.3102/00346543050002315 PMID:6698102

Stewart, J., Bleumers, L., Van Looy, J., Mariîn, I., All, A., Schurmans, D., . . . Misuraca, G. (2013). The potential of digital games for empowerment and social inclusion of groups at risk of social and economic exclusion: Evidence and opportunity for policy. *JRC Scientific and Policy Report*. Retrieved July 31, 2017, from http://ftp.jrc.es/EURdoc/JRC78777.pdf

Taekman, J. M., & Shelley, K. (2010). Virtual environments in healthcare: Immersion, disruption, and flow. *International Anesthesiology Clinics*, *48*(3), 101–121. doi:10.1097/AIA.0b013e3181eace73 PMID:20616640

Wiklund, M., & Ekenberg, L. (2009). Going to school in World of Warcraft. Observations from a trial programme using off-the-shelf computer games as learning tools in secondary education. *Designs for Learning*, *2*(1), 36–55. doi:10.16993/dfl.18

Zhang, P. (2008). Motivational Affordances: Reasons for ICT Design and Use. *Communications of the ACM*, *51*(11), 145–147. doi:10.1145/1400214.1400244

Zimmermann, E. (2009). Gaming Literacy. Game Design as a Model for Literacy in the Twenty-First Century. In M.J.P. Wolf & B. Perron (Eds.), The Video Game Theory Reader (pp. 23–32). New York: Routledge.

KEY TERMS AND DEFINITIONS

Educational Games: Are games designed to aid in learning about specific subjects, in expanding concepts, in stimulating growth, in understanding a historical event or a culture, in developing a skill while playing; educational games can be applied in any educational environment using any gaming approach.

Game Engine: A software application that includes an authoring and programming interface and a number of software libraries that provide high quality graphics and visualization, simulation of real-world physics, animation and interaction mechanisms, to aid users in the implementation of digital interactive games for various platforms.

Game-Based Learning: A special case of gamification applied in education and lifelong learning. Usually includes the integration of educational models, educational content, gaming concepts and high-tech digital visualization and interaction in a single package.

Gamification: The use of specific approaches and techniques, specifically game mechanics, in various environments and settings, in order to attract people in problem solving and to enhance their contribution in a pleasant manner.

Knowledge Integration: The integration of an indefinite amount of digital knowledge resources from various disciplines that can be structured or unstructured, and are stored on the Web or somewhere in the Cloud (anywhere in the world).

Playful Education: The result of a seamless integration of play and learning, under the general scope of game-based learning, that is mainly empowered by the usage or application of state-of-the-art technology and innovative narratives and storytelling.

Serious Games: Initially, serious games where considered to be games with a purpose. The basic idea behind serious games is to hide important and time-consuming tasks behind a gaming veil. They can be applied in societal studies, in crowdsourcing projects and any setting under which the players are actually contributors to a cause that is hidden behind the game.

ENDNOTES

1 Because Play Matters Lab, http://becauseplaymatters.com
2 This complies with the well-known BLAP gamification model (badges, levels, achievements, points)
3 Solution for Play, focuses emphasis on the play and the player
4 Official site of Brøderbund Software Inc. at http://www.broderbund.com
5 Official site of Carmen Sandiego Returns at http://www.hmhco.com/at-home/featured-shops/the-learning-company/carmen-sandiego
6 Official site of the Legend of Zelda series at http://www.zelda.com/
7 Official site of the Breath of the Wild episode of The Legend of Zelda at http://www.zelda.com/breath-of-the-wild/
8 Official site if SimCity at http://www.simcity.com
9 Official site of The Sims at https://www.thesims.com
10 The original Sid Meier's Civilization available at http://www.mobygames.com/game/sid-meiers-civilization
11 Official site of Civilization at https://civilization.com
12 Official site of Active Worlds at https://www.activeworlds.com/web/index.php
13 Official site of the World of Warcraft at https://worldofwarcraft.com/en-us/
14 "What You See Is What You Get"